Computer-mediated communication in the university classroom: An experiment with on-line discussions
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Computer-Mediated Communication in the University Classroom: An Experiment with On-Line Discussions

Scott L. Althaus

This study examines whether supplementing face-to-face discussion with computer-mediated discussion (CMD) enhances the academic performance of undergraduate students in large lecture courses. It also examines the characteristics of students who volunteer to take part in CMD groups when such participation is optional and worth a small amount of credit. Student evaluations and academic performance data from a quasi-experimental study involving 142 undergraduates suggest that a combination of face-to-face and computer-mediated discussion provides a learning environment superior to that of the traditional classroom. Students actively involved in CMD groups not only reported learning more than they otherwise would have, but they also tended to earn higher grades than students taking part in face-to-face discussion only. CMD participants had more prior experience with electronic mail but similar levels of computer experience as other students. Patterns of participation in the on-line discussions are discussed along with ways to increase participation in CMD groups. Keywords: computer-mediated communication, collaborative learning, computer conferencing, on-line education, LISTSERV, electronic mail

Computer conferencing software and electronic mail technologies have been around for more than 30 years, but such systems were adapted for use in the classroom only since the late 1970's. As more attention today is being paid to the educational uses of computer-mediated communication (CMC), it is often assumed that this new medium should be an effective pedagogical tool. Yet with a few notable exceptions (e.g., Hiltz, 1986, 1990, 1993; Marttunen, 1992), there has been almost no systematic effort to gather data on student performance that could be used to test hypotheses about the effectiveness of CMC technology in the classroom. As a result, there is still relatively little hard evidence to support the notion that CMC technology can help create a learning environment superior to traditional face-to-face settings.

This article presents findings from a study of on-line discussion groups that sheds new light on this issue. Drawing from a rich set of student evaluation and performance measures, these findings address some important but neglected questions about the pedagogical uses of computer-mediated communication. In theory, on-line discussions should help more students learn better by placing them in an intellectual environment that encourages active, thoughtful, and equal participation from all corners. But it remains unclear how much demand there is among students for an alternative to the traditional classroom. If given the choice, would students want computer-mediated discussions as a part of their educational development, and if so, why? Who among them would volunteer to participate in such discussion?

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groups? And the biggest question of all—Would students feel that computer-mediated discussions help them learn?

This article explores these questions using data from an extensive trial of on-line discussions conducted at a private, Midwestern university during the 1992–3 academic year. The results from this trial suggest that computer-mediated discussions (CMDs) can provide a unique learning environment that enhances traditional face-to-face classroom discussions. The pages that follow first outline the many pedagogical advantages of bringing computer-mediated communication into the classroom and then discuss some general findings from the experimental trial. Lastly, this article addresses whether students should be required to take part in on-line discussions.

The Advantages of Computer-Mediated Communication in the Classroom

Computer-mediated communication can create a unique environment for discussion that avoids many of the conversational limitations posed by face-to-face communication (McComb, 1994). In her review of 20 years worth of CMC literature, Linda Harasim (1990) suggests several key differences that distinguish computer-mediated conversations from face-to-face discussions: place dependence, time dependence, structure of communication, and richness of communication.

Place Dependence

The most profound difference between face-to-face and computer-mediated communication is that one requires people to be in close physical proximity while the other does not. Face-to-face communication is place-dependent. Effective face-to-face discussion requires that students and their instructors meet in classrooms or other suitable locations that are relatively free from distractions. Computer-mediated communication is place-independent. Electronic discussions can occur between students working in computer labs or in their dorm rooms. Computer-mediated communication takes place in “cyberspace,” the ethereal world born of intersecting computer networks in which individuals access files, read mail, and talk to one another. As cyberspace is accessible from any phone jack in the world, computer-mediated conversations can be held just as easily across the continent as across the table.

The obvious advantage of computer-mediated discussions is that they avoid the need to assemble everyone in a single location for discussion. As one student participant in the CMD experiment noted, computer-mediated discussion “is a good idea, especially when one can’t make it to class.” Students who are unable to attend classroom discussions because of illness or physical disability can fully participate in electronic conversations from wherever they happen to be.

Time Dependence

Face-to-face discussions must occur not only in the same place but also at the same time; in electronic discussions, conversation is normally asynchronous. Classroom discussions take on certain characteristics because of their time-dependence. In a typical 50-minute class session, only 40 to 45 minutes are left as prime discussion time after the topic is introduced and course business is attended to. Classroom
discussions also tend to reward students who are good at devising quick responses and raising questions rather than those who try to explore their own nascent ideas and work towards thoughtful answers.

Because computer-mediated discussions do not occur in real time, they avoid some of the undesirable characteristics of classroom discussions. For one, there is no bidding among participants for a chance to speak because self-selection is the rule (Black, Levin, Mehan, & Quinn, 1983; Harasim, 1990; Quinn, Mehan, Levin, & Black, 1983). Students log on and join the discussion when it is convenient for them. Interruptions are made impossible by nature of the computer networking system. All participants can send messages simultaneously without crowding one another or disrupting the flow of a discussion.

