14. COMPUTER-MEDIATED COMMUNICATION

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14.1 INTRODUCTION: VARIETIES OF CMC TECHNOLOGIES

14.1.1 Scope of This Chapter*

Computer-mediated communication (CMC) is a generic term now commonly used for a variety of systems that enable people to communicate with other people by means of computers and networks. Well-known examples of such systems include computer conferencing, electronic mail, discussion lists, and bulletin boards. However, there are yet other possible applications of CMC, both in the work environment and in education and training. In the work environment, a common and growing phenomenon is collaborative work by individuals or groups who are separated from each other by either time or distance. This has come to be called *computer-supported cooperative work* (CSCW) (Grief, 1988). In the education and training context, in addition to computer "conferencing," we can set up computer-mediated discussions of a more-focused nature as exemplified by the so-called virtual classroom (Hiltz, 1986, 1990), computer-mediated seminars and case study discussions (Romiszowski & DeHaas, 1989; Romiszowski, Jost & Chang, 1990), and computer-mediated job "performance support systems" (Gery, 1991). The variety of alternative modalities is large and growing. In this chapter we shall limit our discussion to those approaches that have been implemented for a few years and have therefore generated a reasonable quantity of research on their effectiveness and operational characteristics.

14.1.2 Out-of-Scope

We will exclude from our analysis the use of computer networks for accessing remote databases or library systems or for the transmission of large bodies of text that are not the basis for a person-to-person discussion and argument (e.g., on-line journals). We shall also exclude computer-assisted instruction (CAI), computer-based training (CBT), and other varieties of computer-assisted learning (see 12.2.3) in which the student interacts with the computer but not necessarily with other people. Similarly, we shall also exclude such systems as, for example, a group of four or five students all together at one time and place, using one computer to work collaboratively on some problem. As we move into the age of synergy between the cognitive sciences, computer sciences, and telecommunications, we are continually being faced with new possibilities for communication over distances. As an example, the recent movement towards multimedia computing has already found an application in computer-based audiographic conferencing systems (see 13.4.2.2) with multimedia support for visual communications and in desktop-video conferencing systems (see 13.4.2.6) that provide two-way digitized video communication between remote sites. Voice mail systems are also being applied in education and training contexts to enable asynchronous audio conferencing or multiway communication between people at remote sites (Bernard & Naidu, 1990; Romiszowski & Iskandar, 1992; Iskandar, 1994).

14.1.3 Partly-in-Scope

However, it is difficult to draw a precise line, as we have recently seen hybrid applications that involve a combination of computer-based instruction and computer-mediated discussions between students at a distance (e.g., Romiszowski & Chang, 1992, 1994). Similarly it is increasingly common to encounter systems that combine the use of information accessed from remote databases with CMC interchanges between users separated from each other by time or distance. Indeed, computer-based collaborative work almost invariably involves such a combination. Some authors see such hybrid "fourth-generation distance education systems" as playing a central role in future technology-based education (Lauzon & Moore, 1989).

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These new developments will also largely be excluded from this chapter, though occasionally they may be mentioned as future developments with implications for future research questions. Finally, although we do not explicitly exclude all applications of CMC in elementary and secondary school settings, we have tended to concentrate our review on the postsecondary levels, both in higher education and business training contexts.

14.2 CHARACTERISTICS OF CMC

A working definition of computer-mediated communication is "communication between different parties separated in space and/or time, mediated by interconnected computers." The computer network acts as a communication medium just as if it were a printed book containing text and graphics or a video broadcasting system. However, the computer brings certain characteristics to the communication process that the majority of previously available communication media did not offer.

14.2.1 Highly Interactive Communication

The first of these characteristics is the capability of supporting complex processes of interaction between the participants. The computer combines the permanent nature of written communication with the speed and to some extent the dynamicism of spoken telephone communication. Unlike the limited interactivity available in other forms of computer-based learning such as CAI, the possibilities for interaction and feedback are almost limitless, being a function of the creativity and personal involvement of the participants in the on-line discussion.

The feedback messages do not have to be preprepared and stored, as is the case with CAI. Also, the participants are able to some extent to express within their messages not only the bare content but also their personal viewpoints and, to a limited extent, the emotional overtones that may be present. Thus, the potential for interaction in a CMC system is both more flexible and potentially richer than in other forms of computer-based education.

14.2.2 Multi-Way Communication

Another aspect of the communication process is that it is essentially multiway communication. At the very least, the communication is two-way, as in the case of two people exchanging messages in an electronic-mail environment. More often, however, the communication is multiway, between all the participants of a group who may receive and respond to messages from all the other participants.

One point that should be considered is whether unlimited multiway communication is in fact always desirable within an educational situation. Many participants in computer conferencing have expressed frustration and disappointment with the difficulty they have had in sorting out relevant from irrelevant information, because there are so many participants contributing messages on a variety of different topics. One approach to creating some order in this chaos is through the development of special-purpose educational CMC software environments that may break down a complex conference into subthemes and issues held in separate "areas," as if in separate rooms in a convention center (for example, CoSy, PARTIcipate). Another approach is through the use of hypertext environments (see Chapter 22) that automatically link the incoming messages so that the users of the CMC system can get a clear idea of the structure of previous discussion. Such hypertext environments have also been applied to breaking down a large group of participants into small groups for intensive discussion, replicating in the on-line environment the classroom-based techniques of seminars or case study (Romiszowski & Chang, 1992; Chang, 1994). The latest windows-based conferencing systems allow participants to view a list of messages in a conference and then to point and click on those they wish to read. This facilitates greater selectivity for users than the old command line systems.

14.2.3 Synchronous or Asynchronous Communication

Finally, the communication process may have both synchronous and asynchronous characteristics. By synchronous communication, we understand communication between two or more people in real time, such as classroom-based, face-to-face discussion, or a telephone conversation. In asynchronous communication, the participants are not on-line at one and the same time, as in the case of correspondence by letter or fax. The interesting aspect of using the computer as a communication medium is that it is possible to use it at will both as a synchronous communication medium like a telephone or an asynchronous communication medium like a letter-writing or fax system, depending on what is ideally required by the particular situation (Rawson, 1990; Sheffield & McQueen, 1990). We will later explore these characteristics of synchronous and asynchronous communication in a computer-mediated environment, identifying potential benefits in different situations for each one of these modalities.

14.3 PERVASIVENESS OF CMC

14.3.1 Origins of CMC Networks

Computer-mediated communication is in fact one of the earlier modes in which computers have been used within the education process. Before CAI was more than an idea in the minds of certain researchers, computer networking and conferencing systems were already implemented, initially to facilitate communication among researchers. Indeed, it was in response to the fear of a possible war damaging the potential of researchers to continue to work that many of the major universities and government research institutions

of the United States were linked by a network named ARPANET, which was so designed as to offer multiple communication paths between the various nodes or sites in the network (Elmer-Dewitt, 1994). The idea was that if certain sites were knocked out, the remaining sites could still communicate with each other independently of the particular geographic location of the disabled sites. This characteristic of the ARPANET system has been maintained in its successors such as Bitnet and Internet. Indeed, Internet is in effect a worldwide network of ARPANET-like local regional networks (Jacobson & Zimpfer, 1992).

14.3.2 Proliferation of the Networks

The linking of all regional networks to all the others creates multiple pathways of access from any one node in any one network to any other node in any of the other networks. This powerful web of electronic communication has become an indispensable tool for research and collaborative work in the scientific community. During the last year or so, the academic exclusivity of Internet has broken down as an ever-increasing number of commercial providers have opened access to anybody willing to subscribe. In 1994, the estimate of the size of Internet was in the region of 25 million connected computers, many of them with, of course, multiple users. This number is double the previous year's, and it is estimated that the number of users will continue to double annually for the foreseeable future (Elmer-Dewitt, 1994). It would seem that we are in the process of a major transformation of the communication habits and patterns of our society.

