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An analysis of computer-mediated communication between urban middle school students and scientists

Murfin, Brian Edward, Ph.D.
The Ohio State University, 1993

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AN ANALYSIS OF COMPUTER-MEDIATED COMMUNICATION BETWEEN URBAN MIDDLE-SCHOOL STUDENTS AND SCIENTISTS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

The Ohio State University
1993

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PUBLICATIONS


**FIELDS OF STUDY**

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Science education
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CHAPTER I
INTRODUCTION

Need for study

Computer-mediated communication (CMC) is becoming an increasingly important tool in education. It is possible that CMC may be useful in fostering partnerships between schools and businesses and in providing students from underrepresented groups with scientist role models. In order to utilize this new mode of communication efficiently, the characteristics of CMC between students and adults should be thoroughly investigated.

CMC may prove to be a very cost-effective method of managing the many complexities involved in maintaining a school/business partnership. Electronic bulletin board systems have been characterized by Hudspeth (1990) as the "Appropriate technology" of the 90's. One great benefit of CMC is that its asynchronous nature eliminates the frustrating "telephone tag" which characterizes so many bureaucratic organizations. Adults who wish to involve themselves with the educational system could so without ever leaving their offices. CMC offers the potential to tap a wealth of resources which are presently unavailable to schools.
It is well known that African-Americans, other minorities, and women are underrepresented in the sciences. A lack of scientist role models has been proposed as one important factor that has contributed to the lack of African-American and female scientists (Oakes, 1990; Epstein as cited in Skypek, Lee, & Cox; Hale, 1978; Jay, 1977;). It is possible that forms of communication such as E-mail, computer conferencing, and electronic bulletin board systems could be used to bring scientists into contact with middle school students. It has been found that computer-mediated communication modifies the character of conversations (Perrolle, 1991). Perrolle (1991, p. 21) stated that this mode of communication "...alters the social norms governing conversation by removing elements of emotion and social control..." and that "It also provides the possibility of more equal participation by obscuring the visual and verbal distinctions of status that give high-ranking or aggressive people an advantage in face-to-face speech."

Computer-mediated communication, CMC, may also offer African-American children, females, introverted children, and students with communication difficulties an alternative and more effective mode of communication.

In addition, some aspects of the "scientific literacy" so avidly sought by the latest curriculum reformers, (Rutherford & Ahlgren, 1990), might be obtainable by using CMC to provide children with distributed, long-term exposure to scientists.
In any event, all persons are going to be required to use some sort of CMC in the future. Paul Levinson (1989, p. 48) clearly stated the implications of CMC for education:

So compelling and promising is this creation of a real (not just metaphoric) global mind, so energising of the intellect is the ability to express oneself, from any place and at any time, that I believe educational institutions will either learn how to effectively integrate this new tool, or fail in the next century.

**Theoretical model**

McLuhan's (1964) idea that the medium is the message may not be applicable to CMC. Because of the narrow bandwidth of CMC, contextual cues, static and dynamic (Bresler, 1990), are greatly reduced and thus the message may actually provide the context for the message itself. Reddy (1979) described the traditional metaphor for human communication as a message being a package moving through a conduit to the receiver. This metaphor has now been recognized to be inadequate. Scollon (1982) has presented an interesting alternative. Scollon's metaphor is communication as "berry picking." A receiver of a communication is not a passive recipient, instead she or he actively picks and chooses components of the message from all the different cues and information available (Bresler, 1990).

Jurgen Habermas has stated that persons engaging in conversation must "negotiate with one another to establish that what is being said is meaningful and true, that the speakers are sincere, and that the communication is socially
appropriate" (Perrolle, 1991, p. 21). Uncertainty reduction theory claims that "...when one is involved in an interpersonal relationship one will work to reduce uncertainty and increase predictability" (Berger, 1987; Berger & Calabrese, 1975). Other factors which may influence visual and computer communication are the message content, the mode in which it is conveyed, the reason for the communication, gender, ethnic group, age, typing skill, size and physical appearance, and body language.

Figure 1 shows a theoretical model which illustrates computer-mediated communication (CMC) and face-to-face (FTF) communication between students and scientists. As can be seen in the diagram, the transactional distance is greater during CMC than in the FTF interaction. The zone of proximal distance, (ZPD or zoped), (Vygotsky, 1962) is the virtual area where the minds of the students and scientists meet electronically. In the ZPD the spontaneity of the child interacts with the logic and experience of the adult scientist.
Figure 1. A theoretical model of CMC and FTF communication between students and scientists
A theoretical model of group dynamics called SYMLOG (System for Multiple Level Observation of Groups) developed by Bales and Cohen (1979) is shown in Figure 2. Use of SYMLOG will enable a fine-grained content analysis of the messages produced in the computer conferences to be carried out.
There are six main directions from the center of the cube: U=up, D=down, P=positive, N=negative, F=forward, B=backward. There are 26 cells in the cube and each cell corresponds to a specific item on a SYMLOG behavior or value rating form.

Figure 2. A theoretical model of SYMLOG
A sample rating form is shown in Table 1.

Table 1.

**SYMLOG Specific Behavior Rating Form**

<table>
<thead>
<tr>
<th>Dimensions Tapped</th>
<th>Adjectives</th>
<th>Choices (rarely, sometimes, often)</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Seemed active, dominant, talkative</td>
<td></td>
</tr>
<tr>
<td>UP</td>
<td>Seemed extroverted, outgoing, positive</td>
<td></td>
</tr>
<tr>
<td>UPF</td>
<td>Acted as a purposeful, democratic leader</td>
<td></td>
</tr>
<tr>
<td>UF</td>
<td>Acted as an assertive, business-like manager</td>
<td></td>
</tr>
<tr>
<td>UNF</td>
<td>Seemed authoritarian, controlling, disapproving</td>
<td></td>
</tr>
<tr>
<td>UN</td>
<td>Seemed domineering, tough-minded, powerful</td>
<td></td>
</tr>
<tr>
<td>UNB</td>
<td>Seemed provocative, egocentric, showed off</td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td>Joked around, seemed expressive, dramatic</td>
<td></td>
</tr>
<tr>
<td>UPB</td>
<td>Seemed entertaining, sociable, smiling, warm</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Seemed friendly, equalitarian</td>
<td></td>
</tr>
<tr>
<td>PF</td>
<td>Showed agreement, worked cooperatively</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Seemed analytical, task-oriented, problem</td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td>Seemed legalistic, insistent, had to be right</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Showed disagreement, seemed to be negativistic</td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>Seemed irritable, cynical, uncooperative</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Showed feelings and emotions</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>Seemed affectionate, likeable, fun to be with</td>
<td></td>
</tr>
<tr>
<td>DP</td>
<td>Seemed to look up to others, showed trust</td>
<td></td>
</tr>
<tr>
<td>DPF</td>
<td>Seemed gentle, willing to accept responsibility</td>
<td></td>
</tr>
<tr>
<td>DF</td>
<td>Seemed to work submissively</td>
<td></td>
</tr>
<tr>
<td>DNF</td>
<td>Seemed to be self-punishing, worked too hard</td>
<td></td>
</tr>
<tr>
<td>DN</td>
<td>Seemed depressed, sad, resentful</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>Seemed alienated, withdrew from task and group</td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>Seemed afraid to try, doubtful of own ability</td>
<td></td>
</tr>
<tr>
<td>DPB</td>
<td>Seemed quiet but happy to be with others</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Seemed passive, introverted, untalkative</td>
<td></td>
</tr>
</tbody>
</table>

(Balles, Hare, & Stone, 1988, p. 346)

Bales' model will form the basis for one of the content analyses of the message transcripts. Using SYMLOG, observed group behavior as evidenced by the written transcripts will be interwoven with the participants' own perceptions and observations of each other's behavior. Bales himself described SYMLOG as
...a comprehensive integration of findings and theories from psychology, social psychology, and related social science disciplines. It is unique in its breadth, its high degree of integration, and its practical implementation. It is a new "field theory"...As a field theory, SYMLOG takes effective account of the fact that every act of behavior takes place in a larger context, that it is a part of an interactive "field" of influences. The approach assumes that one needs to understand the larger context--personal, interpersonal, group, and situation--in order to understand the patterns of behavior and to influence them successfully. The measurement patterns of SYMLOG are designed to measure both behavior patterns and their larger context.  
(Bales, 1988, p. 322)

Definition of terms
An analog signal is a smoothly varying value of voltage or current that varies continuously in amplitude and time.

ASCII stands for the American Standard Code for Information Interchange. This is a standard character encoding scheme adopted in 1963. It is a 7 bit code providing 128 different bit patterns.

A Battellite is a scientist or non-scientist employed by the Battelle Institute.

A bulletin board system (BBS) is a program which runs on a computer and allows users to perform several communication and information transfer functions (Landberg, 1986). Most BBS's allow electronic mail which can be semi-private, private or open to all, and computer conferencing. In addition files can be uploaded and downloaded to and from the BBS.
A **bit** is an acronym for a binary digit.

A **byte** is a subdivision of a word in a machine usually made up of eight bits. Every time an alphabetic or numerical key is struck, a byte is entered.

A **career-related message** will contain at least one phrase, word or example of electronic paralanguage which conveys career interest or information.

**Computer anxiety** is a measure of a person's fear of using computers as measured by the Computer Anxiety Scale Short Form.

A **communication genre (CG)** is the CMC equivalent of a literary or speech genre. A communication genre is a context-specific style of communicating which is made up of definite procedural rules and conventions.

**Computer-mediated communication, (CMC),** is a general term which includes any communication which takes place through a computer.

**Computer conferencing, (CC),** entails setting up areas on an electronic bulletin board which restrict the conversations to certain topics. A computer conference does have a central
location where a transcript of all past conversations may be accessed (Newman, 1990). CC also has a single numbering sequence (Newman, 1990).

The number of messages sent and received, the number of replies sent and received, number of times online, and length of messages are quantitative measures of computer usage.

**Depersonalization** is a result of not being able to see the person one is communicating with. A message sender may tend to forget that the receiver of the message is a human being.

**Deindividuation** describes the state in which individuals lose their identifying characteristics, such as physical appearance. Deindividuation can lead to an individual being regarded as a faceless nonentity.

A **digital** signal uses discrete units to represent numbers, symbols, etc. Digital information is most often represented by the use of two-state electrical phenomena (on/off, high voltage/low voltage, current/no current, etc.)

**Electronic mail**, (E-mail), involves the sending of text from one person to another utilizing a computer. E-mail has traditionally been private or semi-private.
Electronic paralanguage, (EP), consists of any information besides the content of the words themselves, which is conveyed through CMC. An example of EP is the use of a smiley, :-) to indicate that the user is happy.

**Flaming** is the uninhibited expression of emotion which occurs during CMC.

A **Heavy user** is defined as a user who ranks in the upper third of the sample of users in one or more of the following categories: number of logons or number of messages sent. The number of messages sent had a higher priority in determining the classification of the user as Heavy or Light. The total number of bytes per user was not considered.

An **information system** is made up of the following five parts: users, rules and procedures, data, software and hardware (Paul Scovell, 1991).

**Keyboarding or typing skill** is a measure of how many words per minute a person can type, before and after correcting for accuracy.

**Latency of verbal response**, (LVR), is the time it takes an individual in a face-to-face group to respond to a query and this is a fairly constant personality characteristic.
A Light user is a user who is in the lower third of the sample of users in one of the following categories: number of logons or number of messages sent. The total number of bytes per user was not considered.

A local area network, LAN, is made up of computers which are linked in the same "local" area.

A lurker is a CMC user who only reads messages and does not post messages or take part in online discussions.

A managerial message is concerned with bulletin board and organizational procedures. An example of this could be a request for information.

Mechanomorphism is a state of mind in which a person attributes machine-like characteristics to the receiver or sender of CMC.

Message content involves the classification of messages as science-related or non-science related.

Message tone describes whether a message is positive, neutral, or negative.
Message type states whether a message falls into one of the following categories: career-related, person-to-person, managerial, personal-problem, or one-to-many.

A modem, (short for modulator and demodulator), converts a digital signal from a computer to an analog signal which can be transmitted through a phone line. Next another modem converts the analog signal back to a digital signal which can be utilized by the receiving computer.

A moderator is the person responsible for keeping the discussion in a computer conference on the correct topic.

Multiloguing is communication between more than two persons and in which turn-taking is irrelevant (Shank, 1993).

A negative message contains at least one negative word, phrase, or instance of negative electronic paralanguage.

A network is made up of terminals, nodes, and interconnecting media.

A neutral message contains no positive or negative phrases, words, or electronic paralanguage.
A non-science message will have no references to science topics.

A one-to-many message is directed to more than one person.

A personal-problem message is a message which discusses a personal problem of the sender or receiver.

A person-to-person message contains information which is related to the interpersonal relationship between the sender and receiver and is not intended to be of interest to other persons outside the dyad.

A positive message will contain at least one friendly word, phrase, or an instance of positive electronic paralanguage.

A primary dyad is face-to-face communication between two persons.

A science-related message will contain at least one reference to a science topic.

The term scientist refers to a practicing adult scientist, other than the students' science teacher, who communicates with students via electronic mail and computer conferencing.
A secondary complementary dyad is a pair of persons of unequal status communicating with each other through the computer, for example, an adult and a child.

Social presence is "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships" (Asteroff, 1987, p. 65).

A sysop (system operator) is the person who runs and maintains an electronic bulletin board system.

Transactional distance is the psychological and communications space between a teacher and a learner.

A virtual day is defined as a day on which a message was posted on the bulletin board. Virtual days follow in chronological order but are not necessarily twenty-four hours apart.

Statement of the Problem
The main goal of this study was to determine the characteristics of effective and ineffective computer-mediated communication between urban middle school students and scientists. Quantitative measures of CMC effectiveness are the number of logons, number of messages sent and total number of bytes sent. It was proposed that successful and Heavy
users of CMC and their messages would differ in measurable ways from infrequent users of CMC and their messages. The hypotheses which were investigated are as follows:

1) Heavy users type faster than Light users;
2) Heavy users have a computer at home while Light users do not;
3) Heavy users have less computer anxiety than do Light users;
4) Heavy users have a more positive attitude towards computers than do Light users;
5) Heavy users utilize more electronic paralanguage than do Light users;
6) Heavy users send different social contextual cues than do Light users;
7) There is no ethnic difference between Heavy and Light users;
8) An equal number of boys and girls will be classified as Heavy and Light users;
9) The socioemotional content of the messages will increase and become more friendly over time;

The characteristics of CMC users and their messages were correlated with measures which indicate the successful use of CMC. SYMLOG (System for the Multiple Level Observation of Groups) was used to meld the results of a qualitative content analysis of samples of messages with ratings by each participant of every other participant's general behavior and
values. The results of the SYMLOG analysis were examined in order to reveal any differences between Heavy and Light users of CMC.

It was hoped that a multiple electronic zone of proximal development (Mezoped) would result, in which adult logic and experience would meet the spontaneity and creativity of children. With the assistance of adult scientists, the children may be able to reach higher levels of cognitive understanding than they would by relying on their own resources. In addition, since the minds of the children and adults were in such close proximity, physically and socially, and the interactions regularly distributed over a period of time, it was suggested that modeling may occur and that the students may acquire more positive attitudes toward science, scientific ways of thinking, and other aspects of scientific literacy, as well as specific knowledge about careers. Finally, CMC may offer a child the chance to safely and privately experiment with different styles of interpersonal interaction and an opportunity to create a successful, new, online identity which does not carry the baggage of race, gender, socioeconomic status (SES) or the jeers of peers.

It was also proposed that the interaction between the scientists and students would cause the students to show more interest in science-related careers. It was expected that Heavy users of CMC would benefit from the greater contact with the scientists and that this would be detectable through
increased interest in certain careers being revealed in pre- and post-interviews. Exposure to scientists in this manner may increase the students' chances of surviving the long journey through the educational pipeline toward a science career.

Assumptions

All students were interviewed prior to the start of the study to determine the students' previous contact with scientists. The students' experiences with computers and their perceptions of their parents' attitudes towards computers were also investigated in the interviews. None of the students had used computers for communications purposes before. The scientists and non-scientists had varying levels of computer-mediated communication (CMC) experience. It was assumed that all of the students participating in the study would have sufficient typing and reading ability to send and receive E-mail messages. The scientists and non-scientists were expected to check their E-mail twice a week and respond to the students as soon as it was convenient for them.

Delimitations

1. This study was confined to students from one school and scientists and non-scientists from one research institute for reasons of convenience.
2. The SYMLOG content analysis was only done on selected student-scientist and student-non-scientist transcripts due to time limitations.

3. This research did not investigate the effect of computer-mediated communication on science achievement or attitudes towards science because the former will probably not be affected much due to the nature of the student-scientist interaction. Changes in the latter may not be measurable in the time span allotted to the study.

Limitations

The sample size of students was limited due to the lack of computer facilities in the school involved in the study. The number of scientists used in the study was also restricted by the number of Battelle research scientist volunteers who had daily convenient access to computers with E-mail capability. Another factor which restricted the numbers of participants was the need for detailed analysis of the student-scientist transcripts and the hard-disk space available on the computer.
CHAPTER II
REVIEW OF RELATED LITERATURE

Educational CMC Research

Anthony Kaye (1989, p. 3) has stated that "...CMC will ultimately emerge as a new educational paradigm..." CMC has been used for distance education at the British Open University; Athabasca University in Alberta, Canada; and Jutland Open University. According to Kaye, the traditional classroom has failed miserably in many cases, as described in the following passage:

The fact that, in most so-called civilized societies, we oblige children between the ages of 6 and 16 to spend six to eight hours a day in school classrooms and prosecute the parents of those children who try to escape, does not mean that the majority of people would choose a classroom as their preferred mode of learning! (Kaye, 1989, p. 21)

In a study of equity issues in the use of computers in education, Rosemary Sutton found that African-Americans had fewer computers at home than had Whites and that girls are underrepresented in all categories of computer use, except word processing (Sutton, 1989, p. 8). In addition, girls have been found to have less positive attitudes towards computers than boys (Chen, 1986; Collis, 1985; Levin & Gordon, 1989; Wilder, Mackie & Cooper, 1985), while increased experience
with computers has been shown to lead to improved attitudes (Loyd & Loyd, 1988).

Some schools are attempting to use CMC, computer-mediated communication. Chemistry students at the University of Hawaii’s University High School interviewed scientists using the Electronic Information Exchange System (EIES) network, computers, and a speakerphone (Edwards, 1984). Randy Allen of Gahanna Lincoln High School in Gahanna, Ohio, carried out a modem project with his students (Coburn, 1988). His students used various online services from Compuserve to design and conduct research projects.

The National Geographic Kids Network has been operating successfully across the United States (Julyan, 1989). The students participating in this program are from the fourth, fifth, and sixth grades. They have been exchanging data, comparing observations, testing hypotheses, and discussing their results with students in other parts of the country using telecommunications software (Julyan, 1989).

The Tippecanoe School System and IBM formed a partnership in 1987 to integrate technology into the local school system (Troutner, 1988). As part of this project, Chemistry I students at Harrison High School received help with their lab reports by being linked, using a modem, with chemistry teaching assistants at Purdue University.

The Earth Lab project was supported by the National Science Foundation and carried out by the Bank Street College
of Education and Apple Computer, Inc. (Brienne and Goldman, 1990). Students were provided with an electronic mail capability which was used to "...share and analyze their data, hypotheses, and results with team members, scientists and wider audiences; access the resources of science experts..." (Brienne and Goldman, 1990, p. 27).

An innovative tutoring program, (ACOT, Apple Classroom of Tomorrow), for at-risk, minority fifth and sixth grade students using computers, has yielded valuable information (Ross, Smith, Morrison, & Erickson, 1989). In this study it was found that girls used a bulletin board system (BBS) more frequently than did boys, one-third of the students very rarely logged on the bulletin board system, and 48% of the messages posted were social in nature (Ross et al., 1989). File transfer was found to be too difficult for the students and was not used. There were complaints from the tutors that the single phone line was often busy and that the 30 minutes time allocation per day was insufficient (Ross et al. 1989, p. 26).