Asynchronous discussion also gives students more time to read messages posted by others, reflect on them, and compose thoughtful responses. One study found that in classroom discussion the average student answer was 12 words long, while in e-mail discussion the average message length was 106 words (Quinn et al., 1983). That same study found that students in a typical on-line session spent 19 minutes reading messages left by others and 47 minutes composing their own statements.

Perhaps the greatest advantage to on-line discussions is that student participation is self-paced. The absence of time limitations in computer-mediated discussions is especially helpful to students who have difficulty articulating their thoughts verbally, who are shy, especially thoughtful, or whose native language is not English (Berge & Collins, 1993; Harasim, 1990; Turoff, 1990). This virtue can also be a vice: the lack of immediate feedback may encourage students to procrastinate in their responses or withdraw entirely from the discussion (Romiszowski & de Hass, 1989).

Structure of Communication

Most classroom interaction involves one of three kinds of communication structures: one to one, one to many, or many to many (Harasim, 1987). Typically, classroom discussions follow the one-to-many model. Research has shown that anywhere from 40 to 80% of class time in face-to-face discussions is taken up by the teacher (Dunkin & Biddle, 1974; Krupnick, 1985; McDonald & Elias, 1976). Instructor-centered discussions may appear to be collaborative, but the style an instructor uses to moderate discussions can often keep students from interacting with one another. In contrast, on-line discussion is naturally interactive and collaborative, in part because it lends itself so easily to many-to-many communication. Whereas much of classroom discussion tends to be dominated by instructors, studies of on-line discussions have found that instructors tend to contribute a much smaller proportion of messages in computer-mediated exchanges (Harasim, 1989; Hiltz, 1986).

Richness of Communication

Face-to-face communication relies on many information sources. Body language, spoken text, vocal tone, inflection, and parts of the physical environment (such as a chalkboard) can all be used to get messages across. Compared with face-to-face interaction, computer-mediated communication conveys a relatively limited stream of textual information. Because the meaning of a text-only message is divorced from the sender's physical presence and verbal delivery style, these factors may become irrelevant to the communication process. All that remains is what the person actually says.
It almost goes without saying that text-based communication benefits those with physical disabilities (Coombs, 1989). Hearing impaired people can talk with others without needing a human interpreter, and visually impaired people can, with the aid of a computer and speech synthesizer, discuss written material without a reader. People with physical handicaps go unnoticed, and those with speech or neuromuscular disabilities can take as much time as they need to compose their statements. But the most important benefits of text-based communication are shared by all users. Linda Harasim (1990) points to three general advantages of on-line discussion: text-based communicators often become more reflective than verbal communicators, more attentive to the messages of others, and are put on more equal social footing with one another.

Bringing Computer-Mediated Communication into the Classroom

Results from the year-long CMD trial demonstrate how these many advantages can help students learn more than they might otherwise learn in traditional face-to-face settings. During the 1992-3 academic year, the author moderated several computer-mediated discussions in conjunction with the face-to-face discussion sections he ran for large freshman- and sophomore-level sociology courses. Although the content of these courses was specific to the field of sociology, the instructional environment was identical to that of most large, lower-division communication studies courses, particularly those that combine large lecture sessions with smaller discussion sections run by teaching assistants.

All 134 students enrolled in the author’s face-to-face discussion sections were invited to participate in computer-mediated discussion groups. In addition, students from outside the author’s sections were invited at the beginning of the Spring quarter to participate in a course-wide CMD. This resulted in an additional eight student participants from outside the author’s face-to-face discussion sections. Surveys of the total group of 142 students determined that 59% were male, 37% were first-year students, 29% were second-year, 17% were third-year, and 17% were fourth-year students. Moreover, only 7% said they already were or else intended to be sociology majors, which suggests that most were taking sociology courses to fulfill distribution requirements. As such, these students may be quite similar to those found in typical lower-division communication studies courses. It is important to emphasize that this group is not a random sample of undergraduates and therefore any generalizations made from these results are largely speculative. Nevertheless, these data provide a unique insight into the ways that computer-mediated discussion groups were actually used by students.

Each CMD section consisted of a special electronic mail account set up through the university’s academic computing services which transmitted incoming messages to the on-line mailboxes of participating students. In essence, this account mimicked the basic features of a LISTSERV mail system. (For detailed information on the use of LISTSERV and other types of electronic discussion groups, see Berge, 1994.) To conduct a LISTSERV discussion through electronic mail, a special e-mail account is set up that directs incoming messages to a special list of recipients. Instead of having participants address individual copies of their messages to each person in the group—a rather time-consuming and repetitive process—they send just one message to the special account, which automatically distributes copies to other members of the group.
The CMD sections used e-mail rather than computer conferencing software for two reasons. The first and most obvious one was that the host university did not yet support conferencing software. It would still have been possible to mimic conferencing functions by creating special electronic bulletin boards or newsgroups, but these public-access forums could not be set up to keep outsiders from joining student discussions. Second, since many of the undergraduates in these classes had little if any experience with on-line technology, it was felt that the only task required of new users should be the simplest one possible: to log on to their own e-mail accounts. Anything more might have been too daunting for some students.