14.3.3 Corporate Uses of CMC

In the area of business communications, CMC has already become firmly established. Today, most of the major companies in the United States and Europe either rent or maintain their own data and personal communication networks so that all departments can communicate effectively and efficiently by electronic means. One aspect of increasing importance in these systems is the use of electronic mail, computer conferencing, and, increasingly, computer-supported collaborative work between individuals or groups who may be scattered in different regions of a country or even different continents. The "globalization" of business communication has become necessary for staying competitive.

An interesting aspect of the economics of this trend is illustrated by the growing tendency for North American telephone companies to offer low cost rates for business communication in Europe, given that much of the business day in Europe falls in a quiet period of early morning when telecommunication traffic in North America is at its lowest. Now, European companies are retaliating by adopting the same global marketing strategy rather than attempting to rely on (unenforceable) protective legislation. The tendency to this "whole world" view of telecommunications, coupled with the possibility of digitizing and storing messages for transmission at more convenient or more economical times, is transforming the whole sociopolitical structure of business communications and is now also beginning to impact on personal communications.

14.3.4 Educational Uses of CMC

In education, a particular growth area is the use of computer-mediated communication systems, not only for distance education when the participants are separated physically but also for more convenient communication on the same campus. Applications include institutions that utilize CMC as a principal mode of instruction and communication between tutors and students for whole courses, programs that run a few course units by means of CMC, and the use of CMC as a support medium for enrichment in otherwise conventional courses. However, such developments are not free of problems.

One of the problems identified in the educational uses of computer conferencing is that of teacher workload. Experiences from the NKI Electronic College in Norway show that teachers' main reservation about educational CMC is the open-ended demand on their time (Paulsen, 1992). As early as 1988, Hiltz noted that teaching an on-line course, at least the first time, was a bit like parenthood. "You are 'on duty' all the time, and there seems to be no end to the demands on your time and energy" (Hiltz, 1988, p. 31).

Nevertheless, many educators enthusiastic about the use of this new teaching medium have adapted strategies from small-group and interactive face-to-face techniques to the on-line world. Examples include seminars, learning partnerships, group projects, team presentations, simulations and role plays, peer counseling, and self-help groups. These and others are described in Miller (1991).

As economic realities shift towards ever-decreasing costs of electronic communication and ever-increasing costs of transport, space, lighting, heating, and teaching salaries, the tendency towards distance education methods, particularly electronically delivered distance education, is likely to increase yet further. In the light of this situation, it is important to verify to what extent the use of computer-mediated communication can be an effective alternative to conventional methods of teaching and learning. It is for these reasons that a review of current research on CMC and identification of potential future research questions is of particular importance at this time.

14.4 ISSUES IN CMC

14.4.1 Changing Technologies

One important trend already mentioned is the explosive rate at which new technologies for communication are being disseminated. The current multimedia and hypermedia developments have already been absorbed into CMC educational environments, producing systems that, at least in principle, have the potential for vastly improving the

rather unstructured and text-based modes of communication that were the characteristic of earlier CMC systems. The incorporation of graphics, audio, video, and, in the future perhaps, even simulations of a virtual reality nature, which may all be transmitted across the digital information superhighways, is opening the potential for a much richer form of CMC. Most of the research completed so far is related to the earlier forms of text-based CMC. Some of these results may be equally valid within the future multimedia distance education systems. However, we may expect many new issues and research questions to emerge as these broadband, multimedia, multimodal communication systems link both people and remote databases into one seamless information and communication environment.

14.4.2 Replicate or Innovate

Another issue that is increasingly facing researchers and practitioners in the area of CMC is whether this medium should be considered as an alternative way of implementing previously well-tried teaching/learning strategies or whether the medium itself may lead to the implementation of novel strategies that previously were not used. Among the research and development work that has followed the line of replication of the past, a notable trend is illustrated by the "virtual classroom" methodologies that have been implemented and researched by Roxanne Hiltz and her collaborators (Hiltz, 1986, 1990). This work has focused on the replication of well-tried classroom-based teaching/learning strategies in an asynchronous networked environment. Variations on the virtual classroom might include the virtual conference room (that is, computer conferencing), the virtual seminar room, and the virtual case study discussion room, each implying a specific set of teaching/learning strategies (Romiszowski, 1993).

An example of a somewhat novel approach is the trend towards the implementation of learner-controlled environments that may combine the use of information resources stored remotely as a hypermedia network of information, together with computer-supported collaborative project work between groups of individuals utilizing the CMC capabilities of the network. A nonconventional example of a popular use of CMC is to supplement conventional classroom-based instruction with group exercises or projects that participants "take home" but continue to interact with both teacher and colleagues through the medium of CMC while working on their projects. This approach, although not new with respect to its project work details, is novel in that it extends the possibilities for group interaction (Grabowski, Suciati & Pusch, 1990).

14.4.3 Technological Synergy

The third issue is the technological synergy between computer sciences, cognitive sciences, and telecommunications sciences, which is offering a host of possibilities such as artificial intelligence software that may act as an intelligent interface between remote databases in libraries and students or may in other ways facilitate the learning process. One possibility that is not yet a full reality is the capability of a computer-mediated communication system to handle instant translation so that group discussions may take place between participants from different countries, the groups using their own native languages in the process. Yet another area of current technological development that is yet to show its promise in practice is virtual reality or, in other words, the physical simulation of personal closeness and involvement in a particular environment. It is possible to imagine CMC systems of the future that will not be open to the criticism of the loss of nonverbal communication elements such as expression, gesture, or even touch. The applications of these new technological possibilities are yet unresearched. However, progress in the field is so rapid that it is not too early to consider some of the research issues that such new technological possibilities may pose.

14.4.4 Changing Theories and Philosophies

One notable current debate that impacts on the role of CMC in education is the "constructivism vs. objectivism" debate. The constructivist viewpoint (see Chapter 7) is often aligned with CMC and opposed to CAI, which is seen as an objectivist approach to teaching and learning (Cunningham, Duffy & Knuth, 1993; Kaye, 1992). The current vigor of this philosophical trend may be partly behind the growth in popularity of CMC systems, particularly in the humanities and philosophical subject areas.

Another, not so recent, debate that has been revived in relation to the use of CMC is the "humanism vs. mechanism" issue. The humanists see the personal interaction between people that CMC allows as an important element in the appropriate uses of computers in education. A similar debate on the "cognitive vs. behaviorist psychology" platform may lead to positions being taken either for or against the use of CMC (Morrison, 1989). Other groups of theorists argue for CMC from the social constructivist standpoint of learning as "conversation." In this viewpoint, the teaching/learning process is seen as a form of conversation, whether real or in the mind of the learner, which leads to an "agreement" on the meaning of specific content. It is argued that CMC, through the provision of real opportunities for conversation, may be a more appropriate medium for the development of those types of learning objectives where a conversational approach is of particular importance, i.e., higher-order learning objectives associated with problem-solving and critical-thinking skills (Romiszowski & Corso, 1990). Yet other philosophical/theoretical viewpoints that have been brought to bear on the relevance and appropriateness of CMC are Habermas's theory of undominated communicative action (Boyd, 1990) and postmodernism (Soby, 1990).

All of these different theoretical and philosophical viewpoints are interesting but are largely unresearched. Some current research is beginning to address certain issues

in this field, but much further research is necessary in order to validate the claims and counterclaims and to develop a robust set of principles for the selection, design, and use of CMC environments in education and training.

14.5 STATUS OF RESEARCH ON CMC

This section investigates the status of research to date on computer-mediated communication. It addresses such issues as the amount and quality of existing research findings, the sources of CMC information, various research methodologies being employed, the extent of theories and knowledge about CMC, and the difficulty of examining dynamic information technologies with static research tools.

