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ABSTRACT

Computer Mediated Conferencing (CMC) courses are attracting students with weak computer communication skills. This document describes a study which examines the outcomes for such students when they enrolled in a CMC course that required high levels of peer interaction. It was anticipated that students with weaker skills would miss important instructional events, have lower levels of task-relevant contributions, have less influence on group products, and engage in less demanding learning activities. In fact, lack of technical skill had only a marginal effect on participation, much less than gender or prior knowledge of course content. The generalizability of this good news is limited by several contextual factors, including student maturity, the provision of a CMC coach, the ethos emerging from the structure and content of the course, and the low skill threshold required for participation. (Contains 3 tables and 34 references.) (Author/BEW)

Computer Communication Skills and Participation in a Computer-Mediated Conferencing Course[1]

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Computer-Mediated Conferencing (CMC) courses are attracting students with weak computer communication skills. This study examined what happened to these students when they enrolled in a CMC course that required high levels of peer interaction. It was anticipated that students with weaker skills would miss important instructional events, have lower levels of task-relevant contributions, have less influence on group products, and engage in less demanding learning activities. Lack of technical skill had a marginal effect on participation, much less than prior knowledge of course content and gender. The generalizability of this good news is limited by several contextual factors, including student maturity, provision of a CMC coach, the ethos emerging from the structure and content of the course, and the low skill threshold required for participation.

The type of student enrolling in distance education courses delivered through Computer-Mediated Conferencing (CMC) is changing. The early courses, often focused on computer-related topics, attracted students who were interested in using computers in their personal and professional lives. They had strong computer communication skills or were willing to develop them. As CMC courses become less of an innovation and more routine practice, students with weaker skills are enrolling. Ross, Crane and Robertson (in press) found evidence of two types of students in CMC courses: (a) a core group of self-directed learners with well developed computer communication skills who were able to access courses through their own efforts and (b) a high need group with few CMC skills who sought help on even the most basic issues. Since CMC courses increase learner control and responsibility for the learning process, students with less developed computer communication skills may be disadvantaged

Previous research has defined access to distance education as an admission/retention issue (e.g., Garrison, 1993). The question has been: Can students who are unable or unwilling to join courses held at a particular time and place obtain a similar program delivered through CMC? The research reported here asks a different question: What do they do when they get there? Do they participate in their courses to the same degree as students with stronger CMC skills?

Theoretical Framework

To participate in a CMC course students have to be able to communicate extensively with their peers and instructor (Harasim, 1987; Hiltz, 1994; Phillips, Santoro & Kuehn, 1988; Wells, 1993). To do so they need to master certain basic computer communication skills: how to create

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documents at their home computer, how to upload to the conference, how to download material, manage files, and so forth. Previous studies indicate that as CMC moves beyond the first wave of enthusiastic hackers they are attracting students who lack these skills. Foell (1989) found that students in a CMC course that attracted novice users had difficulty uploading and downloading files. Anderson & Lee (1995) reported that students in a course using e-mail to supplement face-to-face interactions had problems finding a terminal and using simple commands. Ross et al. (in press) uncovered an array of obstacles that impeded student access to CMC courses, including problems in connecting to the hub computer, using conferencing software, and managing files.

Anticipated Impact of Weak Computer Communication Skills

No previous study has examined the effects of weak computer communication skills on student participation in courses that demand high levels of interaction. Several predictions can be made.

First, students with weak computer communication skills may miss important instructional events. Novices take longer than experts to accomplish basic tasks and expend more energy in doing so. Their performance is slow and inefficient (Anderson, 1982). Since most CMC courses are asynchronous, students have more time to work through technical obstacles. But time lines are limited and the pace of communication demands might exceed the capacities of those with less developed skills.

Second, students with weak computer communication skills may send fewer and shorter messages than students with stronger skills. One reason is that some messages may not reach the conference due to upload failures. Another is that losing messages and having to resend them (or even worse having to recreate them) might demoralize students. Repeated failure has a negative effect on beliefs about personal self-efficacy, which in turn leads to reduced goal setting and low task persistence (Bandura, 1986; Schunk, 1995). Consequently those who fail to reach the conference may make fewer attempts, plunging them into a downward spiral. Adept communicators are more likely to direct their messages to peers who are active in the discussion. Students with lesser skills might not feel included, especially if their contributions are rendered obsolete by more rapid responders, and could withdraw further.