At the beginning of each course, students were invited to join what was described as an experimental trial of e-mail technology in the classroom. Participation in the CMD experiment was completely optional. Students in the Fall and Winter classes were told that they would receive no extra credit for taking part in the "electronic discussion sections," but that they could apply CMD activity toward their class participation grade, which amounted to 5% of their final grade. During these first two quarters on-line discussion groups were matched with the regular face-to-face sections so that participants interacted electronically only with other students from their own classrooms. Students in the Spring course were invited to participate in a course-wide CMD for extra credit points, again amounting to 5% of the final grade. This was the only group where some students knew each other only through on-line exchanges.

In the Fall quarter, students interested in joining on-line discussions but who had never before used e-mail were directed to the staff of the university’s academic computing center for advice and instruction. This procedure was changed after the Fall quarter, as many student evaluations indicated that leaving participants to fend for themselves with an unfamiliar system caused a great deal of confusion and frustration. This feedback led the author to offer training sessions for interested students in the Winter and Spring quarters. Once these training sessions were instituted, many fewer students complained about the system’s difficulty of use.

Students in the experiment were told that to achieve full credit, they should submit one e-mail message per week. The only exception was in the Fall quarter CMD sections, where students were required to submit one message per topic segment covered in lectures. This normally worked out to one message every ten days. Although students were informed that the instructor read all submissions, they were also told that their messages would not be graded for length or content. Participation points were calculated only by quantity of submissions rather than quality.

Because the CMD sections were intended to stimulate peer interaction, the author took only a limited administrative role in facilitating the discussions. At the beginning of each week, he sent out a short list of questions to stimulate and focus discussion. Students were encouraged to use the questions as jumping-off points for conversation, but were not required to answer any of them. The only condition placed on discussion was that anyone bringing in statistics or other pertinent information from outside the class should cite their sources. Other than generating discussion questions and prompting students to mention sources, the author did not normally participate in the on-line discussions.

At the end of each quarter, all students in the trial sections were asked to evaluate the CMD system. A total of 115 out of 142 students completed these evaluation surveys, which had response rates of 83% in the Fall quarter, 85% in the Winter
quarter, and 72% in the Spring quarter. A second data set, designed to test whether CMD participation was associated with class performance, was constructed from the grades students received on each of their assignments. Only the 134 students enrolled in the author’s face-to-face discussion sections were included in this data set.

Results

Student Use of CMD Groups

Most of the students who were invited to join the CMD trials had no prior e-mail experience. Only 26% of students described themselves as experienced e-mail users before coming to the class in which they were exposed to CMD groups; 11% said they had never even heard of electronic mail before taking the course, and 62% said they had heard of e-mail but never used it themselves.

Despite a widespread lack of experience with e-mail technology, nearly 6 out of 10 students reported taking part in the CMD experiment. Of those completing the evaluation surveys, 40% (n = 46) said they never used the CMD system, 24% (n = 28) said they used it once or twice only, 32% (n = 36) said they used it once per week, and 4% (n = 4) said they used it more than once per week. A search through participation logs maintained by the author confirms the general participation trends revealed in the evaluation surveys. According to these logs, 31% of students in the author’s face-to-face discussion sections were “active” CMD participants who submitted on average one message per week to the on-line discussion, while another 5% submitted just one or two messages in the entire quarter.

What of the roughly 25% of students who said they took part in the on-line discussions at least once or twice but who apparently never sent messages to their CMD groups? Some of the discrepancy may be due to nonresponse bias in the evaluation surveys. But much of the discrepancy can be attributed to students, known in the literature as “lurkers” (Romiszowski & de Hass, 1989), who merely listened in to CMD groups without taking an active part in them. The presence of lurkers is supported in remarks made by several students in the evaluation surveys. One mentioned that “I liked reading the other messages that were written. I went often to read the other messages, but I only left a couple of my own.” Another wrote that “I received mail and read most of it but just never replied for no particular reason.”

It appears that there were three distinct groups of students in the classes that supported computer-mediated discussions: non-participants, the 40% of students who never tried the system; partial participants, the roughly 30% who either tried the system and then gave up or who followed CMD traffic without regularly submitting messages themselves; and full participants, the roughly 30% who regularly sent messages to other discussion participants.

Student Evaluations of the CMD System

Evaluations of the CMD experiments from full and partial CMD users (n = 68) were overwhelmingly positive. Of students who had used the CMD system at least once or twice, 59% felt the on-line system was easy to use and another 24% of users reported that the system was neither easy nor particularly hard. When asked to rate their overall experience with the CMD system, 73% said they had a positive experience with the system, 9% reported a negative experience, and the rest were
neutral about the on-line discussions. Surprisingly, the responses of partial and full participants to these questions were almost exactly the same. The only difference was in ease of use, where full participants rated the system slightly easier to use than partial participants. Yet even this difference failed to achieve conventional levels of statistical significance, $t(64) = 1.16, p = .25$.