In a subsequent study, Ross, Morrison, Smith, and Cleveland (1990) evaluated two different programs. In Program One, the students had access only to E-mail on a local BBS while in Program Two, synchronous teleconferencing and E-mail were available, along with access to a national network. Program Two received more positive evaluations by the students than did Program one (Ross et al., 1990). Ten out of 26
students did not post any messages during the 3 week periods sampled for analysis (Ross et al., 1990, p. 251). The biggest dissatisfaction expressed by the tutors was the lack of participation by some of the students. The tutors described the students as "elusive" and "unresponsive" (Ross et al., 1990, p. 257). Sixty percent of the tutors were undecided about whether they enjoyed the tutoring experience although the possible value of the program was definitely realized by the tutors and staff (Ross et al., 1990, p. 256-257). Again, one-third of the students became Heavy users of CMC while another one-third of the students used CMC very infrequently (Ross et al., 1990, p. 257).

Robin Mason (1990) obtained similar results at the Open University where one-third of the students used CMC frequently while another one-third used CMC very little. Mason (1990, p. 3) felt that the underparticipation by the students may have been due to the students retaining a "...passive view of learning..." whereas successful computer conferencing requires active participation on the part of the students. Gloria Kitabchi (1987) noted that there was no significant difference in school attendance among students who participated in APCOT, (the Apple Classroom of Tomorrow), although there were positive evaluations of the program by the parents and the students.

Margaret Riel (1983) used networking to link children in schools in Alaska and San Diego. The students used word
processors to write news stories which were then sent over the network to eventually create the students' own monthly newspaper, The Computer Chronicles.

Armando Arias Jr. and Beryl Bellman (1990) described BESTNET (Binational English and Spanish Telecommunications Network) a project which involved American and Mexican universities. It was found that the students experienced less social stigma when receiving anonymous CMC remedial tutoring (Arias & Bellman, 1990). Arias and Bellman (1990, p. 236) went on to state that, when CMC is being used the students "...do not have to perform what Goffman (1959) and others have called 'front work' in maintaining a social/public identity with those whom they daily interact." It was also noted that computer conferencing worked well for minority students because the students could proceed at their own pace and they were able to ask questions in private (Arias & Bellman, 1990). Other advantages which Arias and Bellman described were that physical handicaps were not visible during CC and that females became more assertive and were able to participate without being interrupted by males.

Ellen Bialo and Jay P. Sivin (1989) investigated the possibility of using computers to help at-risk children. Among other things, Bialo and Sivin (1989, p. 35) found that "...computers can provide a multi-sensory approach to learning..." and computers can be "...patient and non-judgmental..." and computers can provide "...academic
privacy..." and empower students. CMC between the student and teacher could be very important in dealing with negative peer pressure by allowing the students to "succeed privately" (Bialo & Sivin, p. 35).

David Reinking (1988) conducted a study comparing the reading comprehension by 5th and 6th graders of CMC text versus printed text. The students were divided into four groups:

1) printed pages
2) computer text with no options
3) computer text and able to select and change options
4) computer text and required to see all assistance options

It was found that there was no difference between reading comprehension or time taken to read text between computer text with no options or paper text (Reinking, 1988). However, when a computer text was accompanied by assistance which expanded the reader's alternatives and control over the computer, such as the ability to rephrase difficult passages, reading comprehension scores were found to be significantly higher than for those who read printed texts. The rate of reading from a CRT was slower than the reading rate of printed text. The highest reading comprehension scores were obtained by the group which was required to see all computer assistance options. Subjects who read only printed text scored higher on low difficulty passages (Reinking, 1988).
In an interesting study, Jim Dunn (1989) found that children overwhelmingly preferred to read text from a CRT screen and that those reading from the computer screen scored higher on a reading test than students who read from printed text.

A study of CMC in a high school was carried out by Liora Bresler (1990). The University of Illinois' computer network UIUCNET was used. Three types of CMC were available to the students. "Notefiles" were the equivalent of a BBS where notes were posted for all to read and respond to (Bresler, 1990, p. 133). "Pnotes (or personal notes)" were the equivalent of E-mail and allowed private letters to be sent (Bresler, 1990, p. 133). "Termtalk/talkomatic" allowed synchronous communication and is similar to the Chat mode on a BBS. Bresler (1990, p. 140), talked at length about what she termed the "mask effect." The students gave themselves unusual aliases and experimented with different identities. Bresler (1990, p. 147) stated that "For adolescents in particular, being able to legitimately experiment with roles and personalities within a group has an important developmental value." The students also created their own jargon. An example of this was a "derf" (Fred backwards). This was a term for a user who had borrowed someone else's identity (Bresler, 1990, p. 141). Bresler (1990, p. 142) also found gender differences in that the females seemed to be more cooperative, supportive and there was "...extensive use of
qualifiers...", less "...foul language..." and the girls used ellipses more often than boys. Salutations and closings were not usually used in the messages (Bresler, 1990). Bresler found that people who corrected other's mistakes too often were criticized by the community of users. Some errors were more likely to be forgiven than others. For example, typing errors were more forgivable than grammar errors or muddled writing (Bresler, 1990).

Margaret Riel, an advocate of the application of cooperative learning techniques to CMC, stated that "A crowd of people which only shares an opportunity to communicate is not a group; it lacks organization and shared purpose." (1990, p. 448). Riel has developed a technique which she terms "Learning Circles" based on Sharan's Group Investigation model (p. 450). According to Riel, (1990, p. 450), there are five stages in this technique:

1. "Forming the Learning Circle"
2. "Project planning"
3. "Accomplishing the task"
4. "Creating the publication"
5. "Sharing and evaluating the publication"

Riel (1990, p. 448) suggested the following metaphors for use in structuring an electronic learning circle: "electronic forums, computer conferences, special interest groups (SIGS), teachers' lounges, chats, and parties."
Fred S. Goldberg (1988) stated that there are three system models for telecommunications in the classroom. These are 1) direct microcomputer to microcomputer; 2) microcomputer to minicomputer or microcomputer to a BBS; or 3) microcomputer to a mainframe computer. He further described four models which can be used in telecommunications instruction: 1) study of the subject of telecommunications itself; 2) "computer-mediated dialogue;" 3) "User-supported libraries;" and 4) use "as a research tool" (Goldberg, 1988, p. 27). Goldberg found that the number one problem in implementing CMC in schools was obtaining a dedicated phone line.

The phone line problem also exists in Great Britain. Teachers feel a need to exert control and power over students and "Siting a telephone line in a classroom, and/or giving students access to it, is therefore contrary to accepted institutional norms" (Somekh, 1989, p. 244). Somekh (1989) found that teachers who lacked experience with telecommunications wished to use CMC privately after school hours so that their lack of proficiency did not cause them to lose face in front of their students.

Computer conferencing is characterized by informal discourse which some persons downgrade as being non-educational, trivial, or banal. David Graddol (1989) disagreed with this view. Graddol (1989, p. 237) described the traditional classroom setting in which a teacher has
"privileged speaking rights." The teacher is allowed to take a turn after each speaker while students are not given the same advantage. Graddol asserts that this is a very inefficient form of interaction. In Graddol's (1989, p. 237) view, off topic, informal talk can engender "adventitious learning." Graddol describes informal face-to-face discussions as being highly structured and thus allowing smooth changes of speakers to take place. When a person has completed her or his speech, signals are given out which cue the next speaker. Face-to-face discussions are also highly competitive while a teacher-led discussion is very asymmetric. In computer conferencing there are no interruptions or prevention of turn-taking and the skills required in face-to-face discussions are also rendered unnecessary (Graddol, 1989). Another difference is that in computer conferencing the current speaker does not usually choose the next speaker, in contrast to face-to-face encounters (Graddol, 1989). In face-to-face classroom discussions, multiple turns are unusual while in computer conferencing they are much more common (Graddol, 1989). In computer conferencing, because participants can take multiple turns, they can also manage more than one topic at a time, whereas in a face-to-face discussion one topic may dominate a discussion (Graddol, 1989). A very important result of this ability to simultaneously deal with multiple topics is that "...minority
interests can be represented within the mainstream community" (Graddol, 1989, p. 240).

James A. Levin, Haesun Kim, and Margaret M. Riel (1990) considered how to analyze CMC messages. Levin et al. used several techniques to analyze messages. "Intermessage reference analysis" was used to determine how many messages referred to previous messages (Levin et al., 1990, p. 192). It was found that the students' messages were referenced somewhat more than messages from adults and that most messages were not even referenced (Levin et al. 1990). A "cluster" was defined as a series of messages which were linked by references (Levin et al., 1990, p. 195) and cluster size, numbers, and their distribution were determined. Message maps were also constructed during data analysis. They also noted that some messages triggered a large number of messages and they wondered what the characteristics of those messages were.

Levin et al. (1990, p. 201) also used "Message Act Analysis," a technique developed by Mehan (cited in Levin et al. 1990), which classified instructional speech acts in "IRE sequences," (I=initiation by teacher; R=reply by students, and E=evaluation by teacher). It was found that there were very different patterns of interaction found between CMC and FTF interactions (Levin et al., 1990). In "Message Flow Analysis" the density of messages was plotted per unit time (Levin et al., 1990, p. 207). It was found that the frequency of
messages was much lower in the Fall, the beginning of the school year.

A model of interaction was proposed called a "teletask force" where a group of people with eclectic talents are brought together to work on a task (Levin et al., 1990, p. 211). Lave (cited in Levin et al., 1990, p. 211) stated that "Patterns that we've observed in instructional electronic network interaction resemble those described in face-to-face apprenticeships...teleapprenticeships."

A qualitative study of computer conferencing in adult education courses taken by high level-managers was carried out by Phillips and Pease, (1985). The major advantages of CC were found to be the open forums where straightforward communication can take place, new ideas can be proposed and new contacts made (Phillips & Pease, 1985). It was found that computer cliques formed and that a "fear of ostracism" developed in some users (Phillips & Pease, 1985, p. 13). Another problem is that because of the lack of feedback sometimes no one noticed or cared if an individual was on the system (Phillips & Pease, 1985). Phillips and Pease (1985, p. 19) described a possible obstacle which may inhibit research in CMC which they called "...the researcher as Secret Agent" and they wondered if the researcher should announce her or his presence when on-line.

Paul Levinson (1989) declared that education has been dominated by "in-person...place-based...book-paced..."
education. He feels that the devices we use in the classroom today were not chosen for their educational effectiveness but because they simply happened to be available (Levinson, 1989). According to Levinson (1989, p. 48)

> Computer-mediated communication and the advent of personal electronic interactivity in general, rank with the alphabet and the printing press as signal developments in cognitive media.

Linda Harasim (1990) has done extensive research comparing online education and face-to-face education. Harasim (1989) found that computer conferencing leads to students verbalizing their ideas, responding more often to their peer’s ideas, and produces an environment rich in information and where students acquire multiple perspectives. In face to face classrooms, sixty to eighty percent of the talk is by the teacher, (Dunkin & Biddle, 1974; McDonald & Elias, 1976), while in on-line education the students have been found to send the majority of the messages (Harasim, 1989, p. 55). On-line seminars were found to be very student-centered and eighty percent of the messages referenced each other (Harasim, 1989).

According to Harasim (1990, p. 43), there are five important attributes of online education:

(1) many-to-many communication
(2) place independence
(3) time independence
(4) text-based
(5) computer mediated interaction.

**Many to many communication.** Group work can lead to less anxiety, reduced uncertainty, increased "engagement in the
learning process", "conversation (verbalizing)", the use of "multiple perspectives (cognitive restructuring)", and "argument (conceptual conflict resolution)" (Harasim, 1990, p. 43-44). Durlin's and Schick's study (cited in Harasim, 1990) has stated that verbalizing to a peer is related to concept attainment. Harasim (1990, p. 44) also declared that "...the act of preparing to teach produces a more highly organized cognitive structure."

**Place-independence.** Learners are given access to entirely new communities through online education (Harasim, 1990).

**Time-independence.** Online classrooms are asynchronous, always open, allow "self-pacing, and self-directed learning" Harasim (1990, p. 46). A student in an online classroom does not need to wait on a slow speaker or ask a rapid speaker to repeat her or his words and shy or hesitant individuals are not interrupted (p. 46). A message can be reread at leisure, and one can reply immediately or wait and reflect or even check a reference before replying (p. 46). Topics can be discussed over long, extended periods of time in contrast to the limited time available in ordinary class periods (p. 46). The students can all take part as much as they wish in discussions. Harasim also stated that computer conferencing tends to inhibit one person taking over a group. The disadvantages of time-independence are "communication anxiety (the feeling of speaking into a vacuum)" when no response is
received quickly (Harasim, 1990, p. 47). Harasim (1990, p. 47) also mentions the "rolling present" which is a problem since one can never be sure if a topic is still current or out of date. Making decisions may also take an excessive amount of time (Harasim, 1990, p. 48).

**Text-based communication.** This is caused by the keyboard and screen mediating messages and it leads to a narrowing of the bandwidth of communication (Harasim, 1990, p. 48). Harasim (1990, p. 48) pointed out that there are "cognitive benefits" in that writing is more reflective than talking face-to-face. Vygotsky (cited in Harasim, 1990, p. 48) felt that "the process of articulating thoughts into written speech involves deliberate analytical action." Harasim also noted that a receiver concentrates on the content of a CMC message because of the narrow bandwidth. Text-based communication has a social "equalizing" effect, it reduces stereotyping and removes obstacles to equal participation (Harasim, 1990, p. 50).

The disadvantages of text-based communication are numerous. "...facial expressions, voice intonations and gestures are eliminated" (Harasim, 1990, p. 50). Jokes, irony, and sarcasm may be misinterpreted and many participants are unduly concerned about the appearance of their text (Harasim, 1990). Some users feel very vulnerable and inhibited since their messages may be stored somewhere
(Harasim, 1990). Text-based communication can also lead to information overload.

**Computer-mediated learning.** While books, radio, and TV encourage passive reception of information, CMC is interactive. Computer conferencing has an unusual characteristic in its "community memory" which is permanent and available to all (Harasim, 1990, p. 52). Persons also have more control over CMC interactions than face-to-face meetings. According to Harasim (1990, p. 54), "Active sharing and seeking of information and playing with ideas is central to on-line collaboration." Finally, Harasim claims that computer conferencing encourages divergent thinking.

Robin Mason (1990) described how computer conferencing has been used in distance education at the Open University in the United Kingdom. One thousand three hundred students used CoSy, (Conferencing System), and one-third were found to use it very frequently while one-third used the system very infrequently. Problems which were noted by Mason (1990, p. 3) were student passivity, technical glitches and that "The nature of the communication was often disappointedly banal..." The system operators and developers regularly found themselves "in the heat of the fire" when users demanded changes in software and the fixing of uncovered bugs. A large number of students were lurkers, users who only read messages and did not post messages, and Mason (1990, p. 7) felt that "The extent to which students retain a passive view of learning,
has obvious repercussions for the success of the conferencing medium." A computer conference called the Forum did not receive as much participation as was expected and the students gave the following reasons for not taking part: lack of time; volume of messages difficult to handle; large public audience; and too many out-of-date messages (Mason, 1989). Mason (1989) also found that using conferences was much more difficult for the students than using e-mail. Other problems which the students experienced were guilt about lurking and disappointment when there was an absence of new messages (Mason, 1989). Most of the students' difficulties were, in Mason's view, due to "the lack of a clear model on which to base their conception of how to participate." (1989, p. 137).

Kenichi Kubota (1991) attempted to apply the principles of collaborative learning to CMC. Kubota (1991, p. 3) believed that CAI (computer-aided instruction) was not sufficient to bring about real learning and that:

In social interaction in the ZPD, learners are able to participate in more advanced learning activity than they are capable of independently, and in doing so they practice skills that will be internalized to advance what learners can do independently

Streibel (cited in Kubota, 1991, p. 5) also criticized the traditional use of the computer in the classroom in which there are "...drill-and-practice and tutorial approaches in CAI which embody positivistic notions and regard learning as mere systematic, algorithmic processes." More importantly, Kubota (1991, p. 5) pointed out that "In traditional
instructional design, developers regard a computer as a substitute for the teacher. CAI courseware relegates the teachers to a managerial function..." Harasim (cited in Kubota, 1991, p. 6) emphasized that "...in the collaborative model, on the other hand, computers are used for social interaction."

**General research on CMC in fields other than education**

Starr Roxanne Hiltz and Murray Turoff in *The Network Nation: Human Communication via Computer* stated that "...networked computers will become the source of a special and new form of human community..." and that "...computerized conferencing ...will revolutionize not only communications, but social and intellectual life as well" (Lehrer, 1988, p. 47). They feel that computer communication holds great potential for applications in the field of education.

Exhaustive comparisons were made by Hiltz and Turoff (1978) between different modes of communication. In face-to-face communication information passes through many channels. This information can be classified into 1) audio- the words used, their arrangement, and vocalizations, and 2) visual- facial expression, clothes, general appearance, body movements, and psychophysiological responses (Hiltz & Turoff, 1978, p. 78).

During face-to-face communication "turn-yielding cues" are extremely important while in computer conferencing, (CC),
they are totally unnecessary (Hiltz & Turoff, 1978, p. 81). Hiltz and Turoff (1978, p. 81) also posited that one reason new computer conferencing (CC) users become discouraged was that they do not receive immediate answers to their messages, and that they are accustomed to another person instantly replying when the first speaker indicates that her or his turn was finished. Thus, in CC, a system must be worked out to cope with the absence of the non-verbal channel and turn-yielding cues. Hiltz and Turoff (1978, p. 87), stated that one can compensate for the narrow bandwidth of CC by including games and jokes; exerting leadership and asking for people's interests and biographies; and arranging telephone conversations, face-to-face meetings, and picture exchanges.

Hiltz and Turoff (1978, p. 87-88) also felt that CC may help to reduce the need for persons to work on keeping up what Goffman calls a "personal front." Hiltz and Turoff (1978, p. 87-88) described this by saying that "An adult has spent years learning to emit a complex set of cues in face-to-face situations, designed to present a certain impression or image to others." In CC the capability to emit cues is greatly reduced.

Hiltz and Turoff (1978) listed some possible reasons for a person's not responding during a CC discussion: 1) disinterest, 2) disagreement with the sender but not wanting to say so, 3) being away on a trip, 4) busy with something else, 5) ill, or 6) a broken down computer. To compensate
for this uncertainty, Hiltz and Turoff observed that norms developed where people would be expected to inform the user community if they were going to be away or otherwise unavailable to receive communication.

Anonymity and pen names were discussed next. Anonymity and pen names seem to indicate a "play form" of CC and are also used to avert embarrassment (Hiltz & Turoff, 1978, p. 94). Robert Bezilla (1977) cited in (Hiltz & Turoff, 1978, p. 95), claimed that anonymity can enhance objectivity, interaction and problem solving.

The authors feel that the "exchange theory" of George Homans (cited in Hiltz & Turoff, 1978, p. 104), explains addiction to computers. Exchange theory asserts that an individual will not take part in a behavior which does not yield a profit. A profit is defined as benefits minus the costs. In CC users receive back considerably more items than they have sent so this form of activity is certainly profitable in some sense. The reason that this is possible is that in CC a message can have multiple addresses and this is not possible for communications sent by mail or by telephone (Hiltz & Turoff, 1978). In addition, an experienced user can obtain even more communications even more quickly (Hiltz & Turoff, 1978).