Third, students with weak CMC skills may have less influence on group products when working with more able peers. Deficiencies in communication skills are highly visible. Messages that arrive incomplete, garbled, or not at all, speak volumes about the competence of the sender. Recipients may extrapolate from the form in which the message arrives to its content, ascribing lower ability to the sender. Studies of small groups in face-to face classrooms have found that overall student ability predicts the influence individual students have on the group product, resulting in a pattern of upper-ability dominance (Cohen & Lotan, 1995; Good, McCaslin & Reys, 1992; Mulryan, 1992, 1995). High ability students may also pick up the pace, pressuring less able students to complete tasks quickly (Mulryan, 1995; Ross & Cousins, 1995). One of the virtues of CMC is that its narrow band width has a levelling effect (Kiesler, Siegel & McGuire, 1984). Social identifiers (gender, race, age, career stature) are muted, making it less likely that discussions will be dominated by a few high status individuals. But by diminishing the salience of these social identifiers, CMC delivery may increase the salience of computer communication skills, possibly depressing the influence of students with less developed skills.

Fourth, a division of labor may arise in which students with weak CMC skills gravitate to tasks that are less demanding and less likely to lead to learning. Studies of small group work in face-to-face classrooms have found that lower ability students may be participating as frequently as higher ability students but not at the same depth. For example, less able students may be engaged in carrying out experiments while excluding themselves from writing tasks in which experimental results are related to the science concepts to be learned (Anderson, 1994). King (1993) found that low-ability students, even when assigned leadership roles, focus on procedural rather than conceptual issues. Such a division of labor has negative consequences for learning. It could arise in CMC courses if students with weak communication skills avoided productive learning tasks because their available energy had been drained by the difficulty of communicating or because the most productive learning tasks required communication skills they did not have.

Alternate Explanations

Differential participation in group deliberations may not be solely attributable to students' computer communication skills. Prior knowledge of the topic is likely to have a substantial impact. Students who have something to say are more likely to say it, producing more task relevant messages. What students say is more likely to be taken seriously if it is obvious they know what they are talking about. In courses in which students have authoritative texts and a credible instructor that provide a basis for judging the worth of individual contributions, students with prior knowledge are likely to have a greater influence on group decisions. In addition students with extensive prior knowledge are more likely to engage in high level conceptualization tasks because they bring to the course a framework for interpreting new information.

Student participation is also affected by gender. Previous studies of small group deliberations in face-to-face settings have consistently found that males participate more extensively than females and have greater influence on group decisions (Wood, 1987). The effect of gender is moderated by group composition (Holden, 1993; Lee, 1993; Tolmie & Howe, 1993). The dominance of males is most likely to occur in groups in which females are a minority.

The impact of communication skills on student participation in CMC programs was examined in the context of a graduate course in which students worked in instructor-absent groups for a seven week period. It was anticipated that students with weaker communication skills would miss instructional events, have lower levels of task-relevant contributions, have less influence on group products, and engage in less demanding learning activities. The study was an exploratory investigation involving a small sample, making it difficult to disentangle the impact of computer communication skills from other factors (especially prior knowledge and gender) likely to affect participation in the course.

Method

Sample

Fifteen[3] graduate students, all practicing teachers, enrolled in a course on theory and research on cooperative learning offered through CMC. Eleven of the fifteen were women. Four were doctoral students; the remainder were working toward master's degrees. In the first three weeks and last two weeks of the course students interacted with the instructor and the rest of the class on an individual basis. During the intervening seven week period they worked in groups of 3-4. The groups were self-selected on the basis of interest in particular approaches to cooperative learning. The approaches were: STAD/TGT (i.e., Student-Teams, Achievement-Divisions and Teams-Games-Tournaments, Slavin, 1995), Jigsaw (e.g., Clarke, 1994), Group Investigation (Sharan & Sharan, 1993), and Tribes (Gibbs, 1994). During the seven week period each group made a group presentation, responded to questions and criticisms from other groups, and responded to the presentations of others. The groups were unsupervised. The instructor did not read any of the messages they exchanged until the course was over. Students received group feedback from the instructor on their final products only. (Individual feedback was given on other assignments.)