Students were asked two questions about the desirability of making computer-mediated discussions widely available in undergraduate classes. The first question, addressed only to students who had used the CMD system at least once, asked whether they would recommend the use of CMDs in other classes. Among these system users, 67% felt that on-line discussions should be adopted in other classes, 27% provided neutral responses, and 6% said that on-line discussions should not be used in other classes. The second question, phrased along similar lines, was directed to all students regardless of participation in the CMDs. Fully 94% felt that computer-mediated discussions should be made available to students. Surprisingly, while there was some difference on this question between those who had used the CMD system and those who had not, the difference was not statistically significant, chi-square $(4, n = 114) = 4.33, p = .36$. Regardless of whether they had taken part in one or not, nearly everyone agreed that on-line discussions were a good idea.

When asked whether their on-line experience helped them master course material, 92% of system users from the Winter and Spring courses said participation in a CMD group helped them learn the ideas and theories covered in class. Many shared comments such as “It was a good chance to go into discussion a little deeper than usual” or “You can think and take your time to respond to some of the more difficult issues.”

It would seem that some of the expected benefits of on-line interaction were experienced by the students who took part in it. Moreover, the positive responses of students in this study are consistent with findings from similar studies (Hiltz, 1990, 1993; Phillips & Santoro, 1989).

Impact of CMD Groups on Academic Performance

Not only did CMD participants claim to have learned more, but those who took part in the on-line discussions tended to earn higher grades on class assignments than students who took part in face-to-face discussions only. While the findings reported to this point came from the student evaluation data, this section draws from academic performance data that include all 134 students enrolled in the author’s face-to-face discussion sections. Those CMD participants in the Spring class who were not in the author’s face-to-face discussion sections ($n = 8$) are treated as missing in these academic performance data. These students had different instructors leading their face-to-face discussions, which may have affected the style and substance of their classroom interactions. Moreover, these students were subject to slightly different grading criteria when it came to class participation, attendance, and paper assignments.

Table 1 displays the four academic performance measures that were common to all three classes in which the CMD groups were tested. To assess differences in academic performance, the group of full participants is compared here to the

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1 As this question was added to the evaluation survey after the Fall quarter, students from the Fall course are counted as missing when totaling this percentage.
combined group of partial and non-participants. In other words, the group identified as CMD participants in Table 1 includes only those students who actually submitted messages to the on-line discussion at least once per week. The group identified in Table 1 as “face-to-face only” therefore consists of the partial and non-participants, those whose interaction with other students occurred only in classroom situations.

As indicated in Table 1, students who took an active part in the on-line groups tended to score better on their first written assignments and final examinations than other students. Moreover, these differences were all statistically significant despite the small numbers of students involved. While most early student papers scored in the B or B+ range, the scores of CMD participants averaged in the A— range. Not only did CMD members get better grades, but the standard deviations of these scores show that the grades earned by CMD participants on this first written assignment were more consistent with one another than were the grades of partial and non-participants. This pattern is consistent with the finding that students in CMD groups tend to develop more effective argumentation skills than other students (Marttunen, 1992). Participants in the CMD groups also tended to receive higher grades on their final examinations. Students who took part in computer-mediated discussions had a B+ average for their final exams, compared to the B— average of students who took part in face-to-face discussions only. This pattern contrasts with previous studies which found that students in CMD groups tend to perform no better on written exams than other students (Hiltz, 1993; Marttunen, 1992).

Students who participated in the CMD groups not only performed better on first papers and final exams, but they also attended class more regularly and were more active in face-to-face discussions than other students. Both of these differences were

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**TABLE 1**

<table>
<thead>
<tr>
<th></th>
<th>First Paper*</th>
<th>Final Exam§</th>
<th>Attendance©</th>
<th>Face-to-Face Participation©</th>
<th>n=</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0-4)</td>
<td>(0-100)</td>
<td>(0-5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FtF + CMD</td>
<td>3.62 (.47)</td>
<td>88.34 (15.74)</td>
<td>4.35 (1.30)</td>
<td>4.03 (1.45)</td>
<td>44</td>
</tr>
<tr>
<td>FtF Only</td>
<td>3.19 (.70)</td>
<td>81.30 (14.94)</td>
<td>3.57 (2.09)</td>
<td>3.08 (1.98)</td>
<td>90</td>
</tr>
<tr>
<td>t-value</td>
<td>4.18***</td>
<td>2.51*</td>
<td>2.67**</td>
<td>3.15**</td>
<td></td>
</tr>
</tbody>
</table>

* p < .05 level; ** p < .01 level; *** p < .001 level.

Note. Standard deviation for each cell in parentheses.

* The “First Paper” variable was scaled as 4 = A, 3 = B, ... 0 = F.
§ The “Final Exam” variable was scaled as percentage correct.
© The “Attendance” variable was scaled as 5 = zero or one unexcused absence, 3 = two unexcused absences, and 0 = more than two unexcused absences.
© The “Face-to-Face Participation” variable was scaled as 5 = good verbal participation in classroom discussions, 2.5 = satisfactory verbal participation, and 0 = unsatisfactory verbal participation. Although students could apply CMD participation toward their class participation grade, the author maintained a separate record of face-to-face participation for all students. Thus the participation results shown here represent a pure measure of face-to-face discussion that is separate from any credit earned in the CMD groups.
statistically significant, which suggests that active CMD participants were more committed to and involved in their courses, both inside and outside the traditional classroom environment.