The "inequality of participation" which characterizes face-to-face groups was discussed next (Hiltz & Turoff, 1978, p. 106). It has been found that there is a strong correlation
between being a leader and the amount of talking done. LVR, (latency of verbal response), as "measured by response time on sentence stub completion tasks," is the strongest predictor of participation in a face-to-face group discussion, and it is more important than IQ or personality type (Hiltz & Turoff, 1978, p. 107). The following excerpt summarizes the possible role of LVR in CC interactions:

Computerized conferencing as a mode of communication would pretty much suppress LVR as an operative variable, it is hypothesized, since all participants can be talking at once. Moreover, the relative verbosity of a person in written communication is much more likely to be resented than unconsciously deferred to. (Hiltz & Turoff, 1978, p. 107)

In addition, Hiltz and Turoff, (1978) stated that a dominant, high status person can persuade a group to accept an incorrect decision easier in a face-to-face situation than in CC. Hiltz and Turoff (1978, p. 111) described how to calculate the "Index of Inequality and Participation" and they found that there was more inequality in face-to-face group discussions than in CC. It was also noted that people made more of an effort to be friendly, socialized more and leave taking was more congenial in CC than in face-to-face meetings (Hiltz & Turoff, 1978, p. 111). CC was judged to be relatively poor at persuasion and settling disputes while very good at making someone’s acquaintance and establishing a friendship (Hiltz & Turoff, 1978, p. 120).

Five reasons for the failure of computer conferences were cited by Hiltz and Turoff (1978, pp. 122-123): 1) no easy
access to a computer or terminal; 2) no wish or need to use CC; 3) no appropriate instructional materials; 4) no clear direction and leadership, and 5) an absence of a "critical mass" of users, (between eight to twelve members per conference were recommended).

Hiltz and Turoff (1978, pp. 341-345) listed the following interesting phenomena which they observed during CC:
1) "The Fishbowl effect" in which a user feels that she or he is being watched;
2) "The Peephole effect" in which entry to a CC is similar to looking through a peephole into a huge ballroom and from which retrieval of messages and information overload become critical;
3) "The Bully effect" results from worry about cost and the rapid response of the computer. This can cause a user to believe that a quick reply is always necessary;
4) "The Concrete effect" occurs when a person believes that she or he must adapt to the computer and that the computer is expensive and cannot be changed;
5) "The Clutter effect" is caused by the provision of too much information;
6) "People Angst" is characterized by being afraid of asking other users for assistance in using the computer;
7) The "Rorschach Blot" afflicts a person who assumes that the computer is like something else they know and therefore "...what is easy for them is easy for the system...;"
8) "Dictating to the User" and "Commitment" to a design are two problems which are self-explanatory;

A study of electronic mail, E-mail, in organizational communication was carried out by Lee Sproull and Sara Kiesler (1986). Chesebro and Bonsall (1989, p. 98) have defined electronic mail as "...a generic term referring to a class of messages transmitted and distributed through any computerized system used as a kind of postal service." E-mail was defined by Sproull and Kiesler (1986, p. 1493) as "...moving text from one computer mailbox to another. "E-mail does not have a "...central location where the history of the communication can be reviewed..." and E-mail does not have a "...single numbering sequence..." (Newman, 1990, p. 100).

Sproull and Kiesler (1986) began their paper with the statement, "The boss is always last to know," and in education one might easily replace "Boss" with teacher, parent, or administrator (Sproull & Kiesler, 1986, p. 1492). An important finding was that E-mail leads to the flow of more information which would not have been communicated under other circumstances.

When the social context is strong, a person's behavior is usually focused on other persons and more controlled, while when the social context is weak a person's behavior is more self-centered and uncontrolled (Sproull & Kiesler, 1986). It was found that groups using E-mail made more extreme decisions than face-to-face groups (Sproull & Kiesler, 1986, p. 1497).
Another important finding was that people preferred E-mail over other forms of communication when sending messages to person of higher status and also for the sending of bad news (Sproull & Kiesler, 1986, p. 1507). It is possible that the use of E-mail might allow teachers to have access to information from children that they could not have obtained in any other way. In support of this conjecture, sixty-two percent of the messages analyzed in Sproull and Kiesler's study contained information which the recipients claimed they would have gotten by no other method (Sproull & Kiesler, 1986, p. 1509).

Paul Levinson (1990, p. 5) believes that CMC may help bring about the "...humanization of text and its transmission." Levinson (1990, p. 9) asserted that CMC has brought about the "liberation of text from paper..." and that CMC is the first major advance in media since the revolution brought about by the printing press in the 15th century.

Andrew Feenberg (1989) discussed the characteristics of CMC as a text-based medium of communication. According to Feenberg (1989), semiologists have found that during face-to-face conversation, complex collections of behavior, called phatic signs, function as rituals. Examples of these are "...standard codes for opening and closing conversation..." such as "Hey, how's it going" which signals a person's availability for conversation (Feenberg, 1989, p. 23). Feenberg also asserts that in CMC a response is usually
interpreted as success while silence is equated to failure. This lack of phatic signs, i.e., nods and reassuring smiles, can lead to uncertainty. Feenberg (1989) feels that this powerful need for a response is what causes criticism of lurkers.

CMC has some other very interesting properties. In CC, individuals can create new identities (Feenberg, 1989). According to Feenberg (1989, p. 24), in CMC, "...lonely individuals have the impression they fully command all the signals they emit, unlike risky face-to-face encounters where such control is difficult and uncertain." Feenberg contrasted the situations where in a face-to-face encounter the identity of a person is fixed beforehand while in CMC a person's identity is created during the interaction. CMC increases a person's control of their image by reducing the chance for embarrassment and as a result it increases the individual's personal freedom and individualism (Feenberg, 1989). An unusual advantage which CC possesses over other media is that there is a "...new variety of social memory..." where "...a group which exists through an exchange of written texts has the peculiar ability to recall and inspect its entire past" (Feenberg, 1989, p. 25).

Feenberg espouses a view of communication which regards communication as a game with set rules and moves to be made.

...playing at computer conferencing consists in making moves that keep others playing. The goal is to prolong the game and to avoid making the last move. This is why computer-conferencing favours open-ended comments which
invite a response, as opposed to closed and complete pronouncements. (Feenberg, 1989, p. 27)

Feenberg next discussed the role of the moderator of a computer conference. The moderator must perform as a "social host" and as "meeting chairperson" (Hiltz & Turoff, cited in Feenberg, 1989, p. 33). Feenberg described the role of the moderator as follows:

The moderator's most basic task is to choose at the outset a 'communication model' for the group... In the absence of visible cues, on-line moderators must make an explicit choice for the group they lead, reducing the strangeness of the medium by selecting a familiar system of roles and rules derived from everyday life. (Feenberg, 1989, p. 33-34)

The necessary contextualizing is accomplished by "performative utterances..." which "...are statements which bring about the very reality they describe" (Feenberg, 1989, p. 34). Thus, when a computer conference is opened, it must be explicitly stated that "This is a task force. .." or "This is a brainstorming session..." etc.

Another important function of the moderator is to encourage "meta-communication, i.e., communication about communication" (Feenberg, 1989, p. 34).

Whenever communication problems arise, participants must overcome their inhibitions and demand further explanation of unclear remarks, call attention to information overload, request clarification of emotional tone and intent, suggest changes in the rules of the conference and so on... Meta-comments concerning the content of the discussion are called 'weaving' comments. These summarize the state of the discussion, identifying its unifying themes and points of disagreement (Feenberg, 1989, p. 34-35).
A list of the moderator's functions according to Feenberg (1989, p. 35) is given below:

1. "Contextualizing functions"
   (a) "Opening discussion"
       - announce theme, identify shared experience, symbols
   (b) "Setting norms"
       - choose familiar communication model
       - describe conference rules of behavior
   (c) "Setting agenda"
       - determine order and flow of topics

2. "Monitoring functions"
   (a) "Recognition"
       - reassure, correct
   (b) "Prompting"
       - solicit comments

3. "Meta-functions"
   (a) "Meta-commenting"
       - correct problems
   (b) "Weaving"
       - summarize, identify unifying threads

The long-term goal is to get users to share the moderator functions (Feenberg, 1989).

Feenberg has a few last words about context.

...creating a purely electronic or virtual meeting place results in a loss of context. Contextualization is the weak link in computer conferences...The absence of tacit cues and coded objects strands participants in a
contextual void that may leave them speechless...the contextualisation of computer conferences must be carefully planned... (Feenberg, 1989, p. 36)

Feenberg stated that a face-to-face meeting is the most effective way of providing context, although mail and telephone can be substitutes.

Anonymity and the manipulation of context on a BBS was explored in a study by David Meyers (1987). A BBS was set up in New Orleans and the participants in the study were restricted to Heavy users of the BBS. Myers declared that the most important finding of this study was the extent to which the Heavy users of CMC orchestrated the communication context and invented their own personal BBS identities (Meyers, 1987, p. 254). He found that there were two levels of learning the context of a BBS. First, one needed to become proficient with the hardware and software, and second, the shared values and understood rules regulating communication within the BBS context needed to be identified (Meyers, 1987). Meyers (1987, p. 258) identified persons he termed "communication leaders," whose main characteristic was that they were very adroit at manipulating the BBS context in order to control the other users. There were two types of "communication leaders," those who used their knowledge of hardware and/or software to manipulate context and others who utilized "social context manipulations" to exert control (Meyers, 1987, p. 259-260).
Meyers (1987, p. 263) stated that the system expert regards the "computer as machine" while the social expert thinks of the "computer as community."

Tess Galati (1986) found that CMC produced changes in the way people write. CMC produced text tends to be produced more quickly and is more concise; sentence fragments and contractions are more common; there is less concern with "polish" and there is "more emphasis on clarity and persuasiveness" (Galati, 1986, p. 43).

A study of group processes in CMC was carried out by Jane Siegel, Vitaly Dubrovsky, Sara Kiesler, and Timothy W. McGuire (1986). According to Siegel et al. (1986), nonverbal cues from apparel, whereabouts, deportment, and eloquence impart individuating details about persons which focus attention and raise concern for them. A characteristic of the deindividuation, (the process by which individuals become faceless entities), which may result during CMC, is increased disregard of self and other persons which can lead to relatively uninhibited and uncontrolled behavior (Siegel et al., 1986). They also noted that CMC "...will reduce feelings of embarrassment, guilt, and empathy for others; produce less social comparison with others; as well as reduce fears of retribution or rejection" (Siegel et al., 1986, p. 161).

In a later investigation, Vitaly J. Dubrovsky, Sara Keisler and Beheruz N. Sethna (1991) examined the effects of status in CMC and face-to-face decision making groups,
something which they termed the "Equalization effect."
Barnlund and Harland (cited in Dubrovsky et al., 1991, p. 122) asserted that "People have more contact within social categories than across them." By removing visible signs of status, CMC may be able to break down barriers between social groups. Dubrovsky et al., (1991, p. 122) observed that "Bad news travels up the hierarchy more slowly than down." This certainly has implications for communication between teachers and their students and mentors and their mentees. CMC may be able to increase the flow of information up the status hierarchy. When group members note cues which indicate social status, they alter "...their targets of communication, the tone and content of their communications, and their social behavior to fit the imputed situation" (Dubrovsky et al., 1991, p. 122).

According to Dubrovsky et al. (1991, p. 123), in face-to-face meetings social context cues are strong and behavior is "...other-focused, differentiated, controlled." In contrast, during CMC, social context cues are weak and there is "...relatively self-centered, unregulated behavior" (Dubrovsky et al., 1991, p. 123). Dubrovsky et al. (1991, p. 124) identified two ways in which communication is deregulated by the absence of social cues: 1) "...reduced evaluation anxiety..." and 2) "...reduced feedback..." This can lead to positive results, i.e., formation of friendships, or negative consequences, i.e., flaming. Asch; Hoffman, (cited in
Dubrovsky et al. (1991, p. 133) found that the inequality of participation in face-to-face groups was 0.21 while in E-mail groups it was only 0.15.

CMC has also been found to reduce the effect of social pressure on an individual to agree with the judgments of the majority of a group (Smilowitz, Compton, & Flint, 1989). In a face-to-face encounter an individual is expected to be "on the ball" and to respond without hesitation while in CMC this is not necessary (Smilowitz et al., 1989, p. 319).

Elihu M. Gerson (1988) made the observation that it is easier to walk out of a computer conference than a face-to-face meeting. Some persons just do not participate in CMC and Keith Grint (1989, p. 191) found that this may have been due to the following factors: fear of public humiliation by "invisible others"; sensory overload or too much trivial information; software problems; reconstruction of statuses, i.e., users whose messages were considered trivial were ignored; and gender, i.e., it was assumed that technical messages were from males and male spouses were less tolerant of their wives using CMC than vice-versa.

The social uses of E-mail and computer conferencing on Confer (a conference facility) at the University of Massachusetts were explored by Laurel Hellerstein (1986). She found that there was a computing subculture "...invisible to those who do not regularly use the computer" (Hellerstein, 1986, p. 8). Active members of the subculture relied very
much on CMC for their social interactions (Hellerstein, 1986). Hellerstein (1986, p. 12-13) found that Heavy users utilized the computer several times or more per week for social purposes which was much different than the uses to which the Light users put CMC. Forty percent of Heavy users used CMC to send messages to friends while only twenty-six percent of Light users sent messages to friends (Hellerstein, 1986, p. 13). Five percent of Heavy users used CMC to get help with their homework while twenty-six percent of Light users used CMC for help with homework. Thirty percent of Heavy users used CMC to initiate friendships and only eleven percent of Light users used CMC to meet new friends (Hellerstein, 1986, p. 13).

Electronic emotion was the subject of a study by Ronald Rice and Gail Love (1987). Rice and Love used the duration of a communication and the frequency of messaging as indicators of CMC behavior. Approximately thirty percent of the total content of the messages was classified as socioemotional (Rice & Love, 1987, p. 99).

Electronic paralanguage was the subject of a dissertation by Janet F. Asteroff (1987). According to Asteroff (1987, p. 3), paralanguage is a way CMC users attempt "...to communicate more information than is available in written language." An important technique which Asteroff used was showing the transcripts of a participant’s mail to the participant during an interview and asking for the participant’s reasons for the
characteristics of the message. Asteroff used Bales’ categories with modifications suggested by Rice and Love and the sentence was used as the unit of analysis. She found 92/128 initiating messages and 36/128 replies to messages (Asteroff, 1987, p. 57). Some examples of electronic paralanguage given by Asteroff (1987, p. 122-129) are as follows:

1. "Vocal spellings" e.g. ru doing alright?
2. "Vocal segregates" e.g. "wham" "arghh" "*gak*"
3. "Manipulation of grammatical markers" e.g. ... ???
4. "Manipulation of Special Symbols"
   e.g. *#&<>!
       _word_ (substitute for underscore)
       @b[word] (substitute for boldface)
5. "Spatial Arrays"
   :-) "smiley face", Christmas trees etc.

This has been termed an "emoticon: n. a figure created with the symbols on a keyboard that is read with the head tilted to the left. Used to convey the spirit in which a line of text was typed." (Asteroff, 1987, p. 126)

The redundant properties of paralanguage in a face-to-face situation help to prevent misunderstandings and incorrect conclusions being drawn (Asteroff, 1987). Asteroff (1987) also noted that paralanguage can be understood better and easier than the language itself across different cultures.

Min-Sun Kim and Narayan S. Raja (1991) examined verbal aggression and self-disclosure on computer bulletin boards.
The authors investigated USENET which is a huge collection of newsgroups, read by over half a million readers around the world, with no central authority.

They found that there were some informal USENET rules such as

1) Do not forget the person on the receiving end of a message is human.
2) Think twice before posting personal information.
3) Be brief.
4) Use descriptive subject titles.
5) Use humor and sarcasm carefully. (Kim & Raja, 1991)

Andrew Feenberg and Beryl Bellman (1990) investigated social factors in CMC. They began by stating that groups "...have specific characteristics of their own which transcend the individual level..." (Feenberg & Bellman, 1990, p. 68). Feenberg and Bellman (1990) gave five criteria which should be followed in network design:

1) The systems, training and materials should be suited for the groups.
2) The software and systems should be suited for the groups.
3) Select the best conference architecture for the group’s purposes.
4) Provide leadership and moderation for the group.
5) Begin computer conferencing with a purpose and goals clear to all group members.

An advantage of CMC and CC is the ability to bypass human bottlenecks and red tape. Elaine McCreary (1989) stated that CMC has allowed hitherto unheard of connections to become established between people who would never have communicated with each other in any other way.

Lynn Davie (1989) listed the most common problems she observed in CMC. Connecting the modem to the computer and phone line and using the telecommunications software proved to be the most common dilemmas (Davie, 1989, p. 77). Another difficulty which was experienced was what Davie termed the "small window" problem and she suggested limiting text to two screens to avoid this (Davie, 1989, p. 78). Perplexing metaphors, flaming and emotions, difficulty in decision-making, fear of publishing, poor typing ability, and discontinuous transactions were other problems noted (Davie, 1989). The functions of a CMC facilitator according to Davie (1989) are listed below:

1) welcome each student
2) reinforce message attempts
3) reference prior notes
4) send many notes, comments on messages, suggest links, resources
5) model behavior
6) send short messages
Denis Newman (1990, p. 100) stated that "...the creation of a shared object is the basis of the computer-mediated conversation..." and that a BBS creates "...a single stream of discourse to which participants can refer." Newman (1990, p. 113-115) stated that a group needs a common purpose "...outside the network activities for which the network was instrumental..." and that a "...sense of community arises from the interactions by virtue of the shared common history..."

Elaine K. McCreary (1990) discussed behavioral models for CMC. McCreary (1990, p. 119) mentioned that "...if the participants are not getting what they want from the activity, they will leave." It is up to a moderator to make sure the group passes through the following four stages of conference development:

1. successful beginnings,
2. nurturing the introductory stages,
3. maintaining the mature conference, and
4. wrapping up the conference.

(McCreary, 1990, p. 121)

McCreary (1990, p. 122-123) described "Tuckman's Stages of Group Development" and asserted that they could be applied to computer conferencing. They are as follows:

Phase 1: "Forming" During this stage users test the limits of the BBS to determine acceptable behaviors. They also seek boundaries and attempt to ascertain the ground rules of the BBS.
Phase 2: "Storming" This stage is characterized by conflict, frustration, anxiety, infighting. Important issues polarize the group and there may be a leadership struggle.

Phase 3: "Norming" During this time there is development of cohesion and mutual support and a decline in the amount of conflict. A "team dialect" may develop and polarized issues are settled.

Phase 4: "Performing" This period is marked by positive interdependence and a "...unified group applying itself to the task." (McCreary, 1990, p. 123)

According to McCreary (1990, p. 124), disruptions are normal on a BBS and "The real challenge lies at the level of learning how to work and even how to 'be' together rather than simply to focus on getting the job done." McCreary (1990, p. 124) also emphasized that "...one of the moderator's principal functions is to see that Phase 2 gets a full airing." If the group does not move successfully through all of the phases it will not achieve the highest amount of synergy.

Some other interesting points are made by McCreary (1990, p. 125) in the following passage:

In face-to-face meetings larger than three persons, it is not possible to sit side by side with every other person in the group. In CMC, however, this is precisely what happens...Conference mode makes absolute proximity universal and unavoidable. This produces a contracted social space that does not allow for variable distance in accord with variable compatibility...
McCreary (1990, p. 129) made a final provocative statement on CMC which warned that "...we should not underestimate the consequence of shedding our distracting visual layer."

Chesebro and Bonsall (1989, p. 54) systematically compared the different aspects of humans and computers and also face-to-face (FTF) communication and CMC. An important point they made was that human behavior is context-dependent while a computer functions in a "context-free environment". When comparing FTF, (face-to-face communication), and CMC, (computer-mediated communication), Chesebro and Bonsall indicated that in FTF there is both verbal and nonverbal communication while in CMC there is no nonverbal channel. This is one reason why CMC is described as having a narrower "bandwidth" than FTF communication. Mehrabian (1981) maintained that nonverbal communication is responsible for 93% of the social meaning imparted in a FTF situation. According to Chesebro and Bonsall (1989, p. 59), computer users generated "...visual signs intended to simulate the non-verbal facial reactions, emotions, and vocalistic patterns that characterize face-to-face communication." Peter H. Lewis (1986) listed a few common signs:

- w) = I'm happy.
- :( = I'm sad.
- :S = I have mixed feelings.
- 8) = I'm wide awake.
- :O = I'm surprised.
(:O = I'm very surprised.
:P = Pffft! (Sticking out the tongue)
:9 = Yummy!
:/ = Hmmmm.
:V = I'm chatting.
B) = I'm wearing my shades.