14.5.1 Sources of CMC Information

Research surrounding CMC parallels the expansion of this technology. Journal articles begin appearing with frequency around 1984, although the roots of research in the field go back to the 1960s and earlier (Hiltz & Turoff, 1978). Regular academic conferences are convened, and several edited books devoted to CMC appear from the early 1980s (Kerr & Hiltz, 1982; Harasim, 1990; Kay, 1992; Mason & Kaye, 1989; Mason, 1993). Since 1990, scholars have developed several comprehensive bibliographies. Among these, Romiszowski (1991) and Burge (1992) each list approximately 400 references, from conferences proceedings, edited book chapters, professional papers, and journal articles.

Now there is a constant stream of conference proceedings and edited books appearing at the rate of several per year, some devoted to specific and others to general aspects of research and development in CMC. Notable among recent publications are the anthology on *Collaborative Learning through Computer Conferencing,* edited by Kaye (1992), the Proceedings of the Third Teleteaching Conference held in Trondheim, Norway, edited by Davies and Samways (1993), and the regular Conference Proceedings emanating from such universities as Wisconsin at Madison, United States; Guelph in Ontario, Canada; and the Open University in the United Kingdom.

Examination of these materials finds many of them to be anecdotal in nature, written by pioneers in implementing CMC technology for educational purposes, promoting the exciting educational possibilities of this new medium, and reporting case descriptions of their own experiences with these innovations. However, some basic research is underway; a 1992 survey found over 35 CMC studies completed or in progress (Cole, Beam, Karn & Hoad-Reddick, 1992). These authors report that the majority of studies came out of a quantitative/positivist paradigm. However, they argue, as does Mason (1992), that interpretist and critical-theory paradigms (see Chapter 9) may be more appropriate for studying the CMC environment. So far, few studies have been performed from these "neoqualitative" perspectives.

14.5.2 Principal Issues Investigated

As mentioned above, a large proportion of earlier writing and indeed some of current writing on CMC is exploring the potential of CMC rather than reporting hard research. As an example, among the 400 publications listed in the bibliography prepared by Romiszowski (1991), only some 10% to 15% were research studies. This compares to 25% on overviews, reviews, applications, trends, and policy; another 15% on design, development, and implementation strategies; 15% on the hardware, software, systems, and logistics; another 20% on aspects of networking, and hardware- and system-related issues; finally, some 15% on topics of database access and "computer-supported cooperative work."

The research papers can be further classified into several areas of interest as follows. First, there are issues of general concern such as the access to CMC and whether it has a democratizing or elitist impact on society; the quality of on-line information and its equivalence to printed material (particularly relevant in the case of on-line journals); the social impact of CMC on the users; methods of implementation and use in both distance education and in conventional courses; and research aspects of software capability, design, and utilization.

A second group of research interests can be generally referred to as "teaching and learning concerns." These include the content and objectives that may be treated by CMC, the process of interactivity and interaction as it occurs in CMC, appropriate learning strategies and tactics that may be employed in CMC, aspects of learner control or system control of CMC systems, and the effectiveness or other outcomes of CMC used for educational purposes.

A third group of research interests may be best referred to as "implementation concerns." These include aspects of student participation or nonparticipation and their attitudes, attitudes and participation styles of instructors and teachers using CMC, aspects to do with the implementation and administration of CMC systems, and logistic and planning aspects to do with staff and support systems.

The later sections of this chapter will follow the organization schema presented here to review the principal findings to date from the, as yet relatively sparse, research that has been performed in this area of educational technology.

14.5.3 Methods Being Used

Because of the difficulty of reaching CMC users, often separated by space or time, most research efforts to date involved survey research, either through electronic or conventionally distributed questionnaires (see, for example, Ryan, 1992; Grabowski, Suciati & Pusch, 1990; Phillips & Pease, 1987). Another relatively popular method is the evaluative case study (e.g., Phillips, 1990; Mason, 1990; Phillips, Santoro & Kuehn, 1988). However, many researchers recognize the value of automatic computer-based recording of communications transactions and have sought to capitalize on usage, interaction, and transcript

information directly available from the conferences (Mason, 1992; Henri, 1992; Tucker, 1991; Levin, Kim & Riel, 1990). Harasim (1987) first used mainframe computer records to analyze student access times and dispersion of participation in a graduate computer conference. There is little use to date, in the study of CMC, of qualitative approaches based on observation and interviewing (either in person or over the telephone). This is so for several reasons: (a) the labor intensity of qualitative research study, (b) the expense and difficulty of contacting ex-CMC users, and (c) the newly emerging acceptance of qualitative research in education. Some recent studies, for example, Eastmond (1993) and Burge (1993), have, however, adopted such a methodology.

Nevertheless, the most glaring omission in CMC research continues to be the lack of analytical techniques applied to the content of the conference transcript. Given that the educational value of computer conferencing is much touted by enthusiasts, it is remarkable that so few evaluators are willing to tackle this research area. One of the pioneers in this field is Henri (1992), who presents an analytical framework to categorize five dimensions of the learning process exteriorized in messages: participation, interactions, social, cognitive, and metacognitive. Another is Mason (1992), who has attempted to draw up a typology of conference messages related to the educational values they display.

14.5.4 Extent of Theory/Knowledge Base

CMC scholarship tends to proudly acclaim the educational merits of this technology for a variety of reasons—access, collaboration, interactivity, self-direction, and experiential learning, to name a few—yet few of these are grounded in systematic, rigorous inquiry. Current CMC research, like much of that in distance education, focuses on narrow topics within specific institutional contexts and has not sought to generalize to wider contexts. Yet, slowly, the studies are appearing, some by the early promotional scholars and others to substantiate and refute their claims. The broad dimensions of CMC inquiry are laid out, yet few attempts to present theories or research-based models of any aspect of CMC study have emerged. Exceptions would be Burge's (1993) "power-load-margin" work, building on Howard McClusky's work, and Eastmond's (1993) "adult distance study through computer conferencing" (ADSCC) model. Paulsen (1993) and Moore (1991) have developed theories of distance education based on the attributes of computer conferencing, but these are yet waiting for experimental verification.

14.5.5 Moving-Target Difficulty

Exacerbating the research and theory-building endeavors is the continual flux of CMC technologies. Descriptive studies portray the dynamics of CMC at the present moment, but technological changes continually alter and enrich the instructional systems captured in the umbrella term CMC. However, as noted earlier (and in Eastmond's 1993 study), many conventional educational patterns are replicated on-line, either purposely (such as in the virtual or electronic-classroom efforts) or unintentionally, as educators seek to design appropriate instructional practices for CMC.

14.6 FINDINGS TO DATE

What do findings from research to date tell us about computer-mediated communication? This section presents findings from that research, addressing first the general concerns surrounding CMC use, and then looking at various contexts that use CMC: educational, organizational, and network contexts.

14.6.1 General Concerns

14.6.1.1. Equitable Access. Those who advocate the use of CMC, especially for distance education, argue that this technology allows for greater access at reduced costs by reaching rural areas, providing communication access for those who cannot attend class because of hectic life schedules, physical limitations, or institutional barriers (Dirr, 1990).

However, others counterargue that computer usage in general is accessible to wealthier, high-achieving male European-American students who live in urban areas (Faddis, 1985; Neuman, 1991; O'Connor, 1992). White (1991) reports how relatively few Americans have access to CMC technology. The situation in other developed countries (e.g., Britain) is similar (Kirkwood, 1993), while in the developing world, computer technology often significantly increases the gap between the "haves" and the "have-nots." Most CMC use is institutional, but, as Eastmond (1993) reports, CMC use often depends on adults' occupational status and socialization as to whether they value this sort of experience.

A policy study directed towards providing home-computing access to distance learners at the British Open University (Jones, Kirkup, Kirkwood & Mason, 1992) found that a rental policy of low cost for the necessary equipment was particularly important for women and less-advantaged students. They found that other family members rarely use CMC equipment, but that it requires large life-style changes and investment in time for learning the technology. Novice students required more help, leaning on tutors who often resented providing the necessary support. These studies were based on extensive survey questionnaires to British Open University students using computers for home-based learning as part of the university's home-commuting policy begun in 1988.