Yet these findings do not clarify whether taking part in on-line discussions led to better attendance and more vocal classroom participation, or if higher levels of motivation—revealed in superior levels of attendance and class participation—caused students to join the CMD groups. Likewise, it is unclear whether it was the on-line discussions that helped students earn higher grades on first papers and final exams, or whether it was merely that large numbers of high-achievers happened to join the CMD groups. The proper way to sort causal ordering would have been to randomly assign students to CMD and face-to-face groups, but the voluntary nature of the experiment precluded such a formal means of statistical control.

While there is no straightforward way to determine from these data whether high levels of academic performance led to CMD participation or the other way around, there are some interesting clues to help sort out the direction of influence. Although not shown in Table 1, students in two of the three classes were assigned a second paper. For this second written assignment, which was given to students in the Winter and Spring classes, the mean score for full CMD participants \( n = 23 \) was 3.52 with a standard deviation of .87. Other students \( n = 66 \) averaged a 3.43 with a standard deviation of .76. The performance gap in the first papers between CMD participants and other students was nowhere to be found in these second papers, \( t(87) = .50, p = .62 \). In the two classes assigned second papers, the average scores of partial and non-participants moved up into the B+/A— range and matched those of active CMD members. This suggests that while most students improved on their written assignments as the course progressed, full participants in the on-line discussions started ahead and stayed that way. It therefore seems likely that full participants had better writing skills before they were introduced to the CMD groups. If this is the case, then the superior performance of CMD members on their first papers was probably not caused by taking part in the on-line discussions.

In contrast, participating in the on-line discussions seems to have elevated the final examination grades of CMD members. Evidence to support this conclusion comes from the two classes that also had midterm examinations. For the two classes that had midterm examinations (Fall and Winter), the mean score for full CMD participants \( n = 38 \) was 83.9 with a standard deviation of 11.7, while other students \( n = 58 \) had a mean score of 82.9 with a standard deviation of 13.2. While participants in the on-line discussions did better on final exams than other students, no significant differences were found between the midterm exam grades of these groups, \( t(94) = .40, p = .69 \). Both groups averaged in the B— range on these midterm exams. Nonetheless, differences between these groups were evident by the time of the final exam. For the two classes that had both midterm and final examinations, the mean final exam score for full CMD participants \( n = 38 \) was 91.2 with a standard deviation of 7.2, while other students \( n = 56 \) had a mean final exam score of 85.5 with a standard deviation of 11.8. Students from these two classes who took part in the CMD groups received an average grade of A— on their final examinations, while students who only took part in face-to-face discussions had a B average on these final exams, \( t(92) = 2.88, p < .01 \). The grades of both groups improved between the midterm and final examinations, but the grades of CMD participants improved significantly more than those of other students. This pattern suggests that CMD
participation contributed to the difference in final exam scores. That this finding contrasts so sharply with those of previous studies (Hiltz, 1990, 1993; Marttunen, 1992) suggests that the way computer-mediated communication is structured and integrated with other elements of the learning environment may have a considerable bearing on student outcomes.

Although the precise impact of computer-mediated communication on academic performance is somewhat ambiguous, the evidence supports some conclusions better than others. It appears that the students who were full participants in the computer-mediated discussions were probably better writers to begin with. If this is the case, then CMD participation may have had little independent effect on paper grades. Yet taking part in the on-line discussions seems to be reflected in the higher marks CMD members received on their final examinations. It remains unclear whether taking part in the on-line discussions increased either attendance or participation in face-to-face discussions.

Evidence from the academic performance measures may best be viewed in light of the participant evaluations. Students who took part in the on-line discussion groups insisted overwhelmingly that they learned more than they would have in face-to-face discussions only. The evidence from academic performance measures supports their claim. Whenever there was a significant difference between groups, the grades of CMD participants were invariably higher than those of students who participated exclusively in traditional classroom discussions. Both groups sat through the same lectures, read the same books, and participated in the same face-to-face discussions. The only difference in exposure to class material was that one group also took part in computer-mediated discussions. All appearances suggest that these students did indeed learn more than their peers.

Issues for On-line Participation

Those who voluntarily participated in on-line discussions were not a representative cross-section of students enrolled in the courses. This section first identifies some characteristics of those who voluntarily participated in the CMD trial and explores what attracted some students to the on-line discussion and what kept others from joining in. It then outlines some ways to get more students involved in CMD groups.

On-line Participation: Why Some and Not Others?