However, FTF communication can still convey a much greater amount of information than CMC. Chesbro and Bonsall (1989, p. 59) mention that "vocal quality, pitch and tone are as important as the content or ideas or message itself." In CMC a person can include parenthetical asides indicating mood, feelings, etc., but this requires greater concentration and conscious effort, while in FTF this type of information is sent automatically. According to Chesbro and Bonsall feedback in FTF is synchronistic and is characterized by verbal turn-taking and a continuous flow of nonverbal cues while CMC has only asynchronous feedback. Chesbro and Bonsall (1989, p. 60) stated that CMC users do try to compensate by "...following a kind of computer etiquette..." where messages are sent in "...groups of 40 or so characters."

Chesbro and Bonsall (1989, p. 61) also stated that "In computer-mediated exchanges, a person exerts discretionary control over what and when sociological information is conveyed to others."

Chesbro and Bonsall (1989) pointed out that CMC and FTF communication differ in their use of time. Face-to-face
situations are always occurring in real time while the asynchronicity of CMC can be manipulated to the user's advantage. Preparations could be made before committing oneself to sending a message. A person could wait until she or he is in a better mood to read a message known to contain bad news. In CMC a letter can be read at one's own pace and over and over while FTF communication is fleeting and gone in an instant.

CMC has a distinct advantage over traditional CAI (computer-aided instruction). When a computer is used to communicate with a human, the user has more control over the computer and the computer does not directly affect the content of a computer message (Chesebro & Bonsall, 1989, p. 97). However, in CAI "...the user must implicitly agree to follow the leads provided by the computer...the computer program controls the structure and direction of the interaction" (Chesebro & Bonsall, 1989, p. 151). In addition "A dispassionate attitude typically characterizes the user's psychological state when he or she is only using the transmission function of a computer" (Chesebro & Bonsall, 1989, p. 97-98).

An important principle that John Naisbitt advocates is "High Tech/High Touch...every increase in the use of technology must be compensated for with an increase in the amount of social contact available to people" (Chesebro & Bonsall, 1989, p. 141).
The social consequences of the use of CMC were next examined by Chesebro and Bonsall. As a result of the use of CMC

The human environment is gradually becoming a solely symbolic world. The decision to preserve contacts with physical events, with other human beings, with the production goods, and with nature itself will be a human choice rather than a necessity. We suspect that these adjustments to the information society will be difficult to make. (Chesebro & Bonsall, 1989, p. 175)

Computer obsessions can occur and there are many different causes of this phenomenon. On the other hand, computer phobias are also experienced by some persons. The causes of computerphobia vary greatly from one person to another although a general "technophobia" is also usually associated with the phenomenon. There seems to be an association between computers and power and this may be the root of some people's fear of computers. An example is that some people may worry that computers may make their jobs obsolete or cause them to lose control over their lives (Chesebro & Bonsall, 1989, pp. 218-219).

A study on the etiology of computer phobia was conducted by Michelle M. Weil, Larry D. Rosen and Stuart E. Wugalter (1990). It was found that from 10% up to 40% of the population experiences some form of uneasiness to varying degrees while using computers (Weil, Rosen & Wugalter, 1990, p. 361). They also noted that increased experience with computers is not always sufficient to cure computer phobia (Weil, et al., 1990).
Weil et al. (1990) asserted that many common stereotypes about computerphobics have been proven false. The authors declared that

...this study suggests that early role modeling of technology by people who are not themselves comfortable with technology can be predictive of later technological discomfort. (Weil et al., 1990, p. 376)

Several ways to avoid the development of computerphobia in children have been suggested by Weil et al. (1990, p. 377), such as: making the use of the computer non-evaluative, allowing "free play," by children with computers and retraining teachers. There are positive social aspects of CMC such as "computer friendships" (Chesebro & Bonsall, 1989, p. 220). It has been reported that Heavy users of CMC use the medium mainly for social reasons and that many persons make new friends through CMC (Chesebro & Bonsall, 1989).

The right to use computers has now led some to make charges of "information discrimination" (Chesebro & Bonsall, 1989, p. 230). Senator Frank R. Lautenberg (cited in Perlez, 1983) stated that the schools of affluent areas had more computers than poor areas. He also declared that "In an age that demands computer literacy, a school without a computer is like a school without a library" (Perlez, 1983, p. B22). Chesebro and Bonsall also describe other ways in which "information discrimination" might operate:

Insofar as only middle- and upper- class homes are able to purchase personal computers, those in low-income families will lack an initial exposure to the computer. These economic differences could also be said to reinforce racial differences, thereby casting information
as an implicit form of racism...Information discrimination against women might also be alleged. Insofar as video games are designed to appeal to teenage boys, girls are discouraged from exposure to computers, and insofar as most word-processor operators are women, they are more susceptible than men to electronic sweatshop conditions, a form of "technosexism" in Leveen's (1983) view. (Chesebro & Bonsall, 1989, p. 231)

It seems that many projects involving electronic mail and computer communication have been carried out but no detailed analysis of the quality and nature of the communication between children and adult scientists has been performed. In order to justify the use of computer-mediated communication to bring African-American, at-risk students and females into contact with scientist role models, the effectiveness of these programs should be evaluated carefully.
CHAPTER III
METHOD AND PROCEDURES

Design

The population in this study consisted of middle-school students from an urban school. The students in this racially integrated school were mostly from lower socioeconomic classes, as evidenced by the fact that over ninety percent of the students received free lunches. The sample consisted of 20 student volunteers, half male and half female and half African-American and half White, and eight scientist volunteers and two non-scientist volunteers from the Battelle research institute. An action research approach, with the investigator being a participant observer, was followed. The students and Battellites were active participants in the project and their feedback was encouraged. A mixed methodology was used, and qualitative and quantitative measurements were taken. Characteristics of the participants, i.e., ethnic group, gender, the presence of a computer in the home, computer anxiety, typing speed and accuracy, amount and type of electronic paralanguage (EP) used, and percentage of socioemotional content were correlated with measures indicating the amount of CMC, i.e., number of messages, number of logons, total number of bytes sent. It was hypothesized
that these characteristics would vary between Heavy and Light users of CMC and that they may or may not vary with gender and ethnic group.

A System for the Multiple Level Observation of Groups (SYMLOG) was used to carry out a fine-grained, qualitative content analysis of samples of transcripts from the first quarter of the project, the middle half, and the final quarter, between the students and Battellites (Bales, 1988; Bales, 1979). The image, usually a sentence or clause, was the unit of analysis. All participants in the study rated all other participants on their perceived behavior and values, using SYMLOG rating forms. An attempt was made to use SYMLOG to monitor the interactions of the group over time. SYMLOG field diagrams were constructed, using a computer program supplied by Richard Polley, for all participants and examined in order to detect any patterns or trends. A questionnaire to assess the effectiveness of the project was completed by all participants at the end of the study.

Pre- and post- interviews were conducted with all students and the resulting information was used to detect any effects resulting from CMC, contact with the scientists and non-scientists, or both.

**Variables**

The independent variables consist of one within-subjects variable and three between-subjects variables. The first
independent variable is the number of access days to CMC by the students and scientists and non-scientists. The other three independent variables are the gender and ethnic groups of the students and the amount of use of CMC, i.e. Heavy vs. Light users of CMC. The dependent variables which were measured were computer anxiety, typing speed corrected for accuracy, number of logons, number of messages sent, total length of messages sent, and the amount of electronic paralanguage used.

Instrumentation

At the beginning of the study an interview was conducted with all the students to assess their prior exposure to scientist role models. The Computer Anxiety Scale Short Form, shown in Appendix J, was administered to all participants in the study (Campbell, 1986). Finally, a computer program, "Mavis Beacon Teaches Typing," was used to measure the typing speed corrected for accuracy of the students.

A short Pre FTF questionnaire, included in Appendix D, was administered to all participants before the first FTF meeting. The Field Adaptation II Adjective List Suitable for Populations Including Children (Polley, Hare and Stone, 1988, p. 348), shown in Table 2, was modified slightly and administered to all participants. The dimensions shown in Table 2 correspond to the various cells in Figure 2. SYMLOG
theory was also used to carry out a content analysis of samples of the message transcripts.

Table 2.

Field Adaptation II Adjective List Suitable for Populations Including Children

<table>
<thead>
<tr>
<th>Dimensions Tapped</th>
<th>Adjectives</th>
<th>Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>1. active</td>
<td>(rarely, sometimes, often)</td>
</tr>
<tr>
<td>UP</td>
<td>2. outgoing, comes over to say hello</td>
<td></td>
</tr>
<tr>
<td>UPF</td>
<td>3. gives helpful suggestions</td>
<td></td>
</tr>
<tr>
<td>UF</td>
<td>4. organizes activities, says what to do</td>
<td></td>
</tr>
<tr>
<td>UNF</td>
<td>5. tends to be bossy and disapproving</td>
<td></td>
</tr>
<tr>
<td>UN</td>
<td>6. gets angry</td>
<td></td>
</tr>
<tr>
<td>UNB</td>
<td>7. wants to show off</td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td>8. jokes around</td>
<td></td>
</tr>
<tr>
<td>UPB</td>
<td>9. helps others have a good time</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>10. friendly</td>
<td></td>
</tr>
<tr>
<td>PF</td>
<td>11. helps others when they work</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12. spends a lot of time on tasks or projects</td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td>13. finicky, not satisfied</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>14. unfriendly</td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>15. doesn't keep promises</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>16. play acts or makes believe, dramatizes</td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>17. fun to be with</td>
<td></td>
</tr>
<tr>
<td>DP</td>
<td>18. is appreciative, says thank you</td>
<td></td>
</tr>
<tr>
<td>DPF</td>
<td>19. respectful</td>
<td></td>
</tr>
<tr>
<td>DF</td>
<td>20. dutiful</td>
<td></td>
</tr>
<tr>
<td>DNF</td>
<td>21. acts overburdened, as if there is too much to do</td>
<td></td>
</tr>
<tr>
<td>DN</td>
<td>22. wants to be alone</td>
<td></td>
</tr>
<tr>
<td>DNB</td>
<td>23. acts hopeless, as if nothing will work out</td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td>24. acts shy</td>
<td></td>
</tr>
<tr>
<td>DPB</td>
<td>25. quietly happy, pleased</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>26. quiet</td>
<td></td>
</tr>
</tbody>
</table>

Treatments

The main treatment in this study was making computer-mediated communication with scientists or non-scientists available to middle school students.

Procedure

Results of a pilot study were shared and discussed with the Battellites who participated and various suggestions were implemented in the procedure.

The science and computer awareness teachers at an urban middle school in a large midwestern city, asked for student volunteers at the beginning of the Fall school term. Twenty students, half of them male and half of them female, and half of them African-American and half of them White were selected to participate in the study. Ten adult volunteers from Battelle also took part in the study. It was assumed that thirty participants would reach the "critical mass of users" necessary for successful computer conferencing to take place (Thomas, 1989). These students were required to have the consent forms which are shown in Appendix A signed by their parent/s or guardians. Letters which were given to all interested volunteers are also included in Appendix A.

A public relations officer from Battelle, an international, technical organization that serves industry and government by developing and managing technology, solicited volunteers through an announcement in a Battelle newsletter
asking for volunteers to use computer-mediated communication to interact with urban middle school students. An attempt was made to obtain half female and half male and half African-American and half White adult role models but most of the Battelle volunteers were white males.
The project agenda which was presented to all participants is shown in Figure 3.

First week - Volunteers recruited.

Second week - Meeting with Battellites; Student interviews; CAS-SF administered; typing speed measured; EBO booklet given to all participants.

Third week - Student and Battellite hours decided upon; initial logons by students and Battellites; All participants enter autobiography; Exploration of EBO.

Fourth week - BBS name contest announced; All participants generate problem lists; Lists prioritized and combined by sysop.

Fifth week - Combined list presented. All participants come with possible solutions.

Sixth week - Continued listing of solutions; Weaving of final product by sysop.

Seventh week - Publication of newsletter; Visit to Battelle.

Eighth week - New problem list; Repeat procedure.

Ninth week - Solutions. Visit to School.

Tenth week - Solutions.

Eleventh week - Publication of newsletter; Visit to Battelle.

Twelfth week - SYMLOG ratings completed by students and Battellites; Questionnaires completed; Post-study interviews with students.

Figure 3. Agenda for the CMC and FTF interactions between the students and Battellites.

The computer anxiety instrument was administered to the students and Battellites. Next, all students were interviewed using the pre-study interview protocol shown in Appendix B.
The pretesting and interviewing period took one week. After the computer anxiety instrument was administered to all the students, all participants were given a booklet describing the use of the BBS. Information on the nature of CMC and on meta-communications skills and strategies to overcome limitations known to characterize CMC was also included.

The electronic bulletin board used in this study was the RBBS-PC version 17.3C. The BBS used in the pilot study was obtained from Bowen and Peyton's (1988) *The Complete Electronic Bulletin Board Starter Kit*. The BBS utilized a metaphor in an attempt to provide a more familiar context for the participants. A printed map was posted on a bulletin board in the students' computer room. The map illustrated the following areas on the BBS:

**The Mall**— This was the area of the BBS where public messages on miscellaneous non-science topics, and personal, private, or purely social messages could be posted.

**The Gym**— This was a conference dealing with sports and science.

**Mickey D's**— This conference dealt with food and science.

**The Club**— Music, the arts and science were discussed here.

**The Forum**— This was where the brainstorming on world problems was conducted. The results of the discussion in the Forum were published in a newsletter.
Main- This was where the user first entered the BBS. Information and questions about the BBS, computers and miscellaneous science topics were found in this area.

A contest was held in which all participants submitted three possible names for the newsletter. A $10.00 prize was awarded to the person who supplied the winning name, "WzUp?". Macros were utilized to provide quick and easy access to the conferences. Each macro consisted of a series of commands which enabled direct entry to a conference. These were executed when the students entered the name of a conference.

Periods three and four of the school day were devoted to eighth grade computer awareness class. This was when the students logged on to the BBS. During weeks one and two, approximately four to six students managed to logon per day. As the students gained proficiency with the BBS, approximately eight students were able to logon per day. In addition, any students who wished could use the computer during their lunch period. The time period from approximately 9:30 am until 1:30 pm was reserved for student use. The Battelle participants were able to access the BBS from 1:30 pm until 9:30 am the morning of the next day, excluding three one-hour offline maintenance periods. The Battellites were informed that more extensive hours could be provided if necessary. After the first month, the BBS was up and running twenty-four hours a day, seven days a week.
The BBS hours for the first four weeks are shown in Figure 4.

<table>
<thead>
<tr>
<th></th>
<th>Online</th>
<th>Offline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday through Friday</td>
<td>12am to 7am</td>
<td>7am to 8am</td>
</tr>
<tr>
<td></td>
<td>8am to 5pm</td>
<td>5pm to 6pm</td>
</tr>
<tr>
<td></td>
<td>6pm to 11pm</td>
<td>11pm to 12pm</td>
</tr>
<tr>
<td>Saturday</td>
<td>12pm to 4pm</td>
<td>4pm to 12pm</td>
</tr>
<tr>
<td>Sunday</td>
<td>12pm to 4pm</td>
<td>4pm to 8am</td>
</tr>
</tbody>
</table>

Figure 4. Hours of operation of the BBS.

During week two the investigator personally instructed each student in how to log on to the BBS, enter and edit and read messages. All participants in this study chose and used aliases to provide anonymity. Any adults who had problems were able to consult over the phone with the sysop.

During week two all participants were asked to enter a message under their chosen alias introducing themselves and a short autobiography containing details about hobbies and areas of interest. The adults were also asked to provide information on their careers, such as educational requirements and the nature of their jobs. During this time participants were requested to explore the BBS, leave and read messages and join conferences.

A modified Learning Circle approach after Riel (1990) was followed, although there was only one all-inclusive learning circle. The first two stages, forming the circle and project
planning were carried out in advance by the sysop. The last three phases, accomplishing the task, creating the publication, and evaluating the publication involved all of the BBS participants.

At the beginning of week three, bulletins concerning the major theme and purpose of the board, and a contest to choose the name for the BBS were displayed to all participants. The main purpose of the BBS was to identify problems in our world which might be alleviated or solved by science. These problems could be on a micro or macro level. They could be personal, social, environmental, school, city, state, country, or world-wide problems. In the Forum, each participant was asked to generate a list of possible problems for the group to focus on. According to Goldberg (1988, p. 29) in CMC "...research topics with open-ended objectives were more successful than narrowly defined projects," so closed, convergent questions were avoided. The sysop then combined and prioritized all the lists. During the first cycle of the learning circle the three most chosen topics were selected for further discussion. The second cycle used the next three most common choices. Once the problems were selected, each participant again generated a list of ways in which science could be applied to them. These lists were again combined and prioritized by the sysop and presented to the group for comments. The end-product was woven together into an article
for the newsletter with students and Battellites as co-authors.

At the same time, any participants who wished, could join any of the other conferences. Other communication was also encouraged, such as asking for help with homework, advice, talk about careers, or just friendly conversation. Bulletins were used to provide important information to all participants.

A face-to-face meeting at the Battelle Institute between all participants was organized for the fifth week of the study and again after the tenth week. Prior to the first meeting a short Pre FTF questionnaire, which can be found in Appendix D, was administered to all participants. Visits by the Battellites to the school after the fifth week were also encouraged. No face-to-face meetings were held until the participants had formed their initial social bonds and relationships without the distracting cues which indicate ethnic group, gender, age, and status. This strategy was confirmed by the Battellites in the pilot study who said that they thought it better to have the face-to-face (FTF) meeting after some time had elapsed and everyone had got to know one another electronically first.

At the end of the tenth week, all students filled out forms rating their perceptions of the values and behaviors of the Battellites and each other. The Battellites also used similar forms to rate all of the students' and other
Battellites' behaviors and values as perceived from their reading of the students' messages. All participants also completed a questionnaire evaluating the success of the program. The post-study questionnaire is shown in the Appendix F. The students' typing speed corrected for accuracy was measured at the end of the project.

A content analysis of samples of message transcripts over time was carried out using SYMLOG. The unit of analysis was the image, which was usually a sentence or clause.

A post-study interview, included in Appendix I, was carried out with all of the students.

Data Collection

Qualitative data were obtained directly from printed transcripts of communications between students and Battellites. The computer anxiety and typing speed of all participants were measured before the study began. All participants were interviewed prior to day one of the study. At the end of the study all participants used SYMLOG rating forms to rate the general behavior of all other participants. In addition, all of the students were interviewed and all of the participants completed a questionnaire evaluating the project.
Data Analysis

A content analysis was carried out on all pre- and post­-interview data. A content analysis of the transcripts of samples of messages over time was carried out using SYMLOG Interaction Scoring of all images presented or behaviors displayed in the messages using the sentence or clause as the unit of analysis. All participants and the investigator rated the behaviors and values of all other participants. Field diagrams were constructed for all participants.

An additional content analysis of message type, content and tone was carried out with the message as the unit of analysis. Correlations were made between characteristics of the participants and their messages and indicators of CMC use such as number of messages sent, number of logons, and total bytes entered. In addition, a trend analysis based on visual inspection of graphs, was conducted to determine whether the dependent variables (data derived from the content analysis of samples of messages) changed over time.

The Statistical Package for the Social Sciences, SPSS, was used to provide descriptive statistics of the post-study questionnaire results. These were examined for any relationships with the dependent variables. Message maps were also constructed to reveal the communication patterns which formed during the course of the study.
CHAPTER IV
RESULTS

At the beginning of this study, the sample consisted of twenty students and ten Battellites. During the course of the project, four students moved and were immediately replaced. Eventually only 18 students participated until the very end of the project. Out of the initial ten Battellites recruited, seven were fully active for the entire study.