14.6.1.2. Information Quality. The larger the CMC network, the richer the resource for information exchange. However, depersonalization also occurs, and so individuals

are less likely to know the position, background, and expertise of those with whom they communicate. This may call into question the credibility of the information and opinions that are gathered over the networks. In the case of some of the research on the British Open University's use of computer conferencing, there was concern that on-line messages held little important information (Grint, 1989), while others asserted that they do (Graddol, 1989). Eastmond (1992) claims that much of students' valuing of CMC activity stems from their conception of learning, corroborating in part Grint's (1989) argument of CMCs being perceived as trivial or not dependent on student's perceptions of the nature of technical information being objective, procedural, and concrete.

14.6.1.3. Social Impact in Distance Education. Students' concern over their physical health surfaced in a couple of studies (Eastmond, 1993; Harasim, 1987), particularly with eye strain, but this did not seem to be a central issue with most CMC users. Some researchers expressed concern that CMC will build global networks while reducing proximate neighborhood and family ties, that CMC may alter peoples' work and communication patterns significantly and may dehumanize interpersonal interaction (Eastmond, 1992; Zuboff, 1988). Levinson (1990) counters (without a research basis) that the technologies are more genuine than we imagine in conveying human communication.

Few studies directly addressed on-line relationships. Boshier's (1988) investigation of computer conferences on listserves found that friendly relationships developed in spite of reduced cues, that participants became more casual and humorous over time, and that this medium invites more equitable participation. Phillips (1990) found that students who participated in an electronic "student lounge" maintained their attitude of positive potential for this medium after direct experience with it. They enjoyed chatting, and making friends and professional contacts, and felt less isolated.

Zuboff (1988) did extensive fieldwork and analysis over a 10-year period on the impact of computerization on companies, looking at manufacturing automation, clerical-work restructuring, the implementation of a database management system, and communications using computer conferencing. She describes worker alienation and the social breakdown of the workplace as new management styles emerged. A study with similar themes (Attewell & Rule, 1988) reviewed literature on organizational changes as a result of computerization.

14.6.1.4. Intellectual Impact on Conventional Courses. The purpose of most of the uses of CMC is to reduce problems caused by large geographic distances between colleagues. However, some very important effects from local uses can also be realized. Kuehn (1988) suggests that electronic mail can extend classroom discussions, increase the ease of evaluating student assignments, increase the connectedness of students and faculty, and increase both the social as well as an intellectual impact from this means of communication. Muffo (1987) also suggests that personal communications themselves can change due to the inclusion of computers, and particularly electronic mail, in the curriculum.

One of the problems observed by Grabowski (1990) was the need to increase opportunities for intellectual and social exchange among students. This includes new students who enter the program each semester and need to adjust to a new environment, establish new friends, adjust to a new pattern for studying, and juggle time for classes and life events, as well as seasoned students who are at the dissertation stage. Grabowski (1990) observed that there were several subpopulations of students: those who were heavy users of CMC, light users, one-time users, and those who did not use it at all. In order to evaluate the perceived usefulness, Grabowski mailed surveys to students who were currently enrolled, both users and nonusers. The principle findings can be summarized as follows:

- Full-time doctoral students without children are the most likely e-mail users.
- A high percentage of the users send e-mail to fellow students, friends, and faculty for the purpose of exchanging information or discussing ideas, and a lower number send e-mail to exchange social information.
- For nonusers, "no need" (40%) was reported most as the reason for nonuse. Technical skills (13%) and convenience (14%) were not as important.

From the data, there was very little indication of social impact, but a very high indication of intellectual impact among users, with 23% of the respondents either agreeing or strongly agreeing with the statement about social impact; whereas 73% agreed or strongly agreed with the statement about the impact on their intellectual life.

14.6.1.5. Software Capability and Design. Opinions vary as to the significance of the software and its impact on the learning environment. For example, Eastmond contends that the "user-friendliness" and transparency of the system for enabling participants in CMC to use software features heavily impacts CMC experience and learning approaches taken with the media (Eastmond, 1992). While the first systems worked with a command-line interface, modern computer conferencing systems such as FirstClass support formatted messages, multimedia attachments to messages, and a point-and-click method of navigating from conference to conference. Educational users have developed tools for managing student assignments, taking polls of student opinion, and monitoring the level of student participation. Mason (1994), however, claims that there are greater influences in the learning environments than in the software:

> Research is just beginning on the effects of these friendlier systems on the educational process. Will ease of learning and using the system lead to more active and interactive participants? While it is hard to expect anything but positive improvements, evaluators of conferencing applications have always concluded that the technology is not the problem. Social and pedagogical issues play by far the bigger part in the creation of a successful learning environment (Mason, 1994, pp. 51–52).

Ultimately, the aim of all CMC systems is that the user is most conscious of the content of the communication, not the equipment or the means of communication. In some sense, computer conferencing has a very long way to go in achieving transparency. Even with the newest software, the user still needs some awareness of telecommunications, some understanding of personal computing, and often a great deal of ingenuity with troubleshooting problems on their own equipment.

An example of the way the software capabilities may influence a student's success and the overall success of a CMC experience was identified by Romiszowski and DeHaas (1989) and Romiszowski and Jost (1989) in analyzing the dynamics of educational computer conferences of a seminarlike nature held within a typical electronic-mail environment. These studies identified two major problems experienced by both the participants and the CMC exercise organizers. The participants experienced a loss of the "sense of structure" of the discussion. The messages coming into their mailbox in a linear stream did not reflect the sequence of elaboration of arguments within the various parallel discussions that were going on in the seminar. The result of this was that participants typically recalled only the most recent messages and did not relate them clearly to earlier messages. At the end of the conference, it was found that participants varied considerably in terms of their overall general view of what has been discussed and decided on.

A second problem, which may be considered more a problem of the organizers of the CMC experience, was the problem of "loss of control" over what exactly would be discussed. Maybe partly as a consequence of the loss of a sense of structure on the part of the students, the students would tend to pick up on a recently circulated message and respond to that out of context, often leading the discussion into a completely new area. It was found that the task of bringing discussants back to the original topic was much more difficult in the CMC environment than would normally be the case in face-to-face discussion.

It was shown that these two problems were largely caused by the software environment within which the conferences were taking place by modifying this environment and demonstrating that both the problems were greatly diminished. Specific modifications used were the development of a structured discussion environment within a hypertext software package that would automatically create separate discussion areas for each topic and automatically create links between relevant messages that could later be followed with ease (Romiszowski & Chang, 1992).

14.6.2 Educational Issues

Educational CMC takes place within an institutional context, with learning as the desired outcome of this activity. This section focuses first on various learning concerns that surface with the use of this medium. Next, it shifts to address institutional concerns, such as students and their participation, instructors and teaching, administration and implementation, and staff and support issues.

14.6.2.1. Teaching/Learning Concerns

14.6.2.1.1. Content and Objectives. The characteristics of CMC, although changing rapidly, still shape the instructional and communication activities they support. Perhaps the most obvious question to arise is whether CMC, which is primarily text based, is equally suited for various subject matters. Florini (1990) suggests that subjects such as science, mathematics, and the arts do not lend themselves to CMC instruction because of its inability to convey audio, visual, and kinesthetic information. Wells (1992) surveyed the types of courses being taught at both the undergraduate and graduate levels in the following subject areas: computer science, foreign language, group performance skills, history, humanities, physics, statistics, education (various types), engineering, management, and media studies. Wells suggests that subject matter that involves discussion, brainstorming, problem solving, collaboration, and reflection is best suited to CMC.

14.6.2.1.2. Interactivity and Interaction Processes. Interactivity, that is, the capability of participants to receive specific feedback of any length to their contributions from any other member of a CMC discussion, is touted as a primary advantage of this medium (Moore, 1991; Harasim, 1989; Feenberg, 1989). Studies of message exchange patterns support the perspective that communication patterns are more democratic and group discussion oriented than would be found in classrooms or other telecommunications settings (Harasim, 1989; Levin, Kim & Riel, 1990; Siegal, Dubrovsky, Kiesler & McGuire, 1986). Eastmond (1993) suggested that CMC wasn't inherently interactive, but instead depended largely on participation frequency, timely contributions by members, and the nature of messages posted. Computer conference participants who got behind found the medium to be rather didactic and passive.