Since less than one third of students became full participants in the CMD groups, it is important to understand why some students chose to participate while others declined. Three broad trends seem plausible. First, more women than men might have chosen to participate in CMD groups, since women tend to be shut out of traditional classroom discussions more than men (Clinchy, 1990; Krupnick, 1985). Second, participants might have been drawn more from the ranks of younger students, since freshmen and sophomores might be more willing to try something new than juniors or seniors. A third possibility is that extensive computer experience or prior familiarity with e-mail technology might have led some students to self-select into the CMD experiment while those having a more limited background in computers might have been dissuaded from taking part.

To explore these possibilities, the group of 40 full participants was compared to the group of 28 partial participants and the group of 46 non-participants. Chi-square testing revealed no significant gender (chi-square [2] = .39, p = .83) or age differ-
ences (chi-square [6] = 6.03, \( p = .42 \)) among these three groups. Women did not flock to the on-line discussions any more than men, and lower-division students were no more likely to participate than upper-division ones. That the ratio of men to women at every level of CMD participation was statistically equivalent is especially noteworthy. While the on-line environment was no more popular among women than men as an outlet for peer interaction, the women who used it were able to participate just as much as male users. This suggests that the CMD groups were much more egalitarian than traditional classroom discussions. Whereas the social context of the traditional classroom tends to encourage male participation at the expense of female voices (Clinchy, 1990; Krupnick, 1985), these on-line discussions promoted equal levels of participation between men and women.

One-way analysis of variance (ANOVA) was used to test the influence of prior computer and electronic mail experience. Computer experience turned out to be statistically equivalent for full, partial, and non-participants, \( F(2, 111) = .76, p = .47 \). This finding is consistent with other classroom studies of on-line discussion groups (Hiltz, 1986; Quinn et al., 1983), but inconsistent with studies exploring differences in usage of a broader range of new technologies (Scott & Rockwell, 1997). Before joining the class in which they were exposed to the CMD experiment, 3% of students stated they had never used a computer, 26% said they used personal computers for word-processing only, 41% used a variety of programs on personal computers, 21% reported some experience with mainframe as well as personal computers, and 9% said they had extensive experience with both mainframe and personal computers. Moreover, this pattern of computer experience was statistically equivalent for freshmen, sophomores, juniors, and seniors—in other words, there did not appear to be a learning curve as students progressed through their years at the university, \( F(3, 110) = .29, p = .83 \). In short, while prior computer experience can aid students trying to navigate a new software system, such experience was unrelated to participation in CMD groups. It may be that the use of CMD technology in the classroom creates incentives for participation that help people with lower levels of computer experience overcome their usual reluctance to adopt new communication technologies (Scott & Rockwell, 1997).

Those students with prior e-mail experience, on the other hand, were somewhat more likely to participate in computer-mediated discussions than those who had never used e-mail before, \( F(2, 111) = 3.46, p < .05 \). Full and partial participants were quite similar to one another in levels of prior e-mail experience, but both groups tended to have more previous exposure to e-mail than the students who never tried the on-line discussions. Of those with no prior e-mail experience, half tried the CMD system and half participated only in face-to-face discussions. By contrast, eight in 10 experienced e-mail users took part in the on-line discussions. To put it another way, three quarters of all students said they had never used e-mail before joining the class in which they were exposed to the CMD experiment, but only 65% of CMD participants reported having no prior e-mail experience. This finding contrasts with other work that determined e-mail experience was unrelated to on-line participation (Hiltz, 1986). Yet this relationship makes intuitive sense—it is easier for someone who already has the necessary technical skills and who uses e-mail on a regular basis to begin using an on-line system.

There seems to be an activation barrier keeping some students without e-mail experience from participating in CMD groups. Several students expressed frustra-
tion with the unfamiliar e-mail environment. One wrote that “It was frustrating for me because I could not figure out how to use the program. It sounds silly, considering my computer experience, but if I could have done that I definitely would have participated.” Another put it more simply: “It's not that I dislike e-mail, just that I am afraid of computers.” Yet for most new users such frustrations seem temporary. In their end-of-quarter evaluations, only 7% of participants without prior e-mail experience gave negative evaluations of the system. Half of new users indicated the system was relatively easy to use while 17% felt the system was somewhat difficult to use. But even though this frustration is temporary for most students, it can keep many without e-mail experience from ever taking part in a computer-mediated discussion.

In summary, students who became full participants in CMD groups tended to have more e-mail experience than other students, but taking part in the on-line discussions was not associated with prior computer experience, year in school, or gender. While encouraging, these findings suggest that special effort may be needed to bring students lacking on-line skills into computer-mediated discussions.

Should On-line Discussions Be Optional or Required?

Since the students who avoided the on-line discussions tended to be those with less e-mail experience, instructors face two options if they want to ensure that the greatest number of students will benefit from computer-mediated interaction. Either they can make on-line participation mandatory for all students, or they can leave participation optional while somehow enticing reluctant students to use this new learning environment.

Forcing on-line participation may often be a bad idea. This view is supported by the results of other on-line experiments as well as the views of student participants in the experiment reported here. Other attempts to integrate computer-mediated discussion with traditional classroom or working environments have shown that when participation is required, many users invariably respond with anxiety and resistance (Komsky, 1991; Quinn et al., 1983). When students in the CMD trials were asked whether participation in on-line discussions should be mandatory or optional, 9 out of 10 recommended that it remain an optional exercise. Only 4% felt that participation in on-line sessions should be required of everyone.