Sources of Data and Procedures

A research assistant not familiar with the hypotheses of the study evaluated students' computer conferencing skills. Students were ranked within groups because previous research has found that it is relative ability within the group, not absolute ability, that predicts influence. The instructor independently ranked all students. There were two minor discrepancies which were resolved through discussion (in both cases the ranking of the research assistant prevailed). The rankings were based on evidence generated prior to the start of the small group activities and came from several sources: (i) Student descriptions of their teaching backgrounds and previous exposure to cooperative learning, the hardware and software they were using, and ratings of their proficiency and confidence in CMC skills on entry to the course. (ii) Student messages sent to a conference branch dedicated to sharing technical problems and solutions. (iii) Records compiled by a CMC coach, a mature adult educator paid on an hourly basis to help students through technical problems. Four of the 15 students in the sample contacted the coach for a total of 13 contacts. (iv) Student messages sent prior to the start of the small groups to the main conference and to a personal chat branch set up for non-academic conversations. In each group the most highly skilled student was placed in level 4, followed by the next in level 3, etc. Of the four men in the study, two were in the highest CMC skill level, one was in the lowest, and the last was in the next lowest. The same sources of data were used to evaluate students' prior knowledge of cooperative learning. Examples of the placements are shown in Table 1.

Table 1 About Here

[3] Initial enrollment in the course was 21, self-assigned to six groups. Two students, first time mothers on maternity leave, dropped out after the small group activities (and the major course assignments) began, leaving two very small groups. After some negotiation the four students in these two groups agreed to merge into a single group which was excluded from the data analysis because of the disruption that had occurred. All student names have been replaced with pseudonyms.

Messages exchanged by students within their groups ($\underline{N}$=673) and the products of each group were entered into ATLAS/ti (Muhr, 1995), a qualitative data analysis program. The software enables users to assign codes to text, create new codes during analysis, and group codes in networks. It also creates SPSS files for quantitative analysis.[4] The group tasks consisted of (i) identifying criteria for judging qualitative research (maximum 500 words), (ii) a presentation outlining the theoretical foundations, key teacher decisions, and evidence of student impact of one approach to cooperative learning (maximum 5000 words), (iii) a response to feedback on the presentation from other groups (maximum 1500 words), and (iv) comments on the presentation of four other groups (maximum 500 words each).

The data were coded using three category schemes. The first emerged from the data through a process of analytic induction. It concerned technical issues: (i) explicit problems (e.g., "I tried to connect on Monday and the scratchpad was acting up so I gave up after several failed attempts"), (ii) implicit problems (e.g., a jumbled line of text), (iii) explicit technical skill (e.g., giving accurate guidance on how to perform a procedure), and (iv) implicit technical skill (e.g., sending a graphic). Technical issues were coded for frequency and duration (number of lines of text).

The second set, influence on group deliberations, involved three codes that were determined in advance. (i) Procedural leadership referred to students giving directives to others (e.g., assigning tasks). (ii) Influence on final products referred to the number of lines in the final text attributable to each student. The contribution had to be substantive. For example, boiler plate language expressing how interesting the group found the previous presentation, usually added by the editor of the final draft, was not coded. Credit was given only to the first person who raised a given idea included in the final text, even if other group members repeated it in subsequent messages. For example, Irene suggested that her group's response to another group's presentation should be critical of the Jigsaw method because when it is first implemented students are so preoccupied with their own mini-presentations (from expert groups) that they do not listen to what other children are saying. This suggestion was repeated by two other group members as they revised the group's critique. George suggested that the problem could be solved, perhaps by teaching interpersonal skills or the problem might disappear with time. In the final text the issue was addressed in a short paragraph. Irene was credited with 4 lines for the original criticism; George was credited with 3 lines for the proposed solution; Jim was given no credit even though he repeated both ideas in various messages. (iii) Rejected contributions referred to lines of messages expressing ideas that did not appear in the final text. For example, Helen suggested that Sally include in her section of the presentation a strategy for minimizing student competition. Helen provided a description of the strategy and a reference to a journal article. Katherine's subsequent draft of her section made no reference to Helen's suggestion and the final text did not include it. Helen's suggestion was coded as a rejected contribution.

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[4]In the ATLAS/ti output the quotation (passage selected from the text) was the case. The data file for each case consisted of its beginning and end points (allowing for calculation of quotation length). Each code category appeared as 0 (for all codes that were not selected for that quotation) or 1 (for codes that were selected, typically one student ID and one other code). The output files from each group were merged and then aggregated so that the student became the case. For each student the aggregated file contained the number of times each code appeared and the total number of lines of text for each code.