CMC has been proclaimed as uniquely suited for collaborative study (Harasim, 1989; Harasim, 1990b; Kaye, 1992). Eastmond (1993) found that a competitive model of computer conferencing was equally adaptable to study through CMC study, and the collaborative model did not work equally well for all students. Siegel et al. (1986) investigated the effects of CMC on communication efficiency, participation, interpersonal behavior, and group choice. They found that CMC groups interacted less and took longer in the decision-making process than similar groups in face-to-face discussion. On the other hand, the CMC group members tended to behave as equals, whereas there was evidence of social inequality and of unequal participation in the face-to-face group.

Romiszowski and Chang (1992) have performed several studies investigating techniques by which the CMC environment could promote the same level of cognitive processing and interactivity that may occur in a one-on-one tutorial between a student and an expert teacher. The strategy employed has been to use an initial, partially prepared exercise that invites a student to create a structural "picture" of

all related elements that are seen to be relevant to the solution of a particular complex, multifaceted problem. This complex student response is then the basis of a CMC discussion that may take place either between student and tutor or between a group of students commenting on each others' alternative solutions. This adaptation of a methodology called "structural communication" has shown itself to be effective for implementing such interactive teaching methods as the Harvard Business Case methodology and, furthermore, reducing the amount of human facilitator or monitor interaction necessary to lead the exercise to a satisfactory conclusion (Romiszowski, 1990; Romiszowski & Chang, 1992; Chang, 1994).

14.6.2.1.3. Learning Strategies and Tactics. Several researchers have looked at the learning strategies students employ when engaged in on-line study. Burge (1993) used structured, open-ended interviews to study how students think they learn through CMC. He found a set of learning strategies with similarities to both those proposed by cognitive psychologists and adult educators for other means of study, with the addition of a group of interpersonal and logistical factors for the "management of the metacontext of learning." Learning strategies he found students using fell into the following major categories: making choices, expression, group interaction, and the organization of information. Eastmond (1993) found distance students who took courses through computer conferencing to transfer learning-to-learn approaches from other instructional contexts. These transferred elements included study patterns, time scheduling, working with others, establishing attitudes, setting goals, seeking task and structure information, and demonstrating competence. However, the nature of this novel instructional context required them to develop idiosyncratic ways of dealing with the on-line learning environment. Some CMC-specific strategies they employed included dealing with multiple discussions, information overload, asynchronicity, textual ambiguity, and processing the on-line information and determining what contributions to make.

14.6.2.1.4. Learner Control and System Control. Some proponents of CMC see the principal use and value of the medium as an emancipatory communication medium, totally under control of the users, for whatever purpose they wish to use it. There is no doubt that such a medium of communication may be valuable in education and was a missing aspect in most conventional distance education systems of the past. The CMC-based common room/coffee-shop is a phenomenon to be welcomed. However, it seems difficult to support the argument that this is the only valid use of CMC systems in education.

CMC has also been promoted (Mason, 1988) as an excellent medium for self-directed learning as a defining characteristic of adult learning (Knowles, 1984). Self-direction manifests itself when students voluntarily elect to take a CMC-based course, determine how, when, and where they will study, and negotiate the learning activities and content focus they will pursue during the course. Eastmond (1993) found that distance students taking CMC courses exhibited varying patterns of self-direction. They were confident about their abilities to manage their schedule and the study process to produce necessary learning results, but they wanted the assignments clearly set forth for them by the instructor.

There are also problems that need to be addressed when using CMC as an integral part of a course. Some of these spring from the *asynchronous* qualities of the communication process. Unlike face-to-face instruction, or real-time teleconferencing, in which the participants communicate during one fixed period of time, CMC allows one to choose *when* to respond to another participant's comment. This offers the benefit of allowing one to think out a more structured, more complex response, and the benefit of being able to participate at times that are personally convenient. This same factor can also generate communication difficulties. One problem is that it may promote procrastination, leaving the response for later, and, perhaps in some cases, failure to respond altogether. This adds to the complexity of the developing structure in that students may, at any time, be inputting new comments related to different stages of the development of the topic. Not only is the discourse "multi-level" in that several different topics may be in simultaneous discussion, but it is also "multispeed" (Romiszowski & DeHaas, 1989).

Another problem originates from the *distance* communication aspect of CMC. Although distance communication (see Chapter 13) allows one to participate in a discourse that may otherwise be impossible, it also introduces some difficulties of *control* of the discourse. The instructor loses some of the benefits offered by a face-to-face group situation. When the discussion drifts off the topic, it often takes longer, and is more difficult, to bring the group back on task. There is also the problem of knowing who is and is not participating. There is only knowledge of who is contributing. How can we know who is "lurking" in the system, so that we can try to draw them into the discourse (Romiszowski & De Haas, 1989)?

14.6.2.1.5. Outcomes and Their Evaluation. Assessment of student achievement in CMC courses versus those offered through correspondence or classroom formats is reported in only a few studies. Cheng, Lehman, and Armstrong (1991) compared achievement, attitudes, time-on-task, and interaction between groups involved in each of the three types of instructional formats for a graduate course about microcomputers. They found that the CMC group scored lower on achievement tests and attitudes than the other two groups, but time-on-task was the same. Completion rates were greatest for those attending class, but a study group at one CMC site improved completion rates there. In another study, Phelps et al. (1981) compare both the effectiveness and the costs of a computer-mediated communication course in the U.S. Army. In this study, the CMC students tended to score somewhat higher than those taking the conventional courses. However, the CMC courses had higher dropout rates. As regards costs, once the initial conversion and start-up costs are recovered, the CMC

courses were found to cost 48% less than the equivalent conventional courses.

14.6.2.2. Implementation Concerns

14.6.2.2.1. Students and Participation. Just a few studies touch on the distance students' life situation, goals, and personal factors that affect their pursuit of a formal education. Robinson (1992) looked at demographic characteristics of distance students at a Canadian university and found that the majority of them were working women, pursuing an education part time. Most of them had prior university experience. Gibson (1991) found that self-confidence impacts student success in an external degree program. Factors that enhanced self-confidence in a learning context were instructor empathy, success in completing work, progress toward a goal, and students' perceived understanding of themselves and the educational process they were undergoing.

By studying the hard-copy transcripts of a computer conferencing course, Harasim (1987) plotted the participation patterns of the students. She found that the smallest group, full-time graduate students, used the system during the weekdays, but the majority of the class who worked full time Monday through Friday used the system most heavily on the weekends. Unsurprisingly, the heaviest usage on weekdays was in the evening, but participation was spread throughout the day on weekends.

Likewise, little research addresses distance students' perceptions of education and their distance learning. Manninen (1991) found class differences to affect participation in courses taught using computer conferencing. Middle-class students found it easier to access the computer network, and they discussed actively on the system. In contrast, working-class students contributed less in reactive responses, but their participation increased over time. Roberts (1990) found that distance university students held learning and career-oriented goals, not social and cultural ones. These students were self-confident, independent, achieving, and persistent. However, differences existed on goals and academic self-concept by gender, class, experience, and income level. Distance students were more confident and learning oriented than their conventional counterparts.

Several studies explored student perceptions of the on-line communications medium generally, not just computer conferencing. Grabowski, Suciati, and Pusch (1990) found that graduate students felt that e-mail was effective for exchanging social and academic information with their peers and professors. Those who chose not to use it did so because they felt no need for it, found access to the computer network inconvenient or unavailable, or simply had not learned the necessary skills for using the technology. Grint (1989) found that students thought it difficult to carry out conversations in asynchronous time and felt that they were overloaded with trivial information before being able to contribute. They were inhibited by their impression of a large, "lurking," anonymous audience who would read their contributions. Students perceived that unless they contributed facts, which was difficult in the new subject-matter area they were studying, their additions to the conference were unimportant. Therefore, they disliked reading the opinions of other students on-line. Status and gender also affected participation among those he studied.