There are many reasons why the thought of required participation meets such strong resistance. Effective participation in the on-line discussions requires that students have minimal typing skills and adequate levels of reading comprehension. While some prior work has suggested that typing ability and writing apprehension may be unrelated to performance in computer-mediated discussions (Hiltz, 1986, 1993; Scott & Rockwell, 1997), it nevertheless stands to reason that non-typists are at least somewhat disadvantaged in a text-based environment. Moreover, students who have difficulty reading will have to spend more time following an on-line discussion than those who can quickly absorb the meaning of written text (Berge & Collins, 1993). While these same students also stand the most to gain from having to read and write on a frequent basis, requiring them to do so might force many into a marginal role in the sometimes fast-paced on-line discussions. In the same way, those having little computer experience—not to mention the 3% of students surveyed who had no computer experience at all—can be expected to have a more difficult time mastering
e-mail or conferencing software than those who have greater familiarity with computers.

But more important than typing skills, reading comprehension or computer experience is the problem of system access. This problem takes two forms: access to the necessary equipment to make connections and access to the network itself. The trouble with equipment access is this: If all students are required to use on-line systems, then those who can link remotely to a discussion's host machine through their home computers will have a much easier time participating than those who must make special trips to computer labs and vie with other students for access to networked equipment. This problem ensures that students lacking the necessary hardware will be forced to expend much more time and energy than other participants in computer-mediated discussions.

Quite a few students in the CMD trials said that they were uneasy with this inherent disparity in such a system. "Students that have computers with modems," wrote one, "have an advantage over others, as they can earn their participation credit outside of class without much inconvenience." Another student gave the following explanation for not participating in the CMD sessions: "I didn't dislike [it], it was just inconvenient for me. I am an engineering major, and spend 30-40 hours/week doing problem sets. I do not have a computer w/modem in my room, and I only go to the computer lab to solve problems and write programs. For me, I just do not have the time. I am also a varsity athlete." The inconvenience for these students is not only in getting to computer labs; once there, they must often wait in a queue for a machine to open up.

Compounding these problems with equipment access are technical difficulties in linking up with the network itself. Even with all the necessary gear, users are regularly thwarted from logging on to campus networks by unexpected system failures and overextended communication ports. One student in the CMD trial complained that "For one week, every time I called Casbah [a university e-mail server] from home I got a busy signal. This was extremely frustrating because I didn't have much time to retry." Expanding modem and network access will eliminate many of these problems, but new ones will arise as more faculty support on-line discussions in their courses. No computer system is foolproof: periodic failures are guaranteed. Many students who are used to system glitches would no doubt shrug them off. But relatively minor inconveniences can seem like major obstacles to students under stress or frustrated with the complexity of an unfamiliar computer system.

All of these chronic difficulties serve to heighten the anxiety of novice discussion participants and thereby lower the satisfaction and enjoyment students can have in expressing themselves on-line. There will almost always be some students who will have a hard time getting accustomed to an on-line system, and forcing these to take part in computer-mediated discussions may cause them enough anxiety to nullify any educational benefits such a system can provide.

Yet the advantages to such participation should not be understated, and it may sometimes be appropriate to require all students to join on-line discussion groups whether they want to or not. Two critical factors in this decision are the average level of computer proficiency among students and the ease with which students can access the on-line discussion. If the level of computer literacy among students is sufficiently high, and if students are able to regularly access the campus computer network
without constantly getting busy signals or waiting in long lines for a limited number of workstations, then requiring CMD participation may be a viable option. But requiring such participation also demands an added level of commitment from instructors. An institution’s computer support services may be unable to provide the kind of support students need, especially if discussions are conducted with computer conferencing software that is not widely used around campus.

It is interesting to note that students who took part in the CMD trials shared the view that on-line discussions should usually remain optional activities. When asked how CMD participation should be graded in future classes, 62% of system users felt it should remain completely optional, and another 29% recommended that it should be treated as extra credit. Only 6% of system users felt that on-line discussions should be a class requirement. But the CMD experiment reported here also suggests that when left to choose for themselves, only a small proportion of students can be expected to actively participate in computer-mediated discussion groups. Not only is it likely that many if not most students would miss out on the learning opportunities provided by computer-mediated interaction, but in courses with smaller enrollments such sizable defections might leave so few willing participants that on-line discussion would be precluded altogether.

The challenge is thus to make computer-mediated interaction more appealing to students. The CMD trials reported here show that interest in on-line discussion is very high, even among non-users. So the problem is not that few students are interested, but rather that so many choose not to participate in spite of their interest. The reason for this behavior seems clear. While the student population of lower-division sociology courses is in many ways unique, the main factor that kept students in the CMD trials from participating in on-line discussions is common to all undergraduates: lack of time. When asked to note what they especially disliked about the CMDs, almost twice as many non-users as users remarked that the discussion groups were simply too time-consuming. Student comments also show that participation in CMD groups lacked tangible rewards to justify the amount of time spent on-line:

It was a pain. Discussion section is one hour per week. I wish my participation be graded on that one hour rather than through a computer system. It took too much time.