Pre-Study Interviews with the Students

Graphs displaying the categories of responses from the students are included in Appendix C. The most popular hobby, chosen by fourteen students, was playing sports, while Nintendo was the most popular game. About half of the students felt that their parents liked science while the others did not know. Twelve of the students claimed to have never met a scientist. Fifteen students had visited the Center for Ohio Science and Industry (COSI). Most of the students only had vague ideas of what the work of a scientist entails. Twelve students stated that science was fun or interesting while five students had negative opinions about science, such as that science is for nerds, is confusing, is hard work, or is not interesting.
Six students asserted that they had a computer at home and Figure 40 in Appendix C displays the different types of computers found in the students' homes. When asked why they liked computers, seven students stated that computers were fun to use, while six students liked using computers for word processing, and four students enjoyed playing computer games. Eleven students stated that both of their parents liked computers. Very few of the students felt that their parents disliked computers.

**Computer Usage by the Battellites and Students**

Table 3 lists the Battellites, their occupations and their amount of CMC usage while Table 4 contains similar information for the students. The students who ranked in the top and lower thirds of users according to the number of messages sent or number of logons were classified as Heavy or Light users as shown in Table 5. The number of messages sent took the top priority over the number of logons in the classification of a user as Heavy or Light. Equal numbers of male and females were classified as Heavy and Light users of CMC. There was, however, a difference in ethnic groups, with the Heavy users being composed of mostly White students while the Light users contained more African-American students.
Table 3. **List of Battelites’ Gender, Ethnic groups, Amount of Usage of CMC and Occupations.**

<table>
<thead>
<tr>
<th>User</th>
<th>Gender</th>
<th>Ethnic group</th>
<th># of msgs</th>
<th>Total bytes</th>
<th># of logons</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASE</td>
<td>M</td>
<td>W</td>
<td>1</td>
<td>277</td>
<td>1</td>
<td>Not known</td>
</tr>
<tr>
<td>AUL</td>
<td>F</td>
<td>W</td>
<td>52</td>
<td>32324</td>
<td>21</td>
<td>Research chemist</td>
</tr>
<tr>
<td>DAB</td>
<td>M</td>
<td>W</td>
<td>41</td>
<td>28262</td>
<td>16</td>
<td>Acoustics engineer</td>
</tr>
<tr>
<td>JEP</td>
<td>M</td>
<td>W</td>
<td>115</td>
<td>78334</td>
<td>23</td>
<td>Mechanical engineer</td>
</tr>
<tr>
<td>MRS</td>
<td>M</td>
<td>W</td>
<td>52</td>
<td>48470</td>
<td>30</td>
<td>Computer scientist</td>
</tr>
<tr>
<td>POP</td>
<td>M</td>
<td>W</td>
<td>3</td>
<td>1627</td>
<td>3</td>
<td>Toxicologist</td>
</tr>
<tr>
<td>SCF</td>
<td>M</td>
<td>W</td>
<td>34</td>
<td>27393</td>
<td>17</td>
<td>Technical secretary polymer chemistry</td>
</tr>
<tr>
<td>SNB</td>
<td>F</td>
<td>W</td>
<td>11</td>
<td>9053</td>
<td>6</td>
<td>Computer use consultant</td>
</tr>
<tr>
<td>TIM</td>
<td>M</td>
<td>W</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Not known</td>
</tr>
<tr>
<td>THM</td>
<td>M</td>
<td>W</td>
<td>67</td>
<td>36107</td>
<td>28</td>
<td>Toxicologist</td>
</tr>
</tbody>
</table>

M=male  
W=White  
F=female
Table 4. List of the Students’ Gender, Ethnic Groups and Amount of Usage of CMC.

<table>
<thead>
<tr>
<th>User</th>
<th>Gender</th>
<th>Ethnic group</th>
<th># of TUs</th>
<th>Total bytes</th>
<th># of logons</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANM</td>
<td>F</td>
<td>W</td>
<td>13</td>
<td>3893</td>
<td>9</td>
</tr>
<tr>
<td>BOT</td>
<td>M</td>
<td>W</td>
<td>15</td>
<td>32324</td>
<td>21</td>
</tr>
<tr>
<td>DAM</td>
<td>M</td>
<td>B</td>
<td>14</td>
<td>5198</td>
<td>12</td>
</tr>
<tr>
<td>DOK</td>
<td>F</td>
<td>W</td>
<td>25</td>
<td>16685</td>
<td>15</td>
</tr>
<tr>
<td>EDW</td>
<td>M</td>
<td>W</td>
<td>21</td>
<td>8740</td>
<td>21</td>
</tr>
<tr>
<td>ENV</td>
<td>F</td>
<td>B</td>
<td>14</td>
<td>5846</td>
<td>9</td>
</tr>
<tr>
<td>FRJ</td>
<td>M</td>
<td>B</td>
<td>11</td>
<td>2662</td>
<td>9</td>
</tr>
<tr>
<td>JAA</td>
<td>F</td>
<td>W</td>
<td>14</td>
<td>7092</td>
<td>12</td>
</tr>
<tr>
<td>JAJ</td>
<td>F</td>
<td>B</td>
<td>12</td>
<td>3586</td>
<td>10</td>
</tr>
<tr>
<td>KOK</td>
<td>F</td>
<td>W</td>
<td>18</td>
<td>10812</td>
<td>13</td>
</tr>
<tr>
<td>LEM</td>
<td>M</td>
<td>A</td>
<td>11</td>
<td>4935</td>
<td>11</td>
</tr>
<tr>
<td>LIR</td>
<td>F</td>
<td>W</td>
<td>11</td>
<td>6620</td>
<td>6</td>
</tr>
<tr>
<td>LOH</td>
<td>M</td>
<td>W</td>
<td>48</td>
<td>28351</td>
<td>36</td>
</tr>
<tr>
<td>MAX</td>
<td>F</td>
<td>B</td>
<td>11</td>
<td>4434</td>
<td>8</td>
</tr>
<tr>
<td>MIM</td>
<td>F</td>
<td>B</td>
<td>19</td>
<td>7189</td>
<td>14</td>
</tr>
<tr>
<td>MIR</td>
<td>M</td>
<td>W</td>
<td>47</td>
<td>16666</td>
<td>27</td>
</tr>
<tr>
<td>MRL</td>
<td>M</td>
<td>B</td>
<td>6</td>
<td>3009</td>
<td>6</td>
</tr>
<tr>
<td>TIH</td>
<td>M</td>
<td>B</td>
<td>14</td>
<td>4069</td>
<td>9</td>
</tr>
</tbody>
</table>

M= Male  B= Black  
F= Female W= White  
A= Asian
Table 5. **Classification of Students as Heavy and Light Users of CMC.**

<table>
<thead>
<tr>
<th>User</th>
<th>Gender</th>
<th>Ethnic group</th>
<th>Type of user</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOH</td>
<td>M</td>
<td>W</td>
<td>Heavy</td>
</tr>
<tr>
<td>MIR</td>
<td>M</td>
<td>W</td>
<td>Heavy</td>
</tr>
<tr>
<td>DOK</td>
<td>F</td>
<td>W</td>
<td>Heavy</td>
</tr>
<tr>
<td>EDW</td>
<td>M</td>
<td>W</td>
<td>Heavy</td>
</tr>
<tr>
<td>MIM</td>
<td>F</td>
<td>B</td>
<td>Heavy</td>
</tr>
<tr>
<td>KOK</td>
<td>F</td>
<td>W</td>
<td>Heavy</td>
</tr>
<tr>
<td>MRL</td>
<td>M</td>
<td>B</td>
<td>Light</td>
</tr>
<tr>
<td>FRJ</td>
<td>M</td>
<td>B</td>
<td>Light</td>
</tr>
<tr>
<td>MAX</td>
<td>F</td>
<td>B</td>
<td>Light</td>
</tr>
<tr>
<td>LEM</td>
<td>M</td>
<td>A</td>
<td>Light</td>
</tr>
<tr>
<td>LIR</td>
<td>F</td>
<td>W</td>
<td>Light</td>
</tr>
<tr>
<td>JAJ</td>
<td>F</td>
<td>B</td>
<td>Light</td>
</tr>
</tbody>
</table>

M=male  W=White  
F=female  B=Black  A=Asian

**Distribution of Messages in Conferences**

The distribution of messages among the different conferences for students and Battellites is shown in Tables 6 and 7, respectively. For both students and Battellites the Mall contained the most messages, followed by Main, the Forum and then the Gym. The number of messages left in the Club and MickeyDs was very small and thus of little significance.
Table 6. **Number of Messages in Conferences for All Students.**

<table>
<thead>
<tr>
<th>User</th>
<th>Mail</th>
<th>Main</th>
<th>Forum</th>
<th>Gym</th>
<th>Club</th>
<th>MickeyD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANM</td>
<td>10</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>BOT</td>
<td>5</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>DAM</td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>DOK</td>
<td>19</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>EDW</td>
<td>9</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>ENV</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>FRJ</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>JAA</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>JAJ</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>KOK</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>LEM</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>LIR</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>LOH</td>
<td>19</td>
<td>4</td>
<td>9</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>48</td>
</tr>
<tr>
<td>MAX</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>MIM</td>
<td>13</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>MIR</td>
<td>23</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>47</td>
</tr>
<tr>
<td>MRL</td>
<td>5</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>TIH</td>
<td>11</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>FAR*</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>JOC*</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>MOD*</td>
<td>15</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>ULW*</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

Totals 200 50 69 30 3 7 359

* = Students who dropped out of the program
Table 7. **Number of Messages in Conferences for All Battellites.**

<table>
<thead>
<tr>
<th>User</th>
<th>Mall</th>
<th>Main</th>
<th>Forum</th>
<th>Gym</th>
<th>Club</th>
<th>MickeyD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUL</td>
<td>32</td>
<td>12</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>52</td>
</tr>
<tr>
<td>DAB</td>
<td>18</td>
<td>8</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>JEP</td>
<td>68</td>
<td>27</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>115</td>
</tr>
<tr>
<td>MRS</td>
<td>19</td>
<td>23</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>52</td>
</tr>
<tr>
<td>SCF</td>
<td>18</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>34</td>
</tr>
<tr>
<td>SNB</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>THM</td>
<td>29</td>
<td>8</td>
<td>20</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>67</td>
</tr>
<tr>
<td>ASE*</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>POP*</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>SYS</td>
<td>34</td>
<td>109</td>
<td>18</td>
<td>9</td>
<td>2</td>
<td>4</td>
<td>176</td>
</tr>
<tr>
<td>Totals</td>
<td>227</td>
<td>205</td>
<td>74</td>
<td>26</td>
<td>3</td>
<td>17</td>
<td>552</td>
</tr>
</tbody>
</table>

* = Battellites who dropped out of study
SYS = sysop
Relationship Between User Type and Total EP, Computer Anxiety and Typing Speed

The results of one-way Anovas investigating whether the dependent variables: total electronic paralanguage, computer anxiety, and typing speed varied in relation to CMC user types, Heavy and Light, are shown in Tables 8 and 9. Inspection of the cell means shows that Heavy users apparently used more EP, had lower computer anxiety scores and faster typing speeds. There was however, only one slightly significant F of 3.95 at p < .075 for total electronic paralanguage by CMC user types.

Table 8. Means and Standard Deviations of Total Electronic Paralanguage, Computer Anxiety, and Typing Speed by CMC User Type.

<table>
<thead>
<tr>
<th>User Type</th>
<th>Total EP</th>
<th>Computer Anxiety</th>
<th>Typing Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Means</td>
<td>SDs</td>
<td>Means</td>
</tr>
<tr>
<td>Heavy</td>
<td>22.33</td>
<td>22.06</td>
<td>35.67</td>
</tr>
<tr>
<td>Light</td>
<td>4.17</td>
<td>3.87</td>
<td>41.33</td>
</tr>
<tr>
<td>Overall</td>
<td>13.25</td>
<td>17.83</td>
<td>38.50</td>
</tr>
</tbody>
</table>
Table 9. **One-Way ANOVAs on Total Electronic Paralanguage, Computer Anxiety, and Typing Speed by CMC User Type (Heavy vs. Light)**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Total EP MS</th>
<th>F</th>
<th>p</th>
<th>Computer Anxiety MS</th>
<th>F</th>
<th>p</th>
<th>Typing Speed MS</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Type</td>
<td>1</td>
<td>990.08</td>
<td>3.95</td>
<td>.075</td>
<td>96.33</td>
<td>.63</td>
<td>.45</td>
<td>24.08</td>
<td>1.82</td>
<td>.21</td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td>250.82</td>
<td></td>
<td></td>
<td>152.47</td>
<td></td>
<td></td>
<td>13.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pearson correlations between amount of CMC usage by all students and the dependent variables: total EP, computer anxiety, and typing speed were calculated, and these are displayed in Table 10. Significant correlations were found between total EP and the number of messages sent and the number of logons per student. However, it is very possible that the significance of the correlations was a result of an artifact whereby an increase in these measures was to be expected with an increased number of messages sent.

Table 10. Correlations Between Number of Messages, Logons, Amount of Bytes and Total Electronic Paralanguage, Computer Anxiety and Typing Speed.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of Messages</th>
<th>Number of Logons</th>
<th>Amount of Bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p value</td>
<td>r</td>
</tr>
<tr>
<td>Total EP</td>
<td>.70</td>
<td>.001</td>
<td>.79</td>
</tr>
<tr>
<td>Computer anxiety</td>
<td>.11</td>
<td>.675</td>
<td>.06</td>
</tr>
<tr>
<td>Typing speed</td>
<td>.11</td>
<td>.674</td>
<td>.21</td>
</tr>
</tbody>
</table>

n=18
Relationship Between Gender, Ethnic Group and Amount of CMC Usage, Total EP, Computer Anxiety, Typing Speed and Computer in the Home.

Table 11 summarizes the results of Spearman correlations between gender and ethnic group and amount of CMC usage, total EP, computer anxiety, typing speed, and whether the student reported having a computer at home. No highly significant correlations were found. Slightly significant correlations were found between the following: gender and computer anxiety with females having less computer anxiety; ethnic group and number of messages, number of logons, and total EP with African-Americans having lower CMC usage and less total EP than White students.
Table 11. Correlations Between Gender and Ethnic Group and Number of Messages, Total Amount of Bytes, Number of Logons, Total Electronic Paralanguage, Typing Speed and Computer in the Home.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Gender</th>
<th>Ethnic Group</th>
<th>Computer in Home</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r$</td>
<td>$p$ value</td>
<td>$r$</td>
</tr>
<tr>
<td>Number of Messages</td>
<td>-.17</td>
<td>.257</td>
<td>-.52</td>
</tr>
<tr>
<td>Bytes</td>
<td>.05</td>
<td>.427</td>
<td>.05</td>
</tr>
<tr>
<td>Number of Logons</td>
<td>-.29</td>
<td>.129</td>
<td>-.57</td>
</tr>
<tr>
<td>Total EP</td>
<td>-.01</td>
<td>.472</td>
<td>-.60</td>
</tr>
<tr>
<td>Computer Anxiety</td>
<td>-.47</td>
<td>.028</td>
<td>-.50</td>
</tr>
<tr>
<td>Typing Speed</td>
<td>.17</td>
<td>.258</td>
<td>-.40</td>
</tr>
<tr>
<td>Computer in the home</td>
<td>-.04</td>
<td>.434</td>
<td>-.20</td>
</tr>
</tbody>
</table>

$n=17$

The following values were used in the calculation of the Spearman correlation coefficients:

Male =1  White=1  No Computer in Home=1
Female=2  Black=2  Computer in Home =2
Results of a Content Analysis with the Message as the Unit of Analysis

The results of the content analysis of all 911 messages, with the message as the unit of analysis, are illustrated in Figures 5 to 16. The units on the horizontal axis of the graphs represent virtual days i.e., days on which messages were posted. In the Main conference, as shown in Figure 5, positive messages increased sharply during the first half of the study and then decreased, with a smaller increase near the end of the project. The numbers of neutral and negative messages remained far less in number than positive messages.

In Figure 6 it can be seen that non-science messages were more numerous than science messages in Main, with a sharp initial increase followed by a decrease and finally a slight increase. Figure 7 shows that managerial and person-to-person messages followed the same pattern mentioned previously. The numbers of personal problem and career messages increased slightly but were present in very small numbers.
Figure 5. Message tone over time in the Main conference
Figure 6. Message content over time in the Main conference.
Figure 7. Message type over time in the Main conference
Message tone in the Mall, Figure 8, exhibited different patterns from that in Main. Positive messages tended to increase and were the most numerous. The number of neutral messages decreased over time while the number of negative messages tended to increase with time. Again, in Figure 9, nonscience messages were more common than science messages in the Mall. In Figure 10 it can be seen that person-to-person messages were much more numerous than the other four message types in the Mall. Personal problem and career messages were present in larger numbers in the Mall than in Main.
Figure 8. Message tone over time in the Mall conference
Figure 9. Message content over time in the Mall conference
Figure 10. Message type over time in the Mall conference
The pattern of message numbers according to message tone was much different in the Forum as compared to the Mall and Main. In Figure 11, negative messages were the most common while neutral messages were the least abundant. The majority of these messages were classified as negative when they contained mention of a problem which has negative implications. For example, a message mentioning world hunger would be classified as negative. The number of science messages was much greater than nonscience messages in the Forum, Figure 12, except for a short period midway through the study where the numbers of science and nonscience messages were about equal. Figure 13 shows that there were no career or personal problem messages found in the Forum and very few managerial messages. Most of the messages in the Forum were person-to-person messages in the first half of the project, while one-to-many messages dominated the second half.
Figure 11. Message tone over time in the Forum conference
Figure 12. Message content over time in the Forum conference
Figure 13. Message type over time in the Forum conference.
Message tone over time for all messages is illustrated in Figure 14. It can be seen that the number of positive messages increased up to the sixth week and then underwent a decline. The number of neutral messages steadily declined over time while the number of negative messages tended to remain steady or to exhibit an overall slight increase.

In Figure 15 it can be seen that person-to-person messages were by far the most common. The other four message types fluctuated over time but the overall trend was to remain steady or to slightly decrease in numbers.

Figure 16 reveals that the numbers of nonscience messages were greater than science messages except for a short period around the fourth week. There was a sharp increase in nonscience messages around week six.
Figure 14. Message tone over time in all conferences
Figure 15. Message type over time in all conferences
Figure 16. Message content over time in all conferences
Results of a Content Analysis of Samples of Messages Over Time Using SYMLOG Categories and the Sentence as the Unit of Analysis.

Some of the results of the content analysis using SYMLOG categories and the sentence as the unit of analysis are shown in Figures 17 and 18. It was found that the number of instances in which action was described remained constant over time while there were no mentions of non-verbal behavior. Descriptions of behavior were most commonly positive and remained steady over time. There were no instances of images describing dominant or subordinate behavior. In Figure 17 it can be seen that the number of positive content images appears to increase slightly over time while negative images underwent a slight decrease. Figure 18 shows that content images referring to the self were the most common and increased over time. References to others also increased slightly while content images dealing with situation decreased slightly. References to the group of users were very few while content images dealing with fantasy showed an increase in the last quarter of the project.
Figure 17. SYMLOG content analysis by sentence of content images I
Figure 18. SYMLOG content analysis of content images II
SYMLOG Field Diagrams with the Students as Raters

Field diagrams for a Heavy and Light user are shown in Figures 19 and 20 respectively. The labels on the field diagrams correspond to the following dimensions shown on the SYMLOG model in Figure 2: negative = self-centered, positive = group-centered, conforming = forward and, nonconforming = backward. The diameter of each small circle indicates the relative dominance of an individual with a larger circle rated as more dominant than a smaller circle. As can be seen from Figures 19 and 20, the group is polarized into two subgroups along the negative-positive (self-centered-group-centered axis). The axis is rotated slightly in an anticlockwise direction. A polarization along the positive, conforming and negative nonconforming axis was the most common pattern which resulted in all of the SYMLOG field diagrams. The positions of students varied greatly. For example, LOH, a Heavy user, was placed on opposite ends of the negative-positive axis by two different raters. However, most of the adults, including the sysop, were placed on the positive end of the negative-positive axis. The ratings by the Battellites were not included, due to many non-responses by some of the Battellites on the rating forms.
Figure 19. A SYMLOG field diagram for a Heavy user of CMC.
Figure 20. A SYMLOG field diagram for a Light user of CMC.
Results of the Pre-FTF Questionnaire

The results of the pre-face-to-face questionnaire are displayed in Figure 21. A copy of the pre-FTF questionnaire can be found in Appendix D. An almost equal number of users stated that they would have liked to meet face-to-face before using CMC although there were more strongly disagree responses than strongly agree. A majority of the users felt they would like to meet each other face-to-face. There was about an even split on item three which asked if the students would like to do the same work as the Battellites. Item four revealed that a clear majority of users was comfortable using CMC.
Figure 21. Results of the Pre FTF Questionnaire
Message Maps for all Participants

Message maps showing from whom each individual received messages are included in Appendix E. Inspection of the maps revealed that twenty out of the twenty-five active participants received three or more messages from the same person during the course of the study thus making formation of a complementary dyad possible. There were very few messages sent by students to other students although some Battellites did communicate among themselves frequently. Messages addressed to "All" were the most commonly received for most persons. Heavy student users tended to communicate with a majority of the Battellites instead of just concentrating on sending messages to one person. Most of the Battellites received messages from other Battellites, and from a large variety of students. The Battellites also received more messages from the sysop than the students did.