The third set of categories was also developed in advance. Woodruff (1995) proposed that small groups be viewed as micro communities that use argument as a form of inquiry, developing shared knowledge through constructive conflict . Woodruff proposed an argumentation hierarchy that was adapted for this study. Level 1 arguments consisted of building a set of collectively valid statements. Passages in which students expressed unelaborated agreement with a proposition were coded this way. For example, "I agree with the presenting group that STAD...focuses on individual morsels of information and that teacher workload must be heavy". Six subcodes were used for Level 1: agreeing or disagreeing with ideas put forth by one's own group, another group, or the course readings. Level 2 arguments in Woodruff's account are elaborations of an idea by suggesting warrants or evidence or ways to test the idea. For example, Jim responded to a team member's suggestion by providing evidence to support her claim.

> My major concern with STAD/TGT is with its application in higher grade levels (previously mentioned by Irene). As a high school science teacher I really can't see using STAD/ TGT very much. High School students need a little more than a superteam notation as a motivation to learn. The reward system is just not befitting a high school environment. High school students will perceive this strategy as a kids' game. I think that STAD/TGT would work best in the lower grades where belonging to a superteam has significance.

Again there were three subcodes for Level 2 arguments, distinguishing among elaborations of ideas offered by the student's own group, other groups, and course readings. Level 3 arguments (labelled identifying misconceptions in this study) note discrepancies between a proposed idea and conventional belief. For example, Tina challenged claims made in the Tribes group presentation.

> In section 3.4.1 (Group Monitoring), I noticed how the responsibility is transferred to the students to manage the tribes. Unfortunately, very little was explained how a teacher would do this. It just doesn't happen with students, they need guidance in order to know what to do in order to manage their groups.

There were subcodes for own group, other groups, and course readings in Level 3. In Level 4 of Woodruff's account an idea is challenged by presenting contrary evidence, thereby suggesting an alternative hypothesis. In this study Level 4 arguments were treated as reconceptualizations in which the arguer generates another point of view and provides some evidence or uses the evidence initially provided. For example, a member of Dianne's team had recounted a story to argue that having friends in the same group contributes to group productivity. Betty offered a different interpretation:

> I wonder if the group that is very productive is so because the group members are friends, or are they friends because they are productive. Or is it a process that through inclusion exercises, - possibly conducted by you, or by themselves, they have grown into both the friendship and/or the productivity.

In the first level of analysis, the quotation matrix function of ATLAS/ti was used to generate displays of each code for each individual. The quotations of high and low communication skill students were compared. In the second level of analysis, the mean frequencies and mean quotation lengths for each code were calculated and the results compared for high (ranked 3 or 4) and low (ranked 1 and 2) communication skill students. Differences between the two groups were expressed as effect sizes (the means for the lows were subtracted from the means for the highs and divided by the standard deviation of the lows), because significance tests would be meaningless for such a small sample. The same procedure was followed for prior knowledge of cooperative learning and for gender.

Results

The first question to be addressed was whether students with weak computer conferencing skills experienced technical difficulties, and if they did whether they missed instructional events. Virtually all students encountered technical problems. The most common involved difficulties in connecting to the host computer from their home machines, especially for students who relied upon overloaded service providers such as the *Electronic Village*, a teacher network.

The type of problem that students worried about was related to their skill levels. For students with weak CMC skills even trivial problems loomed large ("my printer ran out of ink so I was a little disabled"). Students using their home computer's DOS editor to compose messages for uploading lamented that they could not figure out how to get to their word processing program to use its word count and spell check facilities. One low CMC skill student notified her group that she would be helpless for a few days because her computer literate husband was going to be away.

But these concerns paled in comparison with persistent difficulties in uploading and downloading, problems that inhibited access of less skilled students to group activities. Sometimes they lost messages they were sending ("This is my second reply. I just lost my other one when my screen filled up with garbage. I'll be briefer and less intelligent this time."). Receiving information could also be problematic ("I did a search earlier on cooperative learning...before I could download it all, the *Village* wiped out my mailbox"). Sometimes their messages "came out all disjointed on the screen even though originally...it seemed to display OK." They were often unsure whether their messages were getting through. They persisted but often gave up "after several failed attempts".

Students with low CMC skills at times disappeared from the conference entirely, evoking concern of other team members when group decisions had to be made.