Harasim's (1987) research of two graduate courses taught through computer conferencing is probably the most telling about how students perceive this medium. Using both quantitative and qualitative approaches, she found that students spent longer on-line than they were required by the course, and they felt that this medium was effective. Students listed the advantages of computer conferencing as increased interaction, access to a group, the democratic environment it fostered, the convenience of access, their control over the instructional process, the motivation they had to participate, and the textual nature of the computer conferencing medium. The disadvantages they mentioned about this medium were the information overload they felt, the medium's asynchronicity, which caused delayed responses, difficulty they felt following on-line discussions, the loss of visual cues with this communication, increased access inconvenience, and health concerns about computer radiation.

Other studies support Harasim's conclusions while adding some additional insights. Hiltz (1986) found that students commented among themselves and more highly valued computer conferencing when it was a supplemental activity of the course and not the main medium of instruction. Students said that convenience was the greatest advantage of computer conferencing, but the awkwardness they felt in communicating with unknown persons was its greatest liability. Robinson (1992) found that convenience of access at the student's own time schedule was more important than the separation in proximity of distance learners. McCreary and Van Duren (1987) found that those of higher or lower status submit written contributions less frequently to computer conferences. Graduate students' participation was more active and horizontal (among fellow students) than was the on-line activity of undergraduates. Differences in content areas didn't affect participation. Scollon (1981) found that the Native Alaskan students she studied were easily confused by the excessive and scattered communication on-line. Instructors couldn't attend to the many students in the course (60 people), and the volume of communication was particularly difficult for everyone to process. The students welcomed a return to the audio cues of teleconferencing.

14.6.2.3. Instructors and Teaching. The role of the computer conferencing teacher is quite different from the traditional classroom instructor or lecturer. Course design becomes more important, and preparation entails the structuring of conferences and topics, and the design of activities and small group work. During a computer conferencing course, the teacher must adopt the role of facilitator not content provider.

> The facilitator needs to pay careful attention to welcoming each student to the electronic course, and reinforcing early

> attempts to communicate. In the first few weeks, I make sure that my notes in the conference specifically reference prior student notes. I send many individual messages to students suggesting resources and generally reaching out to students. The coaching function is key to easing the students' transition to computer-mediated communication (Davie, 1989, p. 82).

While the teacher's role is particularly time consuming in the initial phase of a computer conferencing course, it usually reduces as students take over the discussions. Nevertheless, some reports indicate that teachers spend up to twice as long, overall, to deliver a course via computer conferencing as they do to give a course by traditional means.

Given that CMC is so time consuming, why are so many teachers willing to teach electronically? The reason lies in the reported rewards: tremendous satisfaction in working towards the goal of developing independent, questioning learners. The literature abounds with comments from teachers recording their personal learning experience in adopting this medium (Gunawardena, 1992). One of the additional rewards for computer conferencing lies in the flexibility it gives them to work at their convenience, not at set times.

14.6.2.3.1. Administrators. Most small-scale uses of computer conferencing begin at grass-roots level with a few enthusiastic teachers, but its eventual acceptance within a large institution usually requires backing at the highest level.

Implementing a program of on-line teaching can raise major policy issues. For example, there is the question of incentives and remuneration of faculty who teach via telecommunications. Very few institutions currently acknowledge the extra effort and time involved in teaching via CMC, with additional payment. Furthermore, the academic promotion process does not adequately reward faculty for taking on teleconferencing duties. Lack of recognition continues to be a significant deterrent to growth and acceptance among faculty. This issue is bound up with the much more complex and long-term issue of whether the use of CMC saves organizations money.

There is growing acceptance of the notion that turning to CMC is not a route to major cost cutting but rather a means of extending access to courses, improving the quality of current provision, and meeting the need for flexible learning that cannot be accommodated otherwise.

14.6.2.3.2. Support Staff. Teaching via computer conferencing requires a high degree of familiarity with the system's features and architecture, and the training and support of teachers and students are critical aspects of any educational program using this medium. While it is relatively easy to train teachers and students to use a CMC system, it is much more difficult to teach the skill of moderating educational computer conferencing: how to promote discussion, devise activities, and encourage interaction. Experienced on-line teachers have written guidelines (Brochet, 1989; Kerr, 1986), but in the end, teachers have to find their own style through practice.

Institutions with large CMC programs often operate a help desk for queries about equipment and communications systems; smaller programs usually have to provide some staff resource to give advice to students with technical difficulties. However, given the technical complications of the current telecommunications scene, some organizations adopt the policy of expecting students to turn to their local dealer for this support.

Managing and supporting equipment through its lifetime is another issue that some institutions face for the first time with telecommunications. For some organizations, a whole new unit and type of staff are necessary. Many underestimate the extent of this element of telecommunications. According to Maloy and Perry (1991), to understate the dollars required to operate, maintain, upgrade, and train to the system is to undercut its assimilation into the instructional process. When this happens, technology remains supplemental, making it even more vulnerable to cost reductions.

14.7 A LOOK TO THE FUTURE

14.7.1 Electronic Networks and Future Education and Training

The development of telecommunications and digital data transmission is revolutionizing the way business is performed. People are working and communicating ever more by means of computer-based workstations that support databases, electronic mail, and a host of other information tools.

As electronic communication networks become more ubiquitous, easier to use, and more powerful, the trend towards electronic, networked business communications will grow rapidly. As a result, people will spend an increasing proportion of their time at workstations and proportionately less at live meetings (Vallee, 1982; Zuboff, 1988).

This trend is also liable to spread to meetings with educational or human resource–development aims. The U.S. telephone company AT&T, for example, has already moved towards the massive use of teleconferencing in place of conventional classroom-based courses for most of its sales and management training needs. The major part of sales and management training in AT&T is now delivered by this method (in 1989, over 69,000 employees participated at least once in some form of teletraining), and results overall are considered to be quite satisfactory (Chute, 1990).

Of course, the rapid expansion in use of electronic teletraining is being driven, as always, not so much by effectiveness, but rather by economic factors. AT&T has reported an overall reduction of over 50% in the costs per student hour of training. This cost saving comes almost entirely from savings in travel and subsistence costs when employees participate in centrally organized "place-based" courses, as well as from reduced loss of productivity due to a reduction in the time that employees are away from their jobs (Chute, 1988, 1990).

14.7.2 New Forms of Education and Training

There are also other pressures, both organizational and philosophical, that are increasing the amount of autonomy, self-directedness, and responsibility that learners have in

respect of their own education and development. From the philosophical side, there is the viewpoint that people should have more control over what they learn and how they learn it. These viewpoints are embodied in the principles of modern adult education, or andragogy. They also reflect earlier humanist traditions. They are further strengthened by the modern concepts of continuing or "permanent education," which spring from the realization that change in society, and particularly in the workplace, is now so fast that everyone is of necessity involved in a process of lifelong learning.

This need for updating may in some respects be very specific and personal for each individual. Hence the growing popularity of the "open learning" concept as a modular approach to education that can take anyone from wherever they are at present in a given domain to wherever they need or want to be, relatively independently of the needs or wants of other people (Paine, 1988).

Given the increasingly competitive nature of business in the international marketplace and the critical importance that access to and use of up-to-date information and methods play in a company's competitiveness, it is not surprising that the concept of human resources development as "self-development" is taking root. This concept sees keeping up-to-date and employable as the responsibility of every employee. The employer's responsibility is to make this possible, by helping to identify the needs of the individual and by facilitating access to the resources necessary to satisfy those needs. Doing so will call less frequently for lengthy courses organized either within the company or by outside providers, but will instead make much more use of networking, access to external databases and electronic libraries, small specialist group teletraining, and self-instruction in all its forms (Eurich, 1990).