Results of the Students' Post-Study Questionnaire.

A table of the students' responses can be found in Appendix G. The responses of the students towards the project were mostly favorable. There were three items, numbers 4, 38, and 47, to which all of the students either agreed or strongly agreed. Most importantly, the students seemed to greatly enjoy communicating with the Battellites. A majority preferred to use CMC instead of the U.S. mail to send
messages. Seventeen students stated that they liked to use computers to communicate with people. A large number of students also indicated that they had received good advice and had made good friends with some of the Battellites. About two-thirds of the students stated that they liked to work in groups while only one-third claimed that they are usually the first to speak up in a group situation. Two-thirds of the group expressed a preference for using a lot of "body language." Two-thirds of the students disagreed that males are better at using computers than females. Only seven of the students indicated that their parents use computers and seven students disagreed that their parents like computers.

There was an even split among the students on whether they enjoyed the Forum, where the application of science to world problems took place. Most of the students disagreed that there were too many conferences. A clear majority of the students felt that the topics discussed in the various conferences were not boring.

Most of the students also indicated that the editor was easy to use and that people answered their mail fast enough. Thirteen out of eighteen students agreed that using the BBS helped them to learn about science while only eight stated that they would like to pursue a science career.

Only six students responded that they had received help with a homework problem while eight agreed that a Battellite had assisted them with a personal problem. Thirteen students
claimed to have been helped with a science problem by a Battellite.

About two-thirds of the students would like to be like one of the Battellites or to get a job at the Battelle Institute. Only five students indicated that they had changed their career choice to either science or some other career after interacting with the Battellites.

Questions dealing with potential problems the students might have had seemed to indicate that most students did not experience much difficulty. Only one student stated that they became angry with a person who sent them a message while eight students became angry with the computer. Only five students stated that they experienced mechanical difficulties with the computer and six students agreed that the phone line was often busy. Only three students had difficulty logging on to the BBS. Most of the students felt that the sysop did a good job. Twelve students agreed with the statement "I love computers."

Most of the students felt that their computer and science teachers encouraged and helped them during the project. All of the students claimed that they enjoyed having an alias. Ten students wished they could have had more than one alias while eleven indicated that their alias is very different from how their school friends think of them.

Results of the Battellites' Post-Study Questionnaire.

A table of the Battellites' responses can be found in
Appendix G. Only seven Battellites completed the questionnaire. Because of the very small sample, only unanimous or near unanimous responses, i.e., all agree or disagree will be noted. All of the Battellites agreed that they enjoyed using the BBS and that it was easy to find their messages. All of the Battellites indicated that they enjoyed communicating with the students and they disagreed that they prefer using the U.S. mail instead of CMC.

Only one Battellite indicated a preference for meeting the students face-to-face instead of using CMC. All of the Battellites disagreed that males are better at using computers than females. All of the Battellites also indicated that the editor was not easy to use to correct mistakes.

All of the Battellites disagreed that the messages in the Mall were boring. All of the Battellites indicated that they like using computers to communicate with other people. The statement that the sysop did a good job was agreed with by all Battellites. Finally, all of the Battellites indicated that they enjoyed using an alias.

Results of the Post-Study Interviews with the Students

Graphs illustrating the responses to the post-study interview questions may be found in Appendix I. All of the students stated that they enjoyed the project for various reasons. The students liked the trip to Battelle most while communicating with and meeting scientists were also mentioned.
When asked what they liked least about the project, six said they didn't know while the rest gave a variety of responses. A large majority of the students declared that they did not have any problems with the computer hardware and about half of the students experienced a variety of problems with the BBS program. When asked how the BBS program could be improved, seven students stated that no improvements were needed. Six students wanted the program speeded up so that they could get straight to their mail with no delay. Eleven students stated that receiving more messages and having more people write to them would have encouraged them to send more messages. The messages which students liked to read most varied greatly according to the individual. There was less variety in the messages the students liked least, with six students saying that there were no messages they disliked. Categories of messages liked least were boring, long depressing messages, and science and sports messages. Six of the students described themselves as "nerds," smart or intelligent, while seven regarded themselves as nice or cheerful, with a third common category made up of "funny," "crazy," or "goofy." A slight majority of the students felt that the personality of their alias was different than their real one. The descriptions of the personalities of their aliases tended to be more positive and varied than the descriptions of the students' real personalities.
The students' first impressions of the Battellites at the face-to-face meeting varied greatly. Seven students thought that the Battellites did not look like their aliases and that they were different than they had expected. There were two negative initial responses to the appearance of the Battellites. A few students said that they were nervous and thought the Battellites would not listen to them or that the meeting would be boring. Clear majorities of the students stated that they were surprised when they met the Battellites and that the Battellites were different than what they had expected. The reasons for the students' surprise at meeting the Battellites were as follows: some expected the Battellites to be African-American when they were really White; the Battellites were nice and did not use a lot of science jargon; they did not all wear white lab coats; the Battellites' ages were different than expected; the students did not think the Battellites would joke around; some of the Battellites acted silly or crazy; and the Battellites' personalities did not fit their names.

When the students were asked if CMC is a good idea, their responses were all favorable, but there were a great variety of reasons. The two most commonly mentioned reasons were that CMC saves time and money and the CMC allows a person to learn new things. Other responses were that physical appearance is not important, one gets to know other people
personally, it is more fun than sending letters, and that CMC provides opportunities to receive and give new ideas.

When the students were asked what message they would leave on the BBS about this project, sixteen students replied by thanking the investigator and stated that the project was good and that they enjoyed it. Six students stated that they learned more about science and computers and that the Battellites were nice and they hoped to meet them again and to use CMC in the future. Three students said that they enjoyed the trip to the Battelle Institute.

Summary of Findings

1. Most students had little previous communication with scientists, and limited or no experience with computers.
2. Heavy and Light users of CMC in this study were half male and half female. Five out of six Heavy users were White while four out of six Light users were African-Americans. One Light user was Asian.
3. The highest number of messages were left in the Mall and most were non-science related. Main contained the next highest number of messages followed by the Forum. The number of messages left in the Club and MickeyD was insignificant.
4. After inspection of the cell means it was noted that Heavy users of CMC appeared to use more electronic paralanguage than Light users of CMC, and that Heavy users had lower computer
anxiety scores and faster typing speeds. There were no highly significant F tests.

5. Significant correlations were found between the following: gender and computer anxiety, with males having less computer anxiety; ethnic group and number of messages, number of logons, and total EP, with African-Americans having lower CMC usage and less total EP than White students.

6. The patterns of messages of varying tones, types and content over time, varied from conference to conference.

**Message tone** Overall, the number of positive messages tended to increase over time, while the number of neutral messages declined and the number of negative messages remained steady. The number of positive messages was much greater than neutral or negative messages although, in the Forum negative messages were the most common.

**Message type** Person-to-person messages were the most common type of message overall while the other four types fluctuated over time.

**Message content** The number of nonscience messages was always greater than science messages except for a short time near week four.

7. The use of SYMLOG categories to carry out a content analysis by sentence revealed several things. No instances of descriptions of non-verbal behavior were noted. A large number of descriptions of positive behavior were found. There were no images found describing dominant or subordinate
behavior. The number of positive content images increased slightly over time while the number of negative images decreased slightly. The most common content images referred to the self, and these increased over time. The next most common content image referred to others, and these also increased over time. References to the group of BBS users were very few, while fantasy images increased over time.

8. The SYMLOG field diagram which resulted from an average of all eighteen raters was too tightly bunched to be interpreted. There was great variety in the field diagrams. The majority of the diagrams were strongly polarized along the group-self centered axis although there was a tendency for a slight rotation in an anticlockwise direction.

9. Slightly more users preferred to meet each other for the first time using computer-mediated communication instead of face-to-face.

10. Message maps revealed differences in the distribution of received messages between Heavy and Light users of CMC. The Battellites received more messages from the students, other Battellites and the sysop, while students tended to only receive messages from the Battellites.

11. Overall, the responses of the students and the Battellites on the post-study questionnaire were favorable towards the project and CMC as a medium of communication.

12. During the post-study interview it was suggested that access to messages be quicker and that the students would have
left more messages if they had received more messages. Again, the response was mostly positive to the project and to CMC. The students were, however, surprised at their face-to-face meeting with the Battellites. The appearance and personalities of the Battellites were very different from what the students expected, mostly in a positive way.
CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Conclusions Resulting from Pre-Study Interviews with the Students

Based on the students' responses, this was the first time most of them had ever had any sustained interaction with a scientist. In addition, all of the students were new to CMC, although some did have computers at home. Most of the students were not interested in science matters and rarely discussed them on their own or outside of school. The students did seem to have very positive attitudes towards the use of computers, in and out of school. The interviews with the students revealed that this form of communication, CMC, may have an advantage in bringing students into contact with scientists, because in ordinary circumstances, middle school students do not seem to show much enthusiasm for science matters or scientists.

Conclusions Based on Computer Usage by the Battellites and the Students

Because of the very small size of the sample, no conclusions can safely be drawn regarding the possible effects of gender and ethnic group on CMC usage. However, there are
some possible reasons for the apparent differences in Heavy and Light users with regard to ethnic group. During the course of the study, students frequently left messages during their lunch period. It was noted that the students did form some ethnically exclusive and single gender groups. A group composed of three White males tended to dominate the lunch period logons. Other groups, one made up of three or four White girls, another composed of an Asian male, and an African-American male, attempted to gain use of the computer during the lunch period. Since in this particular middle school, there are no other times for socializing except lunch, it is possible that some students preferred to meet with their friends elsewhere during this time. In addition, the provision of only one computer and one phone line limited the number of students who could logon at a time. Possibly other groups of students, i.e., the Light users, became discouraged when they were not able to gain regular access to the computer. An additional factor which may have played a part was that two of the African-American male Light users were heavily involved in the sports activities which tend to dominate the thoughts of many middle school males. This may not have been a factor, though, because one of the Heavy users was also a fanatical sports participant and fan. Most probably the main factor in determining the amount of computer usage was the time available for students to logon to the BBS. This was caused in part by an inflexible school schedule which
did not allow time for extracurricular activities, as well as by occasional friction between the computer teacher and individual students, and the presence of only one phone line and modem.

If the previously mentioned conditions had been the same for all participants, then it might have been possible to determine if there were any differences in the amount of computer usage due to gender or ethnic group. A vicious circle leading to infrequent CMC usage could occur though if there is a lack of received messages by certain individuals. Many times students would logon, and if there were no messages, they would logoff immediately, not wanting to take the communication initiative. Both students and Battellites addressed comments to the sysop stating that they wanted to receive more messages. Possibly having a larger group of users would overcome this problem, although the unique nature of CMC may still require more initiative on the part of individuals as compared to face-to-face communication.

With regard to CMC usage by the Battellites, again no conclusions could be drawn with regard to the effect of gender or ethnic group. It noted by the investigator during anecdotal discussions with the students, that some of the Battellites were much more effective message writers than others. As examples of this, some White male Heavy users and Battellites enjoyed receiving messages which this investigator termed "Trekkie" messages, because a fascination with science
fiction predominated and the style of writing was more formal, analytical, and unemotional. Another communication genre noted, a "Homeboy-Homegirl" genre, was a very slangy, almost oral form of communication which certain Battellites and students seemed to be able to turn on and off at will, depending on the potential recipient of their message. Some participants utilized CMC for informal chats, a type of "Gossip" genre characterized by friendly, non-businesslike, less information dense communication. Other messages were couched in a neutral, "Utilitarian" genre in which persons supplied the minimum necessary response, with a high information density, probably as a matter of politeness and a lack of anything additional to say. A final obvious communications genre which emerged was a "Science Nerd" genre, characterized by jargon-laden, turgid explanations of scientific phenomena. Different contexts involving different users would undoubtedly reveal other communication genres (CGs), but no matter the situation, some forms of "social language" (Wertsch, 1991, p. 59) and common rules to "play CMC" would undoubtedly emerge.

Surprisingly, some Battellites thought that certain students were of different ethnic groups than they actually were. The same mixup occurred among some of the students with regard to the Battellites, i.e., it was thought by two female students, MAX and JAJ, that the Battelite AUL was African-American instead of White. This is most probably an effect
due to the lack of visual cues in CMC, in combination with the powerful social presence and independent identity an online alias can develop over time.

Conclusions Regarding the Distribution of Messages in Conferences

The distribution of messages in the conferences may have reflected a preference on the part of the users for certain topics or types of messages. Main was the easiest conference to leave a message in since it was the default conference within which users found themselves right after logon to the BBS. Typing a simple macro allowed quick and easy access to all of the other conferences, but this still could have been a factor in whether a student would change conferences to leave a message. Because there were no rules which dictated the type of message students should leave, it seems obvious that nonscience topics were the prevalent subject of communication between middle school students and scientists. The paucity of messages left in the Club, MickeyD and the Gym may have been due to a lack of online time and initiative rather than to a lack of interest in those topics. Surprisingly, most of the messages left in the conferences did conform to the general guidelines for posting, i.e., messages appropriate to the conference topic predominated. Possibly the presence of an experienced user with sufficient time to initiate and maintain discussions in all conferences would
have provided the spark to generate more interaction in all of the conferences.

**Conclusions Regarding the Relationship Between User Type and Total EP, Computer Anxiety and Typing Speed**

It was not possible to draw any conclusions as to whether Heavy or Light CMC use is related to total EP, computer anxiety and typing speed because of the very small sample of users. A more controlled study with a much larger sample would be required to make any valid conclusions with regard to these variables. It is also not determinable whether the three variables mentioned are the possible results or possible causes of a user being Heavy or Light. Only an experimental study in which these variables were manipulated in a controlled manner could give insight into this question. The only statement which can be made was that the cell means seemed to differ in the expected directions but the size of their standard deviations makes impossible any conclusions that there were any statistically significant differences between the cell means.

A similar argument must be made with regard to correlations between these variables, although an n of 18 may be sufficient to make some inferences. The positive correlation between number of messages sent, number of logons, and total electronic paralanguage may have been genuine. This may possibly be an important characteristic of Heavy CMC
users. This ability to compensate for the loss of non-verbal communication through the use of electronic paralanguage may result in a user having an increased feeling of control over the information she or he is broadcasting to others. It is the investigator's view that users develop most of their skill in using electronic paralanguage by imitating more experienced users and not by reinventing the wheel. Only after a user has managed to become facile in the use of the specific computer hardware and software required in a given situation, can attention be paid to improving one's metacommunication skills. Perhaps correlating a measure of the rate of EP use with CMC usage would have revealed if there is any relationship between EP and CMC usage.

Conclusions Regarding the Relationship Between Gender, Ethnic Group and Amount of CMC Usage, Total EP, Computer Anxiety, Typing Speed and Computer in the Home.

Again, as stated in the preceding paragraphs, the small number of users and the lack of a controlled experimental situation make any conclusions drawn from these correlations suspect. The significant correlations found did, however, make sense when viewed in the Light of previous research on use of computers and in the context of this specific situation. During the course of the study it was observed that the White males tended to dominate access to the computer. The computer teacher had to make a special effort
to ensure that students of both genders and all ethnic groups got equal time. The correlation between number of messages, number of logons, and total EP and ethnic group did accurately reflect the particular situation which existed in the school. The students formed cliques which were for the most part, gender and ethnic group exclusive. The possible reasons for the unequal participation of the different ethnic groups have been discussed earlier. If there had been enough computers available, at the appropriate times, to allow all of the cliques and groups equal access, it is possible that there would have been no detectable differences in the measures of computer usage and total EP between the different ethnic groups and between the sexes.

The implications of unequal access to CMC could be very important. It is possible that the limited CMC resources in most schools will be dominated by the traditional group of White males. This may cause a form of "information discrimination" which will lead to a new generation of "haves" and "have-nots," determined in part by a person's gender or ethnic group.

**Conclusions Drawn From a Content Analysis of All Messages Using the Message as the Unit of Analysis**

The structure imposed on the BBS and on the computer conferences within it undoubtedly affected the message tone, type, and content of the messages posted. It was obvious that
messages containing positive images were more common than neutral or negative ones. One possible reason for this would be the awareness by all users that all messages would be read by the sysop, who knew every user's real identity. Another possibility was that because of the lack of visual cues, the participants were willing to give all of the users a chance and, thus, no possible communications were cut off by negative first impressions based on physical characteristics such as appearance, attractiveness, gender, or ethnic group.

The slight increase in negative messages over time and the slight decrease in neutral messages could possibly be explained again in a paradoxical way by the depersonalizing effect of the medium of CMC. In some situations, such as in USENET newsgroups, this lack of immediate feedback leads to ever-accelerating "flame" wars. In the more benign situation of a small BBS, once the users got to know each other better, responses to messages tended to become more uninhibited and this could have accounted for the increases in the number of more emotionally laden images.

In the Forum, the number of science messages was greater than nonscience messages. This was due to the structure imposed by the sysop, i.e., each student was required to enter certain messages, such as a list of problems and solutions, by a given deadline. Overall, the number of science messages was fairly substantial in all of the conferences even though it was less than the number of nonscience messages. It seems
that there are two obvious ways in which the number of educational science messages on a BBS could be increased. A much larger number of users might solve the problem. Another alternative would be to provide continuous assignments and a timetable for all users to follow. The latter solution may not work very well because of the unique nature of CMC. Computer communication has the potential to cut across different levels of status and all users would probably not be amenable to a highly structured situation. A mix of the two, providing a highly structured program, along with free areas for open discussion, might be able to satisfy the needs of all users while being more productive educationally.

An interesting science discussion among students and Battellites, the "Trekkies," developed in Maine. A very interesting and educational dialogue on the feasibility of "beaming" a la "Star Trek" developed, with participation by both students and scientists. The students seemed to use the opportunity to communicate with scientists in very different ways. For some students, the Battellites were surrogate parents, for others they were good buddies, while some were very interested in answers to specific questions about science and technology.

The electronic brainstorming in the Forum generated a lot of online scientific discussion among the Battellites. The students could have participated more in this, if only they had more online time. The potential for this type of
interaction to be successful seems to be very good, as long as the students are given enough access to the BBS.

Because person-to-person messages were the most common message type, the potential of this medium of communication was not being maximized. The students did not seem to realize that they could address messages to more than one person and thus limited the number of their responses. This could have been due to the students' lack of time online. Most Battellites were able to leisurely read through all the messages on the BBS while the students usually got on the BBS quickly and only read messages to themselves. The Heavy student users did, however, begin reading through all of the messages as they became more proficient in the use of the BBS. Perhaps an emphasis on the fact that CMC can be directed to one or to many, people could make CMC more rewarding to all participants instead of relying on them to discover this on their own.