> Irene have you heard from George or do we assume he is lost in cyberspace...[a day later:] no sign of George? I guess we have to assume his server is down and out for the count. Do you think we should submit [the] presentation without his OK?
>
> Jim, I am baffled too. I am not sure if George was revising his section on the teacher etc. He had said that he was going to...I hate to tamper in case he has it done. If we don't hear soon, we should maybe send [the instructor] a note explaining our delay.

At times students with weak CMC skills advised the rest of the group to go on without them and then felt guilty about not holding up their end.

I couldn't send any messages for the past three days because my login with [the university] was all messed up. I feel so badly to have been no help at all these past few days. I am truly sorry. I am sure you've already sent questions in by now, but I'll go ahead and send my thoughts from earlier in the week just to make myself feel like I did something.

There were occasions when low CMC skill students were unable to do their share because they lacked technical skills such as how to use the internet to locate documents for their topic.

Students with low CMC skills felt victimized by equipment that seemed to have a mind of its own ("sorry, I accidentally touched the mouse and this is what happened"). They rarely offered advice to other group members on technical matters and when they did the guidance was at times incorrect or unhelpful ("Read the manual. It might be something small.")

Although students with greater CMC skills reported half as many technical problems (an average of 6.1 compared to 11.3 for students with weak computer communication skills), the main difference was in the nature of the problems they encountered. They were more likely to be concerned with higher level challenges such as how to send graphics or technical-political questions such as how First Nations teachers could gain access to the *Village*. They also wrestled with technical glitches that were beyond their control (e.g., a "talk" facility that disappeared from the hub computer). In most instances students with high computer communication skills were able to solve their own problems ("usually, I have problems downloading long passages, so I'll download each part separately"). Occasionally they reported experiments they were conducting to identify causes and solutions for technical problems.

Students with high CMC skills were sympathetic to group members encountering technical difficulties and offered assurances that minor blemishes (e.g., spelling errors) did not detract from the quality of the message. They frequently offered sympathy and advice and offered to help students avoid technical challenges that were beyond them. For example, all groups rotated the responsibility for compiling individual submissions into a group response. A student with low CMC skills expressed concern about how much time this was taking because she had to retype all the messages that had been submitted on the topic—she did not know how to manipulate them electronically prior to uploading the group's report. After explaining how to merge files, a highly skilled colleague sympathized.

If you cannot do this, you should not be doing the uploading [of the group product to the rest of the class] because your way is much too much work!!!! Holy cow - no wonder you had so much difficulty with the major assignment. I tried to help you organize by sending everything in one collected piece, but I can see now that that did not do anything to help you. Sorry to hear that you had to do so much extra work.

In summary lack of computer communication skills influenced students ability to access group discussions and impeded their ability to function as equal group members. There were a few occasions in which they missed instructional activities. They expressed much more anxiety and guilt about their computer skills.

The second question addressed was whether students with weaker CMC skills sent fewer and shorter messages. Table 2 displays the mean passage lengths of low and high CMC students. The first category is the sum of all productive contributions made by students, consisting of ideas that they proposed for the group products (regardless of whether or not they were accepted by the group), arguments that they presented to their peers, and managerial moves to guide the group through the tasks. The overall difference in contribution was negligible. Despite the technical difficulties they encountered, students with weak communication skills contributed as much as the others to the work of the group.

Table 2 About Here

The third question was whether students with weaker CMC skills had less influence on the final product. This was not the case. All teams followed similar procedures for assignments. The presentation of one cooperative learning method to the rest of the class was the central preoccupation. Teams began thinking about it as soon as their branch was established. Individuals suggested what the contents of the presentation might be and identified areas they were particularly interested in. The group mulled the task over until a conceptual leader suggested a framework for presentation. In every group the first framework to appear was modified only slightly. Students' typical response to the plan was to volunteer to complete one or more of its sections. After modest trading back and forth individuals wrote their sections independently, usually generating several drafts that were revised on the basis of additional materials acquired by the writer rather than through spirited debate among team members. There was little discussion of each other's sections and the final edit was a simple assembly task.

All groups followed a similar process for responding to the presentations of others. At the beginning of the work period (i.e., when another team had uploaded their presentation to the conference) individuals would send messages expressing thoughts about the cooperative learning approach and the other team's treatment of it. One person would volunteer to coordinate the production. This task rotated among team members. There were several instances in which a student who had previously coordinated production volunteered to do so again and then withdrew when another student who had not done the task volunteered. There was more discussion of ideas when producing responses to the assignments of others, in part because students were more conscious of the word length limitations. A conceptual leader (usually not the production coordinator) would emerge to suggest a structure for the response, listing themes or issues to be addressed. Students with weak computer communication skills were as likely as those with stronger skills to suggest a framework, volunteer for sections, identify materials, exercise procedural leadership, and complete their portions of the assignment.