As the trends outlined above expand through the business community, similar trends will be seen in relation to adult education, especially in the growing use of distance education in formal educational institutions. To some extent, similar economic factors may lead to a greater use of distance education and electronic networking as the prime delivery media for certain courses. More ubiquitous, however, will be the use of electronic communication media as support to conventional courses. This will be brought about partly by organizational and pedagogical benefits that such systems can offer conventional courses and partly because it will be seen to be the duty of education to use such systems in order to prepare its graduates for the realities of a workplace where they will be obliged to use them.

This last point really brings home the importance of examining now how to get high-quality educational experiences and effective learning from future networked communication systems. The particular focus should be on the effective implementation of group discussion or "conversational" methodologies on electronic telecommunications networks. This focus is particularly important, as we know much less about how to converse effectively on electronic networks than we do about electronic self-instruction. There is a long history and fairly developed technology of the design, development, and delivery-at-a-distance of self-study materials. There is much less known about the running of effective group discussion sessions at a distance.

Such teaching methods as seminars or case studies are traditionally implemented in small or medium-sized groups, led by skilled and experienced "facilitators." Much of the success of these teaching methods is ascribed to the facilitators and the skill with which they focus discussion; guide the approaches adopted by the participants; use natural group dynamics to stimulate interest, participation, and deep involvement; pull together what has been learned in the final debriefing discussion; and so on. Can such participatory discussion methods be effectively orchestrated at a distance? How might this be done?

14.7.3 Two Paradigms Compared

In order to answer these questions, let us review a little theory and also some of the research already available on this topic. It may help to compare and contrast two alternative paradigms, or perhaps philosophies, which are current in education: the "instructional" and the "conversational" paradigms. These are summarized in Table 14-1.

The instructional paradigm is the one that has driven much (though by no means all) of the research and development of the past 30 years that has been performed under the label of educational (or instructional) technology. The conversational paradigm may be seen as the basis of much of the work done on small-group study, group dynamics, experiential learning, and so on.

In relation to distance teaching specifically, one may notice at the bottom of Table14-1 that the more conventional "study module" or typical correspondence model may serve as a good example of the instructional paradigm. Synchronous teleconferencing, both audio and video based, is on the other hand a good example of the conversational paradigm in action. CMC, however, is seen as being able to support both conversational and instructional procedures. For example, joint cooperation on the analysis and development of a hypertext document satisfies all the basic requirements of a conversation between the participants. The study of an on-line version of a maintenance manual for an airplane in order to learn a particular set of troubleshooting procedures satisfies the requirements of instruction. This versatility of CMC systems and their potential integration with on-line information sources such as hypertext makes them particularly interesting systems to study with a view to their rational adoption in education and training (Horn, 1989; Romiszowski, 1990).

14.7.4 Future Trends

The future of computer conferencing is undoubtedly one of great mergers: with synchronous media, with multimedia, and with the whole panoply of desktop facilities. Some would say, the sooner the better! While this merger is already happening at the leading edge with integrated text, sound, and graphics being exchanged on higher-speed

TABLE 14-1. TWO TEACHING PARADIGMS

Paradigm		"Instruction"	"Conversation"
Objectives: (output)	(why?)	specific predefined products standard	general negotiable processes variable
Messages: (input)	(what?) (when?) (who?) (whom?)	designed preprepared instructor one-to-many	created on-line participants many-to-many
Interaction:	(process-focus) (analysis) (feedback) (complexity)	behaviors criterion-ref. corrective one-layer thick	ideas content/structure constructive interwoven layers
Distance education: (example)		correspondence courses	teleconferencing, videoconferencing
		computer-mediated communication	

modems, the growth area for CMC lies with the resources available over the Internet. The role of the on-line teacher will increasingly be that of guide to these resources. It will be interesting to see what needs computer conferencing fulfills with the advent of cheap audio and visual connections. If messages remain asynchronous (like telephone-answering machines), will text be relegated to formal papers and documents? Will the stimulation of voice and visual communication overcome learners' inertia and be more compelling to respond to than text?

Another trend predicted to continue is international on-line connections, for example, collaborations among students studying similar courses at different institutions. School children carrying out multicultural investigations are a powerful and inexpensive resource for extending the classroom walls.

> It would be naive to think that communication will automatically lead to greater knowledge, increased respect for individual and cultural differences, and a new appreciation of similarities. But a more peaceful world will not evolve without communication. The technology of CMC does not lead directly to the answers, but the dialogue it supports is a significant way for people to begin to embrace the common questions (Wells, 1993, p. 85).

As "pure" computer conferencing falls increasingly towards the trailing edge of technology, it will continue to find specialist uses in education and training. Old computer equipment will be perfectly adequate for textual communication, and could be used with those who currently cannot afford access. By comparison with multimedia conferencing, computer conferencing will be an inexpensive technology, which will continue to grow at the grass-roots level.

In the short term, conferencing systems with improved interfaces will find increasing markets, and learners will increasingly have to adapt to the interactive and collaborative paradigm they represent. However, this technology-led growth will eventually meet a new generation of users reared with the computer and schooled in international communication, and then tele-learning will become the norm rather than the exception.

14.8 A RESEARCH AGENDA

The previous section of the chapter looked at what the future may be holding in store. It presented scenarios based on technological change and its impact in the workplace and the home and the impact of those on technological change in educational institutions. It also looked at some aspects of future technological synergy that will be offering evermore powerful communication alternatives that may (or may not) have applicability in education and training systems.

The reason for putting this section prior to the research agenda is to indicate more clearly how the research issues listed in this section are linked to our vision of what the future possibly may hold in store. The driving objective behind the research agenda that follows is to try to be proactive and anticipative of technological change and its potential impact, both for the good and for the bad, on education and training systems.

The organizing principle for the following research agenda is a four-level planning model that considers separately, but in an integrated manner, the research issues that should be investigated in order to supply the answers we will need in order to:

1. Make sensible policy decisions regarding CMC.
2. Make effective strategic planning decisions.
3. Make tactical decisions within specific CMC projects.

4. Make good logistic decisions in relation to selection and use of the hardware and software that will be the tools of future CMC systems.

14.8.1 General Research: The Policy Level

Under this heading, perhaps one of the most important (and least practiced) forms of educational research is the "futures study." In some respects the scenario presented in the section called "A Look to the Future" is an example of a futures study. The need is for more rigorous futures research that may evaluate, in advance, the impact of potential changes in the workplace or in society that may be brought about by technological progress or other change.

These in turn should be evaluated in terms of two factors. The first factor is in terms of the direct impact of societal changes on education, that is, on the goals, the content, the delivery methods in the macro sense (for example, to what extent will the demand for distance education grow and in what sectors of the market?), and so on. Secondly, the study should investigate in what way new technological developments can offer solutions to some of education's current or anticipated future problems and challenges.

This particular area of research is especially prone to what we described earlier as the "moving-target difficulty," in that technological change is happening at such a rate that the prediction of futures may be considered to be a continuing task rather than a project that may be done once and for all during a particular decade. The implications of not evaluating the alternatives in advance, or of evaluating incorrectly, are potentially very great both in terms of misapplied project funding and in terms of possible disappointment with end results of an innovation.

This area of futures research cannot be undertaken exclusively from a technological or an end-user standpoint. Technology and the citizens of society exist within a complex system that has its economic, political, and other pressures and constraints. A very clear example of possible misjudgments can be seen in plans that have been undertaken over the last years on the assumptions that certain technological improvements will be available within certain time spans. In the mid- and late 1980s, millions of dollars were invested in the United States into the "education utility" concept on the assumption that within a year or two all schools will be networked with sufficient bandwidth in order to enable a provider of educational information located at a distance to offer better service than the established system of booksellers, printers, videotape producers, etc. The education utility would replace all these traditional informational providers with one central electronic database that would supply any information to anyone anywhere on demand, just as electricity or water is supplied, and then bill the end user at the end of the month for the information actually used, just as the electricity or water utilities bill (Gooler, 1986).