Even though personal-problem messages were far fewer in number than other message types, their numbers did remain at a fairly steady level in the major conferences. Several Battellites expressed satisfaction and gratitude for being able to help students solve some of their personal problems. Comments to the sysop and personal phone calls were sometimes made in order to find out more about the students' situation when they were having problems. One Battellite left the following comment to the sysop during the pilot study: "Thank
you, you have given us a great gift." The same Battellite has maintained a close relationship with two of the students and sometimes the students make visits to the Battelle Institute and go to movies with the Battellite, almost a year after the pilot study ended.

An example of the disproportionate influence personal-problem messages can have on students was the case of a learning disabled student, who had great difficulty reading and typing and who was constantly in trouble and usually found in PEAK, a form of in-school suspension. After this student began participating in this project, his behavior improved markedly and his teachers, the guidance counselor, and principal all remarked on the dramatic improvement in his behavior. Even after the project officially ended, this student remains a dedicated user of CMC. Months after completion of the project his behavior was still exemplary compared to his conduct before taking part in the project. Both male and female students were counseled by Battellites about their personal problems and the experience seemed to be rewarding and beneficial to both groups.

Managerial messages are an unavoidable consequence of distance education. The ideal would be to keep their number to a minimum to avoid cluttering up the computer conferences and during this study they did seem to remain fairly steady in number overall, although there were regular, small fluctuations. The function of managerial messages was very
important, as this is one way in which users can learn essential information handling, communication, and metacommunication skills. The sysop also receives useful feedback which can be utilized to make software and hardware improvements.

An interesting addition to a content analysis would be a category for communication genre. A communications genre is, however, context-specific, in contrast to the acontextual categories used in the content analyses carried out in this study. Individual interactions could be analyzed over time to determine whether communication genre was an important factor in successful CMC. A modification of the theoretical model presented previously can now be presented. After consideration of the data and the emergence of different computer genres, a dynamic, context-specific, feedback controlled theoretical model of computer-mediated communication can be presented. In this model the mediating device, the computer, acts as a filter which removes most of the distracting stimuli which ordinarily affect face-to-face communications. The success or failure of CMC mainly depends on the characteristics of the message itself and not the medium or the visible characteristics of the sender or receiver. The contexts in which the sender and receiver find themselves influence the message but a very critical factor seems to be the communication genre itself. The categories used in the content analysis of this study were basically
context independent and common to many communication genres. Intensive qualitative methods would be needed to investigate further the phenomenon of communication genres in CMC. A communication genre could be likened to the rules of a game. Unless both sender and receiver were able to comprehend the canons of a communication genre, then successful communication would probably not result. Communication actually takes place in a shared communication space which is popularly termed "cyberspace." The term cyberspace can be subsumed by Vygotsky's Zone of Proximal Development in this particular communications context. In normal face-to-face encounters between adults and children a multitude of stimuli are competing for the child's attention, and thus a great effort is needed to focus both participants' attention on the actual message intended to be conveyed and received. CMC acts as a purifying filter by screening out all of the distractions which result from physical appearance, etc. During CMC, a reversal of priorities occurs, with the characteristics of the message and its manner of conveyance taking the highest importance. If Vygotsky's theories are true that many higher order thinking skills are learned and are the result of social interactions between children and adults, then a multiple electronic zone of proximal development (MEZOPED) may succeed in providing a pristine virtual meeting place for the spontaneity of children to interact with the logic and experience of adults. According to Shank (1993, p. 7), many
of the interactions which occur on the "Net" use abductive reasoning since they end "...with meaning claims, and their purposes are to foster a shared understanding of circumstances and phenomena." CMC may be an ideal "place" for children to develop this critical skill of "abductive multiloguing" (Shank, 1993), which may prove to be a very useful tool in the process of future scientific discovery. It is possible that many to many mind to mind interactions in a multiple zone of proximal development may yield unexpected educational benefits in the future. Examples of this may be improvements in cooperative problem-solving and teleapprenticeships, where students learn about and experience possible science careers through computer conferencing.

A model of successful and unsuccessful acquisition of electronic paralanguage is shown in Figures 22 and 23. Figures 24 and 25 extend this model to the concept of comprehending/acquiring or noncomprehension/nonacquisition of a communication genre. In each diagram, the thickness of an arrow indicates the amount of electronic paralanguage (EP) or communication genre (CG) used in each message. The letters s and r refer to a message sent or a message received, respectively. The numbers in the diagram show the relative order in which the messages were posted. These representations are extreme oversimplifications since the number of feedback loops necessary to achieve facility in the use of a communication genre is unknown at this time. A
message could consist of a blend of communication genres and the models do not incorporate this possibility. Finally, this model does not illustrate the multiloguing (Shank, 1993) which is very characteristic of computer conferencing and CMC.

Figure 22. A dynamic theoretical model of successful computer-mediated communication between middle school students and scientists involving the acquisition of electronic paralanguage skills
Figure 23. A dynamic theoretical model of unsuccessful computer-mediated communication between middle school scientists and scientists involving the nonacquisition of electronic paralanguage skills
Figure 24. A dynamic theoretical model of successful computer-mediated communication between middle school students and scientists involving the acquisition of a communications genre.
Figure 25. A dynamic theoretical model of unsuccessful computer-mediated communication between middle school students and scientists as a result of nonacquisition of a communications genre.
Table 12 compares the characteristics of theoretical models for successful and unsuccessful computer-mediated communication.


<table>
<thead>
<tr>
<th>Successful Communication</th>
<th>Unsuccessful Communication</th>
</tr>
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<tbody>
<tr>
<td>1. Approaches equilibrium</td>
<td>1. Unstable relationship</td>
</tr>
<tr>
<td>2. Messages sent and received become more similar</td>
<td>2. Messages sent and received become dissimilar</td>
</tr>
<tr>
<td>3. Diagram becomes symmetrical</td>
<td>3. Diagram becomes asymmetrical</td>
</tr>
</tbody>
</table>

Future studies of CMC might attempt to identify context and culture specific communications genres and then study the
processes involved in their acquisition. It was noted during the course of the content analysis that mimicry and imitation seem to play a major role in CMC. Another important avenue of research might be to investigate receptivity to different communication genres and the specific characteristics of the genres such as lexical (information) density.

**Conclusions From a Content Analysis of Samples of Messages Over Time Using SYMLOG Categories and the Sentence as the Unit of Analysis.**

Because the SYMLOG categories were originally designed for use with face-to-face groups, the absence of some sorts of behaviors or images was to be expected. For example, descriptions of non-verbal behavior were not observed during the analysis. However, expressions indicating dominance or submission were conspicuous in their absence. Most probably, cues and information that were filtered out of messages by the mediating agent of the computer are what normally supply information on the status of an individual during face-to-face communication. The preponderance of positive images was very similar to the results of the content analysis by message.

The abundance of references to self instead of to the group or to others revealed that, during CMC, the physical absence of the receiver may cause a sender to concentrate more on the composition of the message rather than on its effect on the receiver. Since both receiver and sender experience the
same phenomenon, both may happily carry on their egocentric interaction without noticing the seeming lack of concern for each other. The lack of references to the group is troubling if one is attempting to generate a team spirit. It did seem that in face-to-face meetings there was a sort of group solidarity but for some reason the virtual online group did not have as much social presence as the face-to-face group. It is possible that when there is a paucity of individuating information about all group members, such as during computer conferencing, the characteristics of the self tend to dominate and overshadow the groups' existence.

Conclusions From the SYMLOG Field Diagrams with the Students as Raters

The ratings made by the students of other students were based on face-to-face interactions which occurred during school while the ratings of the Battellites were based on one face-to-face meeting and any information which the students received through CMC. Most of the Battellites seemed to have been perceived as group centered and positive although there were a few exceptions. The polarization of groups in the field diagrams was mostly a result of students being rated along a continuum from self-centered (negative) to group centered (positive). More students were rated on the group centered side than the self centered. This provides further evidence that the interactions between the students and
Battellites were mostly viewed in a positive manner. The slight anti-clockwise rotation of the line of polarization indicated that conforming seemed to be more closely associated with positive group behavior and nonconforming was viewed as more negative behavior.

Because of the lack of complete ratings from all the Battellites, and the face-to-face meeting, a measure of the transmission of social presence solely by CMC was unobtainable. However, this technique could prove valuable in other respects. One way to improve aspects of computer conferencing might be to provide timely SYMLOG feedback to all users, as Bales (1979) and others have done with face-to-face groups, and then to engage in online discussions of the results. This might help sysops and conference moderators deal with negative phenomena such as flaming and extreme disinhibition, which result from the depersonalization characteristic of CMC.

Conclusions from the Pre-Face-to-Face (FTF) Questionnaire

Most Battellites mentioned to the sysop that they appreciated the chance to communicate electronically with the students before the face-to-face meeting. Results of this questionnaire seemed to contradict this notion. One possible explanation for the results is that the students were intensely interested in taking field trips to Battelle. Question one may have been interpreted by the students as
asking them if they just would have liked to have had an extra trip to Battelle. The overwhelming number of positive responses to questions two and three provides another point of view which confirms that CMC was a positive experience for most participants. One reason that a large number of students did not want to work in the same occupations as the Battellites was that, according to the pre-study interviews, some students had already made career choices in non-science fields.

**Conclusions from Message Maps**

The lack of messages sent from student to student was probably the result of a lack of online time and the students’ physical proximity to each other during the day. The Battellites, however, were separated physically and temporally by their jobs and most did not see each other face-to-face. One interesting note was that two Battellites who first met in cyberspace during the pilot study, became close friends and participated again during the subsequent study. These Battellites also remained good friends with some of the students from the pilot study.

It is possible that Heavy student users, as a result of their communicating with a greater variety of Battellites, were more able to find a Battellite whose communications genre was compatible with their own. Since communication genres seem to be very context specific, there are undoubtedly a
multitude of communication genres. Communication genres between rural high school students and scientists might prove to be very different from the communication genres revealed during this study. It is also highly probable that other ethnic groups have their own culturally determined communication genres. A student who only sent a few messages to one or two Battellites, may have, by luck of the draw, inadvertently sent messages to a person whose predominant communication genre, at that time and in that situation, was incompatible with or absent from the student's preferred or available repertoire of communication genres. A general rule of thumb which might be derived from this would be to encourage communication with many users when a new user enters the communications space of an unfamiliar BBS.

The acquisition of a communications genre might proceed in the following manner. First, a novice might receive a message containing a salient communications genre such as "Trekkie," and attempt to imitate certain words and phrases. The initiator of the communications genre would then be required to provide corrective feedback and further information on the appropriate use of the communications genre. This process could break down and communication could stop at any time. The characteristics of communication genres which appeal to some individuals, or repulse, or have no effect on others, still need to be identified.
The reason that the Battellites received more messages from the sysop than the students received is a mundane one. The sysop had frequent face-to-face contact with the students but rarely met the Battellites in person. Increased face-to-face contact between the sysop and the Battellites might have caused the Battellites to post more messages on the BBS.

**Conclusions from the Results of the Students’ Post-Study Questionnaire**

The positive responses of the students to using CMC to communicate with the Battellites can be explained in different ways. One strong possibility is that the use of the computer caused a "novelty" effect. An urban middle school is a regimented, noisy, and not always happy place, so it is possible that anything which was a break from normal routine was a relief to the students. The presence of the investigator, who also acted as sysop, opens up the possibility of reactivity as the cause of the students' positive attitudes. The face-to-face meetings, field trips, and the promise of a pizza party were also strong influences on the students.

Surprisingly, the questionnaire results did not reveal any glaring weaknesses in the hardware or software. If the students had been left entirely on their own with the computer then they might have experienced more problems.
The questionnaire results seemed to confirm findings that have already been discussed in this chapter. The topic of the students' behavior in groups has, however, not yet been discussed. It is unsurprising that a majority of middle school students would like to work in groups when the majority of their lessons involve listening to lectures or individual seatwork. Latency of verbal response does not seem to be an important variable which affects CMC type although specific comparisons would have to be carried out with a larger sample to confirm this. It would be interesting to determine if there is any correlation between the use of body language and computer user type. The investigator suspects that there may be a negative correlation although there is no hard evidence to support this assumption. Surprisingly, the presence of a computer in the home and its use by parents did not seem to be correlated with user type. There was one exception to this with a White male Heavy user whose father had used computer bulletin boards before. The son, however, had never used or seen one in use before this study. In addition, there were Light users who had functioning computers in their homes.

Another surprising result was that all of the students enjoyed having an alias and that a majority wished they could have had more than one. The reason for this may lie in the sense of power an alias gives to individuals low on the status totem pole. When using an alias, an individual is shielded from potentially embarrassing remarks and is more able to
experiment with different forms of communication. An online alias allows students to try out new identities and it is possible that this may even carry over into real life. It would be very enlightening to find out how the eleven students' aliases differed from the way their fellow students viewed them.

The potential for social change and imparting important attitudes and skills seems very great when children can safely experiment with variations in ways of thinking and communicating instead of remaining in fixed inexorable paths which have been dictated to them by society and other circumstances out of their control.

**Conclusions from the Results of the Battellites' Post-Study Questionnaire.**

The Battellites' preference for meeting electronically before a face-to-face meeting was revealed again in these results. After noting the responses of the students, it seemed that most realized that they might have a very difficult time communicating with some of the children if they had first met face-to-face due to large age, cultural, and status differences. There were some interesting differences between the responses of the Battellites and the students. All of the Battellites had probably had enough experience with computer users to realize that men are not innately superior in that regard while the students still retained common
misconceptions. Another area of disparity was the ease of use of the editor. The investigator and the Battellites all felt that the editor was not easy to use while the students seemed to disagree. It is possible that a type of "halo" effect may have been operating in that the students were so pleased to be participating in any kind of project which relieved the humdrum of their daily lives that they may have been overly positive in their ratings of various aspects of the project.

A final interesting note was that all of the Battellites indicated that they enjoyed the use of an alias. Perhaps the use of an alias functions slightly differently in an adult, by in effect, providing a CMC user with an opportunity to play "Let's pretend." Thus, an adult could have fun and play, just like a child, without fear of receiving the disapproval of other adults.

Conclusions from the Post-Study Interviews with the Students

An important motivational issue with regard to urban middle school students emerged when the results revealed that the aspect of the program most liked by the students was the trip to Battelle.

It seems that future e-mail, BBS, or computer-conferencing systems should allow immediate access to the mail by the students. Possibly, bulletins and other important announcements could appear after the user reads her or his messages or before logging off, although for some system-
related messages, this might prove impossible. Another alternative for important messages would be to include them as the first message in everyone's mailbox.

To ensure more participation by all of the students, a system should be established so that the sysop is informed regularly as to how many messages each user has sent, received and read. Despite the fact that adults are capable of producing much more CMC output than children, in the future, it would probably be better to have equal numbers of adults and students. During the course of this project, there were unavoidable circumstances, such as serious illnesses, births of babies, extensive travel, etc. which reduced the participation of the Battellites.

The great variety in types of messages which the students preferred to read provided some evidence for the existence of CMC communication genres. In contrast, the types of messages liked least were fewer in number. One wonders when, in the communication process, dislike or enjoyment of a message begins to take place. Undoubtedly, in a face-to-face interaction, a value judgement might occur upon first sight or hearing of another individual, although not always. Possibly, the making of a value judgement is delayed during CMC in contrast to face-to-face communication. Maybe the tone of a message alters the nature of a communication genre, and thus a negative communication genre might be a more inclusive or general category than a positive one. In an evolutionary
sense this would have the advantage, to an individual, of being required to be familiar with fewer CG's in order to discern and comprehend the implications of a negative and potentially harmful communication.

The implications of the students describing their aliases in a more positive manner than their real personality could add more weight to the argument that the use of aliases in CMC may be beneficial. It might even be possible that the students may be carrying out a sort of internal dialogue, as espoused by Bakhtin (1981), with their aliases. The use of aliases in CMC and their effects may be a very fertile area of research in the future. A simple experimental situation could be devised where, all other things being equal, one set of users operates with aliases while a control group utilizes only their real names.

As previously mentioned, both the Battellites and students were surprised (most pleasantly) at their first face-to-face meeting. Obviously, CMC does not carry much important information such as gender, physical appearance, ethnic group, age, status, etc., but, as a result of this study, it seems to be very debatable whether these attributes are useful or even necessary for adults to communicate with children using CMC.

The nature of this study was exploratory, and as a result, many questions have been left unanswered. The field of CMC between children and scientists, the existence and nature of communication genres (CGs) and the usefulness of
aliases are all important areas which merit further investigation. Another important finding resulting from this study is the evidence for the potential emergence of "access to information discrimination." Unless the issues of equal access to new technology are addressed, the benefits of CMC will be available only to a privileged few.

Summary of Conclusions
1. Because students enjoy communicating with computers, this could be a very useful way to bring urban middle school students into contact with scientists.
2. No conclusions could be drawn on the effect of ethnic group and gender on computer-mediated communication (CMC) usage. Lack of online time on the computer was a major limiting factor which influenced the amount of use of CMC.
3. Both the students and adults tended to be reluctant to take the initiative in communication.
4. The presence of communication genres (CG) was noted. CG’s seemed to be an important, context-sensitive factor which influenced whether CMC was successful or not.
5. In a few cases, the perceived ethnic group and gender of a user was thought to be different than the user’s true gender or ethnic group. The amount of ethnic and gender information transmitted during CMC is obviously much less than in a face-to-face (FTF) interaction.
6. It was not possible to draw any conclusions as to whether
Heavy or Light CMC use is related to the amount of total electronic paralanguage (Bp) used, computer anxiety, and typing speed.

7. Correlations were found between ethnic group and number of messages and number of logons. This reflected the observed domination of the CMC time by the white male users.

8. The majority of messages posted on the bulletin board system (BBS) contained positive images. This may have been due to the lack of visual information about the recipients of the messages or to an awareness that all messages were read by the sysop.

9. The decrease in neutral messages could have been caused by the depersonalizing effect of CMC.

10. The number of science messages was greater than nonscience messages in all conferences except in the Forum. The structure imposed by the sysop most probably determined this distribution of messages. The potential for electronic brainstorming seems to be very good.

11. The students communicated with the Battellites for different reasons.

12. Despite the low numbers of personal-problem messages, they seemed very important, to both the students and Battellites. Lasting, positive, interpersonal relationships were formed between some of the students and Battellites.

13. The students did not take advantage of the multiloguing capability provided by CMC and computer conferencing (CC).
14. Participation in this project dramatically improved the general school behavior of a learning disabled student.

15. A model was developed by this investigator to illustrate the influence of communication genres on successful and unsuccessful CMC. Based on this model, during successful communication, the messages sent and received become more similar and a dynamic equilibrium is established. The opposite characterizes unsuccessful communication.

16. The System for Multiple Level Observation of Groups (SYMLOG) was used to analyze a sample of messages over time. The data revealed a preoccupation by the users with themselves over others. There was also a marked lack of reference to the group of users.

17. SYMLOG field diagrams revealed how the student users perceived each other's behavior. A majority of students and Battellites were rated on the group-centered or positive side of the field diagram. The slight anticlockwise rotation of the line of polarization seemed to indicate that conforming behavior may be regarded as positive while nonconforming behavior may be seen as negative. A lack of responses by some Battellites prevented a measure of SYMLOG's effectiveness in computer conferencing situations and in the transmission of social presence.

18. Most of the Battellites preferred to meet the students electronically before meeting them face-to-face. A large
number of the students, however, would have preferred to visit Battelle first before communicating electronically.

19. The students probably did not send each other messages because of their daily, close proximity to each other.

20. The Heavy student users sent and received messages to and from a greater number of Battellites. This may have exposed them to a greater variety of communication genres, thus enabling the students to find or learn a preferred communication genre more easily.

21. The students seemed to have a very positive attitude towards the use of CMC. This may have been due to a "novelty effect." Reactivity or an experimenter effect is also a possibility since the investigator acted as sysop.

22. The students appeared to find the software and hardware easy to use.

23. The presence of a computer in the home and latency of verbal response did not seem to be important variables effecting the amount of CMC usage.