The fourth question was whether students with weak computer communication skills would avoid high level conceptual tasks. Table 2 shows that students with weak CMC skills were more likely to engage in argument construction, the most productive form of small group learning. But the means for the two communication skill groups were virtually identical for the top three categories (elaborating ideas, identifying misconceptions, reconceptualizing issues). The difference was limited to the lowest category of argument, agreeing or disagreeing with an idea that has been put forward. For example:

Finally I must agree with George on his point of STAD/TGT having the potential for *dittoitus*. The time constraints and the effort require to implement this strategy make it very appealing to use the same materials year after year. Thus neglecting new curriculum, more relevant sources, and reflective practice.

Competing Explanations for Differential Participation

Differential participation in learning was partly related to students' computer communication skills. But three other factors appeared to be more important. Table 3, which represents differences between groups as effect sizes, illustrates the strength of two of these factors. The table shows that differences between students with weak and strong computer communication skills were small, particularly when compared to the effect sizes for prior knowledge of cooperative learning and gender.

Prior Knowledge Students who were using cooperative learning methods in their classrooms and/or had attended workshops on the theory and practice of peer-learning approaches made a greater overall contribution to group deliberations. They had more influence on the final product than students who had less prior knowledge, even though more knowledgeable students offered many suggestions that did not make it into the final texts, and they were more likely to offer procedural guidance as the group went about its work. In three of the four groups, the conceptual leader, the student who usually developed the framework for the group product, was someone with higher prior knowledge in cooperative learning. The exception was a group led by a doctoral student who was very knowledgeable about curriculum issues, even though she had done little reading in the cooperative learning literature prior to the course.

Students who were more knowledgeable on entry were more likely to engage in all forms of argument. The differences were especially noticeable in the upper level argument category, although there were comparatively few of these. For example, George tried to get Jim to reconsider his conception of intelligence.

> Jim, perhaps the idea of "slow learner" is parallel to that of "intelligence" and to that of singular achievement in terms of constants as a measure of "learning", which may not have anything to do with the acquisition of knowledge. I realize I'm talking "ideals" here, not daily school pragmatics. I had a discussion with a math teacher the other day whose prime focus was basic skills and the right answer. We had no grounds on which to communicate. He could see no other definition of curriculum seeing it only as a predefined constant. For me Jigsaw is just another methodology for encouraging learning "with" rather than against each other. Of course I am looking at this from the point of a high school teacher who basically thinks in terms of the primacy of process.

Almost all the examples of arguments that identified misconceptions (Level 3) or attempted to reconceptualize issues (Level 4) came from those with prior knowledge. The exceptions came from two doctoral students.

Gender Table 3 shows that men made more contributions to the small group discussions, had a greater influence on the final products, and were more likely to provide procedural leadership in their groups. Gender was visible in other ways, particularly in terms of how family issues affected participation in group activities. For example, two women, but no men, reported that they had been unable to log on earlier in the evening because their children were using the family computer for homework. Gender contrasts were especially noticeable when two groups with different gender compositions were compared: One group had two men and one woman and the other consisted of four women.

Irene, the sole woman in her group, frequently referred to her family and how it affected her activities. She often ended her messages with reference to them.

> I've got a squirmy baby in my lap. I will definitely have to check in later tonight.
>
> My oldest son is asleep on the floor beside me, is my family trying to tell me something?
>
> Will make the short adjustment to my last part of research, but got a wee tired boy to get to bed RIGHTNOW!!!
>
> BABY IS NOT ASLEEP YET! That sums up the last hour for me so far..

Neither of the men responded to these messages. Mid-way through the group work section of the course Irene began to share some health concerns:

> I can tell the holiday is over, my kids have just come down with a flu bug.
>
> My kids are ill and my husband is stricken as well. With everybody up coughing all night and a baby who only wants to be rocked all day, my usually disciplined self is disappearing fast.

Still no response from the men. Irene's situation deteriorated further.

> I don't mind doing the edit but should inform you of what is happening here. My oldest son has a temperature of 104 and when I just took his pulse, it was so rapid I could barely count it. Just talked to a nurse and if it isn't down in the next hour, I am going to take him to emergency. What time I get back could be a problem so couldn't guarantee when I would send in our remarks- maybe not until tomorrow night. At this point, I am more worried about my little guy.