Nearly 10 years have gone by and the education utility concept has not become a reality on a grand scale, although there are numerous "mini-education utilities" that have been implemented by corporations or by certain states (for example, the state of Texas). The technology is here, but the political will and the economic pressures to make it available are not necessarily here. Therefore, futures research of the type suggested here must be a broad systemic approach to the analysis of all factors that may play a part in the actual shaping of the future that we may expect.

Another aspect of general research is to keep up with technological developments. At the present time, developments may focus on the potential integration of computer-mediated communication (which is most commonly used as an asynchronous communication medium), with synchronous technologies of audio conferencing and video conferencing. The technological possibilities exist to integrate these currently separate technologies, so that, for example, some of the distinctions that were made in Table 14-1 may take on a purely academic meaning. However, just how would such integration work, what would it depend on, what will be its capabilities, and what are the expected time-lines and costs for availability?

14.8.2 Organizational Research: The Strategic Level

If the previous category of general research can inform policy decisions in relation to CMC, then this next level of research would principally support strategic decisions in the context of overall planning of CMC systems and the integration of these systems into broader education and training systems. The research issues that require attention are ones related to overall educational system planning, with CMC seen as one component. For example, to what extent ought CMC be involved as a component in open learning systems or in other flexible learning programs? In the industrial-training context, to what extent and in what way can we utilize CMC systems as part of the tendency to develop electronic performance support systems that may enable the trainee to receive all necessary information both for learning and for reference at the workplace as and when required (Gery, 1991)? Alternatively, if the training continues to be off the job, can CMC be utilized to put into reality the concept of a "just-in-time-training" in its broadest sense?

Another important research agenda concerns strategies for effective dissemination of CMC in actual educational systems. The British Open University (OU) is currently engaged in finding answers to the research questions concerned with "scalability" of CMC. How can the undoubted successes of small-group educational computer conferencing be scaled up to large-distance education? So far this medium has only been used as a means of tutorial support on large courses, and this has been shown to have a number of major disadvantages. While some students valued electronic contact with their tutor and found that the medium reduced the isolation often reported by distance learners,

the pedagogical benefits of this minimal use of the system proved fairly marginal. But more significantly, the success of even this low-level use of conferencing was shown to be highly dependent on the quality and quantity of the tutor input. This problem of tutor workload is a critical issue, where tutors are currently paid for only half-dozen hours of student contact throughout an entire course (Mason & Kaye, 1989).

The Open University has experimented with a number of small-scale uses of computer conferencing with 25 to 50 students. Many of these trials have involved the use of the conferencing system FirstClass. The results of these have shown how exciting and educationally valuable this medium can be (Mason, 1994b). However, it is the conclusion of those involved in many of these trials that no ideal model has yet been identified for applying these successes to large courses of 1,000 to 5,000 students. Some of the suggestions under consideration include: the extension and enhancement of peer learning groups; the use of "master classes," in which a few students interact with an expert while the remainder can read only; increased input from central academic staff who normally write courses rather than interact with students; the use of World Wide Web facilities integrated with conferencing facilities; and the development of a few specialist conferencing tutors rather than the expectation that all tutors will be trained and paid for conferencing duties. A variety of uses of conferencing are jumbled together among these suggestions, and it is important to distinguish them: conferencing used for teaching (the content of the course) and conferencing used for tutoring (supporting the student); conferencing used for course delivery (of articles, updating material, directives from the course team) and conferencing used for interaction (between students and teachers). While it is possible, perhaps even desirable, that the OU use conferencing for all these things, it is necessary to be clear on the objectives for each type of use. Over the next few years as the OU expands into continental Europe, extensive use will be made of computer conferencing, and many of these uses will be integrated with various forms of multimedia educational facilities, such as CD-ROM. During this period, the OU will be experimenting widely with a variety of large-scale conferencing models.

Apart from specific courses that use electronic communication as a teaching vehicle, the Open University is also setting an ambitious target for providing administrative access to students through computer networking. By 1996, the OU aims to make a wide range of services available on-line: inquiry and information services including on-line registration; induction material, library access, and support services; local call access and Internet connections for all students; and a network support environment package. While these facilities may not be innovative for campus-based universities, providing these systems for as many students spread as widely as OU students is a major undertaking. The benefits are perceived to be increased individual autonomy and control over the learning process, bringing the university to the home to a much greater extent than before, adding flexibility and tailorability to courses, and freeing the OU from the assumption that large student numbers are needed to achieve economies of scale.

14.8.3 Instructional Research: The Tactical Level

Perhaps one of the most important areas for tactical research at the moment is to investigate the potential applications and specific methodologies for collaborative learning. This research should look at the tools available and also the tools that would be desirable for collaborative learning. These may include shared workspaces, the sharing of documents, and even virtual-reality possibilities of being in almost physical contact with collaborators who are in reality at a distance.

A second area of important research for the future is the design and evaluation of specific CMC environments for the effective implementation of particular types of instructional activities. These may include simulation games, small-group discussions, group assignments, or case study discussions. These techniques, which are typically practiced in small-group discussion situations facilitated by a skilled expert, are among the techniques that are most valued for the development of critical thinking, problem solving, and other higher-order cognitive skills.

As society progresses into the age of technology, more of the routine tasks performed by human beings will be taken over by computers (whether they be physical tasks replaced by robots or intellectual tasks replaced by expert systems). The area for human employability will be evermore restricted to those types of tasks that computer systems cannot perform effectively. Some of these will be tasks that are very reliant on interpersonal skills, empathy, and human contact. Others will be the tasks of the "knowledge worker," that is, the person who can perform intellectual tasks beyond the capability of computer software. Such knowledge work is characterized by the utilization of current knowledge for the creation of new knowledge. It is not so much problem solving as the formulation of problems that are worth solving. It is creativity; it is invention; it is leadership. As an ever-greater proportion of the jobs performed by human beings have these characteristics, there will be an ever-greater need for critical thinking and creativity skills and therefore an increasing need for educational methodologies and techniques that are effective at developing them.

Here we have a somewhat paradoxical situation in that as the scenario presented earlier would suggest, small-group face-to-face meetings will appear evermore expensive as compared with the falling costs of various telecommunications-based methodologies of communication. Therefore, we may be able to afford ever less (in terms of teaching methodologies) of what we require evermore—*unless* we can implement on CMC networks techniques for small-group discussion that will be able to substitute the small-group face-to-face techniques that we may not be able to afford. As an example, the work being performed by

Romiszowski and Chang (1992) and Chang (1994) is focused exactly on this particular set of research questions, concentrating in particular on the replication in a CMC environment of effective business case analysis and discussion methodologies.

14.8.4 Network Research: The Tool Level

We have proceeded through the levels of policymaking, strategic planning, and tactical decision making. The fourth area of research can be referred to as the logistics area, that is, research into the tools required in order to put our strategic and tactical plans into action. Very often in the field of new technological developments, the tools are the elements that appear first. Sometimes, too often in fact, the availability of the tools becomes the starting point for a project, and we follow the process of a "solution in search of a problem to solve," as opposed to a systemic and well-organized problem-solving approach.

It should be stressed that both of these alternative approaches are important in the research field. As new tools appear, such as for example desktop video, there is a need to explore their potential within certain areas of possible application. For example, in the area of education, and particularly computer-mediated communication, in what way is desktop video a new technology that will offer simply a reduced cost per hour of video conferencing, or will it offer certain potential for setting up tactical plans or even overall strategies that were not possible before with the technologies at our disposal? Of course, having set up these possible scenarios and going through the research stages of proving the concept and its viability, then comes the stage of turning the process around in order to verify to what extent there really is a market or a need for this potential new product.

The tools-related research should therefore be integrated very closely with the three upper levels of research that we have already outlined. There is an obvious need for keeping the policy, strategic, and tactical research abreast of the tools research so that we have rational plans for the utilization of specific new tools and technologies as they become available, rather than being swept away by the appearance of the tools without a chance for prior evaluation of whether we are traveling in the most appropriate direction.

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