Why I didn’t use it—I feel comfortable speaking up in class, and since I have to come to class, it’s easier to earn my points in class.

Not worth enough.

I received mail and read most of it but just never replied for no particular reason. I’m [taking the class pass/no-pass] so I didn’t think I needed the points.

I don’t have the extra time to deal with finding a computer and learning how to use it.

I didn’t dislike it. I lacked the time to sit down and write a message.

Despite widespread interest in computer-mediated discussion groups, the perceived reward from taking part in such a group is, for many students, too small to justify their participation.

**What Should On-line Participation Be Worth?**

For participation to remain voluntary and yet attractive to large numbers of students, on-line discussion must be made to appear more worthwhile to students. The CMD trials showed that when on-line participation was completely optional or worth a
small amount of extra credit, nearly a third of students were willing to take an active part in the on-line groups. Many of the remaining students were swayed by external pressures and chose not to participate. To them, CMD participation was simply not worth enough to justify the time it took to join in the discussion. Given the competitive nature of undergraduate life and the time required to participate in an on-line discussion, it is hard to fault their pragmatism.

One workable solution to this problem is to allow students a choice among alternate assignments that draw upon the same critical thinking skills. By presenting a set of alternatives, the decision to participate remains with the student. If each of the alternate assignments is worth the same fraction of a student's final grade, in proportion to the amount of time and effort needed to complete them, then the choice becomes one of personal preference. The choice among assignments should account for the level of involvement teachers expect of on-line participants. A reasonable alternative to participating in a multi-week on-line discussion would be to research and write a substantial term paper. Both emphasize writing ability and critical thinking skills, although the latter is necessarily much more polished than the former. Yet an on-line discussion can be seen as superior in many ways to a term paper, not least because students get much more feedback on their ideas in an on-line forum than they do in a written assignment that is read only by their teacher. Students who are intimidated by the idea of on-line discussion can choose the paper instead, while those who are attracted to on-line interaction will gladly forgo the paper.

Making on-line participation and its alternatives worth a substantial portion of a student's final grade will go a long way toward encouraging many students to join in who would otherwise sit out on the experience. But this solution does not address the concerns of those who are intimidated by on-line systems, like the student who, when asked what he especially disliked about the CMD system, answered "Nothing—it sounded great—I'm just incredibly chicken and lazy ...". Offering more tangible rewards might do little to get students such as these more involved. To entice these students to join a CMD group, instructors must somehow ease them over their "computer anxiety" or timidness toward on-line systems without forcing them to join computer-mediated discussions.

One way to accomplish this is to introduce the on-line system as an optional activity, but require each student to use the system at least once at the start of the course (Quinn et al., 1983). Students might be told that their first assignment is to get an e-mail account, log on to the system, and send a simple message to the instructor. Once this is accomplished, students would no longer be required to use the message system. By requiring students to accomplish a few basic tasks without making them participate in a CMD group, the instructor shows timid students how easy it is to participate in an on-line discussion while leaving them free to choose whether or not to join. Having completed all the tasks necessary to join an on-line discussion, novice users can do so knowing the minimal degree of technical sophistication required to use such a system. Once ushered into the system, they lack any special excuse not to participate. This is just one way that a course's reward structure can be set so that a majority of students can willingly participate in an on-line discussion without feeling penalized for doing so and without being swayed by their fear of or inexperience with computers.
Conclusion

The findings presented here suggest that supplementing face-to-face discussions with on-line interaction can provide students with a learning environment superior to that of the traditional classroom.

On all available measures of academic performance, students who were actively involved in the computer-mediated discussion groups earned higher grades than other students. While it is hard to determine whether this performance was a direct effect of CMD participation, nearly all students who took an active part in the on-line discussions reported that their participation helped them learn the ideas and theories covered in class. This positive response suggests that the on-line discussions did indeed contribute to the superior performance of active participants.

Not only did student participants learn more, but they also enjoyed taking part in this form of interaction. Most of the students who participated in the CMD trials recommended that computer-mediated discussions be used in other courses. Even non-participants said they would prefer to have computer-mediated discussions available in their other undergraduate classes.

Much more research needs to be done on classroom applications of CMC technology before the specific benefits of CMD groups for university-level instruction can be properly understood. For instance, the structure of on-line discussions undoubtedly contributes to student outcomes and assessments, but it is unclear which kinds of structures help students achieve the most desirable benefits. Moreover, while it appears that a combination of on-line and face-to-face discussion can provide a superior learning environment to face-to-face only discussion (Hiltz, 1990), little is yet known about what constitutes an optimal ratio of on-line relative to face-to-face interaction.

This study suggests that computer-mediated communication can enhance the traditional classroom environment. While this is certainly welcome news, it remains to be seen precisely how this new medium can best be used to help students become more capable learners and more critical thinkers.

References