George responded about an hour later: "Irene, forget it! Deal with sick child.", adding the next day, "Irene, hope all is well with kinder?" Jim also responded, two weeks later, "Irene hope your children shack the Flu bugs." These were the only references the two men made to Irene's family concerns and they said nothing about their own families. Irene was grateful that George volunteered to do the edit for her ("Thanks for the understanding!") and continued to keep them informed of developments "I took today off to play nursemaid. My son still has a fever but at least its not as high, so hopefully all will be well soon."

In contrast the group with four women regularly exchanged information about their families—driving a child to the bus station, romantic weekends with a spouse, assembling furniture with a son, and other home concerns. When Jane announced that her son's team had won a hockey tournament, the other three members of the group immediately responded (e.g., "Congrats Jane That must have been really exciting for him and you!"). When Nancy reported that her daughter had the flu ("My little one is sick! Just got her down and hopes she stays there"), the others were sympathetic. When Nancy later congratulated Carolyn on how much work she had done on one of the group assignments, Ann's reply acknowledged how difficult the past week had been for Nancy. "Why I have time to key? No Kids with Kroup & Koffs! Don't know how you juggle all the balls in the air. Wow! I'm impressed."

In the other two groups, each composed of one man and three women, family issues were also discussed. For example, in one group the three women exchanged personal experiences about whether it was a good idea to drive to Florida for the March Break in a mini-van full of kids. Neither of the men participated in these discussions about family issues.

Group Composition As noted above, the proportion of males and females was a key factor influencing whether family issues became part of the group's agenda. Group composition also influenced argumentation. Students varied in their willingness to offer arguments. Two students never offered any while another produced 27. Every group had at least one student who accounted for at least 60 lines of argument, but only one group had more than one member at this level. This group of three, two of whom were doctoral candidates, averaged three times as many lines of arguments as the lowest group.

Discussion

The findings indicate that students' computer communication skills had only a modest impact on their participation in a CMC course. Students with less developed skills encountered serious difficulties, especially in transferring files to and from the hub computer, and these obstacles did reduce their ability to complete some tasks in a timely fashion. But the difficulties were resolved. Students with weak CMC skills participated as well as students with stronger skills. They produced as many task relevant messages, exercised as much procedural leadership, were equally (in one instance more) likely to engage in argumentation, and engaged fully in the most demanding learning activities. Any impediments to participation arising from technical deficiencies were inconsequential compared to the impact of other factors, particularly prior knowledge, gender, and group composition.

This is good news. The study found that students do not need to be hackers to participate in CMC courses. But there were four contextual factors operating in this study that might limit its generalizability. The first concerns enabling student characteristics. Enrollment was restricted to teachers seeking to upgrade their qualifications: They were highly motivated learners, interested in the content of the course, who brought sophisticated learning strategies to it. There may also have been some self-selection on the part of students (about a third) who lived close enough to the university to access a similar course offered in face-to-face mode. Whether high school students or undergraduates (the two largest sources of distance education enrollments) would be as persistent and as capable in acquiring new skills remains to be demonstrated. For example, younger students are less likely than older students to seek help when they need it (e.g., Nelson-LeGall & Glor-Scheib, 1986).

The second contextual factor was the availability of technical support. Students enrolled in this course had access to a CMC coach, a mature adult educator who could be contacted by telephone, fax, or e-mail. A previous study (Ross et al., in press) found that this coach (in collaboration with other technical specialists) was successful in solving most of the problems that students raised. Other studies (e.g., Butcher & Greenberg, 1992) have noted the importance of having a help desk to support CMC courses, particularly when training manuals are inadequate, which they usually are (Davie & Palmer, 1985; Phillips et al., 1988). Although technical support was not required by all students it appeared to be essential to some.

The third contextual factor concerns the ethos of peer support that emerged from the structure and content of the course. How to learn from peers was the end and the means. The materials students were reading emphasized the virtues of students giving and seeking appropriate help to one another, the benefits of peer discussion, and the negative effects of individualism. Learning activities were structured so that students had to work with one another: They were required to generate complex group products demanding a diverse array of abilities; they had substantial discretion about how to organize and complete the assignments, requiring consensus decision making; they were given a single group mark for each product (which was combined with grades received on individual assignments); they were obliged to ask each for help on the assignments before approaching the instructor. The ethos of mutual help made it socially acceptable for students with weak computer communication skills to approach their peers for help and it placed an obligation on those with stronger skills to intervene if help was needed, even if no formal request was made. Having students in the same group for seven weeks may also have contributed to norms of mutual help because students are more likely to seek help when they are familiar with the skills and demeanor of potential help givers (e.g., Nelson-Le Gall & Gumerman, 1984).

The fourth contextual factor is that the level of computer communication skill demanded by the course was relatively low. The most difficult tasks (creating, merging and uploading text files) were quite basic. Students needed to reach a threshold level of competence that was not terribly difficult to achieve and there was little need to go beyond it. In contrast in other CMC courses students might have to create integrated texts generated by different programs (e.g., integrating graphics, texts, and statistics) or use sophisticated engines for searching the Internet. In these courses the variance in CMC skills might be much larger and the hierarchy of students much steeper.

Directions for future research might first examine what happens to students with weak computer communication skills in less supportive contexts. Of special interest are professional upgrading courses with large enrollments, individualized tasks, and competitive reward structures, factors that retard the development of peer helping behaviors. Studies in this context suggest a quantitative approach to research, correlating CMC skills against measures of participation and achievement while controlling for moderating factors like prior knowledge, gender, and group composition. These large enrollment courses offer economies of scale (Andrews, 1996) but the costs for less able students may be considerable.

Another direction for further research follows from the findings of this study concerning gender. Females participated less than males and in different ways. Future research might explore the moderating effect of the gender composition of groups. Qualitative studies focusing on interaction patterns might explore a hypothesis emerging from this study: When women are in the majority, discussion of family issues may bring the group together, giving women a strong sense of group inclusion. Deficits in technical skill might be overcome through group support. When women are in the minority, raising family issues may be divisive, alienating women from the group. In this case women with weak computer communication skills might be seriously disadvantaged.

CMC is likely to become the method of choice for the delivery of distance education because of its economic and pedagogical benefits. Widespread adoption of CMC will increase the number of students enrolling with weak computer communication skills. Research needs to focus on what happens to these students in various settings, shifting attention from access/retention concerns to participation issues. It is not enough to get students to CMC courses. We need to design treatments that will enable them to be successful, regardless of the computer communication skills. It may also be that we need to devise valid criteria to deny enrollment to students who lack the training to benefit from the program.

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Table 1 Examples of Levels of Computer Conferencing Skill and Prior Knowledge of Cooperative Learning

Level	Computer Conferencing Skills	Prior Knowledge of Cooperative Learning
1 [low]	1st CMC course; contacted coach seven times; slow to send 1st message to conference; garbled or incomplete messages	no previous experience or knowledge in cooperative learning
2	2nd CMC course; contacted coach twice; ongoing problems with connections to the hub computer	attended a workshop on one approach: Tribes
3	2nd CMC course; offered advice on how to upload and download to the class	attended conferences on cooperative learning and has used Jigsaw frequently
4 [high]	3rd CMC course; M.Ed. in Educational Computer Applications; opened the branch for his group; suggested strategies in technical branch; included graphics in messages	planning Ed.D. thesis on cooperative learning; extensive use of Jigsaw and STAD in own class; offered workshops to teachers on cooperative learning

Table 2 Mean Passage Lengths of Low and High CMC Skill Students

Passage Category	Low CMC Skill (N=8) Means	SD	High CMC Skill (N=7) Means	SD
All productive contributions	590.75	402.12	561.57	166.66
All arguments	81.00	87.22	52.43	40.80
Influence	377.38	228.25	338.57	161.75
Rejected contributions	98.25	80.78	125.00	127.17
Procedural leadership	52.00	43.08	54.14	63.36

Table 3 Effects of Computer Communication Skill, Prior Knowledge of Cooperative Learning, and Gender on Passage Lengths (Effect Sizes)

	Computer Communication Skills Rank*	Cooperative Learning Prior Knowledge Rank**	Gender***
All productive contributions	-.07	1.05	-.64
All arguments	-.33	.63	-.36
Influence	-.17	.86	-.66
Rejected contributions	.21	1.54	-.02
Procedural leadership	-.05	1.06	-1.55

* positive effect sizes indicate higher means for high computer communication skill students
** positive effect sizes indicate higher means for high prior knowledge students
*** positive effect sizes indicate higher means for male students