24. Both the students and Battellites enjoyed using aliases. The use of aliases seemed to encourage a form of productive play in many of the students and scientists.

25. The Battellites, in contrast to the students, felt that the message editor was not easy to use.

26. The students indicated that they would like to reach their mail immediately after logon. Bulletins and news should be
delivered in a different manner in order to increase the user's satisfaction.

27. The bulletin board system (BBS) program should provide the sysop with detailed information on the participation of all users.

28. The number of types of messages liked most was greater than the number of types of messages liked least. The smaller number of disliked message types might possibly allow quicker comprehension of a negative and potentially dangerous message. In contrast, the greater number of types of liked messages might allow for more creativity of expression.

29. It is possible that an internal dialogue occurs between a user and her or his alias.

30. Effective CMC took place between the Battellites and students in the absence of visual and auditory cues.

Implications

Urban, middle school students do not normally evince much interest in science matters outside of the science classroom. In the case of computer-mediated communication (CMC), the medium may just make the message and the messenger more palatable.

If communication genres are an important factor in successful computer-mediated communication (CMC), then more information is needed about them. When in the communication process does a user accept, reject, or recognize a
communication genre? Can the existence of communication genres be independently verified by multiple observers? Is a specific communication genre perceived by different persons in different ways? How does one recognize a communication genre; by message content, message function, the name of the sender, key words, style, formatting, electronic paralanguage, or tone? How does an individual acquire a communication genre? How long does this process take? Can the process of communication genre acquisition be detected and measured?

A bulletin board system should not stand alone. A closed system, such as the one in this project in which the numbers of users was fixed, tends to lose its hybrid vigor over time. This is most probably the reason for the decline in numbers of messages over time in most conferences.

Typing speed and skill may not be an important variable in successful CMC. If this is true, then the effect of the human-computer interface may not be as important in computer-mediated communication (CMC) as in other areas of human-computer interaction. Once the initial barrier due to unfamiliarity with the system is surmounted, the interface effect may become inconsequential, with the exception of the absence of face-to-face cues.

Recommendations

In order to ensure equal access to computer-mediated communication (CMC) by all users, a system which monitors the
amount of CMC usage should be built into the software design. Information on participation should be made available to the sysop and users. The sysop should be prompted when there is domination or underparticipation in a computer conference by an individual. The provision of online SYMLOG diagrams might also prove to be very useful in the management of computer conferences. Periodic calculation of an index of inequality could serve as a barometer indicating whether all users are participating equally.

The ideal classroom setup would involve a local area network (LAN) which provides telecommunications capability from every computer. The ability to compose and read messages offline would also maximize the use of this medium. The students should be provided with time to check their electronic mail daily, possibly during their homeroom or during a study hall. Schools should have computer facilities available for after school, weekend, and evening use. Every classroom should have a phone line. Laptop computers need to be available for loan to students from lower socioeconomic classes. CMC workshops could be conducted for parents and their children. Schools should buy used, refurbished, computer equipment for CMC purposes because a large amount of memory and technical sophistication is completely unnecessary for text-based CMC. An initial, hands-on session with scientist volunteers might prevent scientists from dropping out of CMC projects with students. Having more required
assignments, such as the initial autobiography, for all users might be a way of encouraging more productive CMC.

CMC should be integrated across the entire curriculum. If this is done it would provide more computer-literate individuals and thus reduce the collective learning curve of the school user base. Implementation of new technology in only one school department could also lead to interdepartmental jealousy and ultimate failure. The daily and frequent access to CMC needed by the students will require great flexibility in the school schedule and the cooperation of all of the teachers in the school. CMC could be used in all subjects and extracurricular activities. Examples of possible cross-subject uses of CMC are an online school newspaper, magazine, announcements, sports scores, science fair results, etc. Computer-mediated communication (CMC) must become embedded in the school's culture.

Short-term, controlled studies should be conducted to uncover ethnic and gender differences in CMC use. A measure of ethnic and gender leakage in CMC should be fairly simple to determine. A randomly selected group of senders and receivers of fixed percentages of ethnic groups and genders could be utilized. All of the senders could be required to send a message which does not exceed a maximum length on a given topic. All overt references to gender or ethnic group would be removed, although all senders would be cautioned to avoid their use. The receivers would then be asked to state the
gender and ethnic group of the sender of each message. It would then be a relatively easy matter to calculate a measure of ethnic and gender leakage via CMC.

Message transcripts from computer conferences should be analyzed for the presence of communication genres. Once successful dyads and unsuccessful communication between individuals are identified, these could be studied in more detail. A thread of messages could be analyzed by attempting to quantify changes in communication genre usage in unbroken threads (successful CMC) and broken threads (unsuccessful CMC) over virtual time. Real time trends may not prove reliable in cyberspace. The order of message entry may be a better measure than the elapsed real time between messages.

In order to encourage the use of electronic paralanguage (EP), macros could be prepared for common graphical arrays and expressions. The use of single key stroke macros could make the use of EP much easier and thus, give users an additional information channel to add to their messages.

A research agenda involving systematic investigation of the important variables in CMC should be established. The model proposed in this study could be used in qualitative investigations of communication genres. More quantitative studies to determine patterns of CMC usage by different ethnic groups, and by males and females could prove very useful. A standard formula for classifying CMC users as Heavy or Light
would also allow comparisons to be made between different studies. Each user could be given a rank in the three measures of computer usage, i.e., number of logons, number of messages sent, and total bytes. The sum of the ranks would be the individual's computer usage score.
APPENDIX A

Human Subjects Approval and Letters of Consent
CONSENT FOR PARTICIPATION IN SOCIAL AND BEHAVIORAL RESEARCH

I consent to my child participating in (or my child’s participation in) research entitled:

An Analysis of Computer-Mediated Communication Between Middle-School Students and Scientist Electronic Role Models

Dr. Stanley Helgeson or his/her authorized representative (Principal Investigator)

has explained the purpose of the study, the procedures to be followed, and the expected duration of my (my child’s) participation. Possible benefits of the study have been described as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Further, I understand that I am (my child is) free to withdraw consent at any time and to discontinue participation in the study without prejudice to me (my child). Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Signed: __________________________
(Participant)

Signed: __________________________
(Principal Investigator or his/her Authorized Representative)

Signed: __________________________
(Person authorized to consent for Participant If Required)

Witness: __________________________

HS-027 (Rev. 3/87) --(To be used only in connection with social and behavioral research.)
Solicitation Script Used to Recruit Science Teacher/s at Everett Middle School

Volunteers Needed!

This is a request for student volunteers along with their science teacher/s to take part in a project involving Ohio State University, scientists and non-scientists from the Battelle Institute and seventh grade students from Everett Middle School. During this project each student will use a computer to send electronic mail to scientists or non-scientists at the Battelle Institute.

The project will last ten weeks and you the science teacher/s will be expected to lend moral support and whatever other assistance you can provide to your students. Each student will be expected to send at least two E-mail letters per week to the scientists and read the letters they send back. The students will also be able to ask the scientists/non-scientists for advice, for help with homework or to just talk. All E-mail letters and conversations will be read and monitored by the researcher. A content analysis will also be carried out by the researcher on all E-mail communications. Your students have the right to drop out of the study at any time or to refuse to answer any questions on the questionnaires. If you and your students participate in this study your students will learn how to use electronic mail and electronic bulletin board systems and get to meet some very interesting people.

The Principal Investigator in this study is Dr. Stanley Helgeson who is a Professor in the Educational Studies department of the Ohio State University. He may be reached at the following telephone number and address if you have any questions:

Dr. Stanley Helgeson
249 Arps Hall
1945 N. High St.
Columbus, OH 5381

292-5381

I am looking forward to your participation.

Thank You,

Brian Murfin
Doctoral student at Ohio State University
Educational Studies
249 Arps Hall
1945 N. High St.
Columbus, Ohio
Volunteers Needed!

This is a request for student volunteers to take part in a project involving Ohio State University, scientists and non-scientists from the Battelle Institute and seventh grade students from Everett Middle School. During this project each student will use a computer to send electronic mail to scientists or non-scientists at the Battelle Institute.

The project will last ten weeks and you will be expected to send two E-mail letters per week to the scientists and read the letters they send to you. You will also be able to ask the scientists/non-scientists for advice, for help with your homework or to just talk. All E-mail letters and conversations will be read and monitored by the researcher. A content analysis will also be carried out by the researcher on all E-mail communications.

You will be given two questionnaires to complete at the end of the project which will take approximately one hour each. You have the right to refuse to answer any question/s. In addition you will complete a short survey on computer anxiety at the beginning and end of the study. If you decide to participate, you may drop out of the study at any time. If you take part in this study you will learn how to use electronic mail (E-mail) and electronic bulletin board systems and get to meet some very interesting people. If you are interested in taking part in this study please inform your science teacher, Ms. Taylor or Mr. Ryan, the Computer Awareness teacher.

The Principal Investigator in this study is Dr. Stanley Helgeson who is a Professor in the Educational Studies department of the Ohio State University. He may be reached at the following telephone number and address if you have any questions:

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The study will last ten weeks and you will be expected to send at least two E-mail letters per week to the student/s and read the letters they send to you. The students will also be able to ask you, the scientists/non-scientists, for advice, for help with their homework or just talk. All E-mail letters and conversations will be read and monitored by the researcher. A content analysis will also be carried out by the researcher on all E-mail communications. At the end of the study you will be asked to rate your perceptions of the students' behaviors and values as you perceive them from the messages you received. This will take approximately one hour to two hours. In addition, you will be asked to complete a questionnaire, which will take approximately thirty minutes, evaluating the success of the project.

If you decide to participate, you may drop out of the study at any time. You also have the right to refuse to answer any questions. Research results and findings will be made available upon request.

If you participate in this study you will contribute to the growing body of knowledge on computer-mediated communication. Another possible outcome of this project will be the chance of increasing the students' career awareness by providing them with contact with scientist and non-scientist role models.

The Principal Investigator in this study is Dr. Stanley Helgeson who is a Professor in the Educational Studies department of the Ohio State University. He may be reached at the following telephone number and address if you have any questions:

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The project will last four weeks and your child will be expected to send two E-mail letters per week to the scientists and read the letters they send to him/her. Your child will also be able to ask the scientists/non-scientists for advice, for help with homework or to just talk. All E-mail letters and conversations will be read and monitored by the researcher. A content analysis of all E-mail communications will also be carried out by the researcher.

Your child will be given two questionnaires at the end of the project which will take one hour each to complete. The first questionnaire will involve the children rating the perceived behavior and values of the scientists and non-scientists they communicated with. The second questionnaire will ask the students to evaluate the success of this project. In addition each student will fill out a short survey on computer anxiety at the beginning and end of the study. The students involved in the study will also be interviewed at the beginning and end of the study. The interview questions will be about any science and computer experiences your child has had out of school such as going to the zoo etc. and questions about the occupations of the members of the student’s immediate family and about their use of computers. Your child has the right to refuse to answer any of the questions. If your child decides to participate, he or she may drop out at any time. If your child participates in this study he/she will learn how to use electronic mail (E-mail) and electronic bulletin board systems and get to meet some very interesting people.

The Principal Investigator in this study is Dr. Stanley Helgeson who is a Professor in the Educational Studies department of the Ohio State University. He may be reached at the following telephone number and address if you have any questions:

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I am looking forward to your child’s participation.

Thank You,

Brian Murfin  
Doctoral student at Ohio State University  
Educational Studies  
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APPENDIX B

Pre-study Interview Outline
1. **Introduction**
   - Greeting, pleasantries e.g. How are you? Talk about
     the weather, miscellaneous topics to set student at
     ease

2. **Family and home life**
   - parents' occupations
   - other relatives' occupations
   - siblings, number, occupations
   - hobbies and leisure activities of significant others
   - favorite TV shows; least favorite TV shows
   - types of magazines and books, newspapers in home
   - favorite toys, games; least favorite toys, games
   - Parents' and significant others' opinions of science

3. **Student's Role models**
   - Who do you admire and why? Who is your hero/heroine
     and why?
   - Who do your fellow students admire and why?

4. **Exposure to scientists.**
   - where, when, who, how many times?

5. **Other possible exposure to science role models**
   - science field trips to COSI, zoo, museum, other

6. **Career preferences**
   - What kind of job do you want to get after you finish
     school? Why?
   - Do you want to go to college? Why or why not?

7. **Student's confidence in their ability to become a scientist**
   - Do you feel you could become a scientist? Why or why
     not?
   - Has anyone ever encouraged or discouraged you from
     becoming a scientist? Please explain your answer.

8. **Using your knowledge of scientists, please describe to me a day in the life of an average scientist, from the time he or she leaves for work until the time he or she comes home.**

9. **After all these questions, what do you really think about science?**

10. **Do you have anything else you would like to tell me about science or scientists?**

11. **Do you have a computer at home? If yes, what kind is it, how long have you had it, what do you use it for?**

12. **Do you like using computers? Why or why not?**

13. **Do your parents and other family members like or dislike computers? Why or why not?**

14. **Do you like working in groups? Are you usually the first one to contribute something in a group discussion, somewhere in the middle, or one of the last to contribute to a discussion?**

15. **Thank student for her/his time and cooperation.**
APPENDIX C

Results of Pre-Study Interviews
Figure 26. Pre study question 2d hobbies
Figure 26. Continued.
Figure 27. Pre study question 2e favorite tv shows
Figure 28. Pre study question 2f reading material in the home
Figure 29. Pre study question 2g favorite toys, games
Figure 30. Pre study question 2h parents' opinions of science
Figure 31. Pre study question 3a "Who do you admire?"
Figure 3.2. Pre study question 3b No. of students with no heroine or hero
Figure 3c. Pre study question 3c "Who do your fellow students admire?"
Figure 34. Pre study questions 4 and 5 Exposure to scientists
Figure 35. Pre study question 6a Career preferences
Figure 36. Pre study question 6b Reasons for career choice
Figure 37. Pre study question 7 Is student able to become a scientist?
Figure 38. Pre study question 8 A day in the life of a scientist
Figure 38. Continued
Figure 39. Pre study question 9 "What do you really think about science?"
Figure 40. Pre study question 11 "Do you have a computer at home?"
Figure 41. Pre study question 12b Reasons for liking computers
Figure 42. Pre study question 13 Do parents like or dislike computers?
Pre FTF Questionnaire

Please circle the answer with which you agree most.

1. I would have liked to meet the Battellites/students face to face before sending them messages with the computer.

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2. I would like to talk with the Battellites/students face-to-face.

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3. I would like to do the same kind of work as one of the Battellites.

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4. I am comfortable using the computer to communicate with the Battellites/students.

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APPENDIX E

Students' Message Maps
Figure 43. Message map for student ANM
Figure 44. Message map for student BOT
Figure 45. Message map for student DAM
Figure 46. Message map for student DOK
Figure 47. Message map for student ENV
Figure 48. Message map for student JAA
Figure 49. Message map for student LOH
Figure 50. Message map for student MIM
Figure 51. Message map for student MRL
Figure 52. Message map for student TIH
Figure 53. Message map for student EDW
Figure 54. Message map for student FRJ
Figure 55. Message map for student JAJ
Figure 56. Message map for student KOK
Figure 57. Message map for student LIR
Figure 58. Message map for student MAX
Figure 59. Message map for student MIR
Figure 60. Message map for student LEM
**Figure 6.1** Message map for Battellite AUL
Figure 62. Message map for Battellite DAB
Figure 63. Message map for Battellite JEP
Figure 64. Message map for Battellite MRS
Figure 65. Message map for Battellite SCF
Figure 66. Message map for Battellite SNB
Figure 67. Message map for Battellite THM
Figure 68. Message map for the sysop
APPENDIX F

Post-Study Questionnaire
Please answer the following questions about your participation in the Everett-Battelle-Ohio State BBS:

Circle the choice which is closest to your feelings about each statement.

Example: Dan Quayle knows how to spell potato.

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1. I enjoyed using the BBS.

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2. It was easy for me to find my messages.

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3. I had enough time to read my messages.

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4. I enjoyed communicating with the Battellites/students.

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5. I would rather send messages using the U.S. mail instead of using a computer.

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6. I would rather have met the Battellites/students face-to-face instead of using the computer.

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<tr>
<th>SA</th>
<th>A</th>
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<tbody>
<tr>
<td><strong>strongly</strong> agree</td>
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<tr>
<td><strong>agree</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>strongly</strong> disagree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>disagree</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. I became good friends with a Battellite/student by communicating through the computer.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
</tr>
</tbody>
</table>

8. I received good advice from a Battellite/student.

<table>
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<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
</tr>
</tbody>
</table>

9. I like working in groups.

<table>
<thead>
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<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

10. I am usually the first person to speak up in a face-to-face group.

<table>
<thead>
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<th>SA</th>
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<th>SD</th>
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</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

11. I like to use a lot of "body language" and gestures when I speak to people face-to-face.

<table>
<thead>
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<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

12. There is a computer in my home.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</table>

13. Males are better at using computers than females.

<table>
<thead>
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<th>SA</th>
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<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
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<td>strongly disagree</td>
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</table>


<table>
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<th>A</th>
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</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
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</table>
15. My parents like computers.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
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<th>SD</th>
</tr>
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<tbody>
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<td></td>
<td>strongly</td>
<td>agree</td>
<td>disagree</td>
<td>strongly disagree</td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

16. The editor for correcting mistakes was easy to use.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
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<th>SD</th>
</tr>
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<td>strongly</td>
<td>agree</td>
<td>disagree</td>
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</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

17. I enjoyed the Forum most of all the conferences.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
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<tr>
<td></td>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

18. There were too many conferences.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
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<th>SD</th>
</tr>
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<tbody>
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<td>strongly</td>
<td>agree</td>
<td>disagree</td>
<td>strongly disagree</td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
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</tbody>
</table>

19. People did not answer their mail fast enough.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
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<th>SD</th>
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<tr>
<td></td>
<td>agree</td>
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</tbody>
</table>

20. The things talked about in the Forum were boring.

<table>
<thead>
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<th>SA</th>
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<th>D</th>
<th>SD</th>
</tr>
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<tr>
<td></td>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

21. The things talked about in Mickey D’s were interesting.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
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<tbody>
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<td>agree</td>
<td>disagree</td>
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</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

22. The things talked about in the Gym were boring.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
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<tbody>
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<td></td>
<td>strongly</td>
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<td>disagree</td>
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</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
23. The things talked about in the Club were interesting.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
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<td>disagree</td>
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<tr>
<td>agree</td>
<td></td>
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</tbody>
</table>

24. The things talked about in the Mall were boring.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly</td>
<td>agree</td>
<td>disagree</td>
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</tr>
<tr>
<td>agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25. Using the BBS has helped me to learn more about science.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

26. I would like to pursue a career in science.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

27. I like using computers to communicate with other people.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
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<tbody>
<tr>
<td>strongly</td>
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</tr>
<tr>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

28. A Battellite helped me with my homework through the BBS.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
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<tbody>
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</tr>
<tr>
<td>agree</td>
<td></td>
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</tbody>
</table>

30. A Battellite helped me to solve a science problem.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
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<th>SD</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
31. I would like to be like one or more of the Battellites.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
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<tr>
<td></td>
<td>strongly Agree</td>
<td>disagree</td>
<td>strongly Disagree</td>
<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

32. I would like get a job working at the Battelle institute.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
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</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
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</tbody>
</table>

33. I have changed my career choice to science after communicating with the Battellites.

<table>
<thead>
<tr>
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<th>SA</th>
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<th>SD</th>
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<td>disagree</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
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</tbody>
</table>

34. I have changed my career choice to something other than science after communicating with the Battellites.

<table>
<thead>
<tr>
<th></th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
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<td>disagree</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
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</table>

35. I would like to use CMC (computer-mediated communication) again in the future.

<table>
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<th>SA</th>
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<th>D</th>
<th>SD</th>
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<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

36. I sometimes became angry with a person who sent me messages using the computer.

<table>
<thead>
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<th>SD</th>
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<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
<td></td>
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</tr>
</tbody>
</table>

37. Sometimes I became angry with the computer.

<table>
<thead>
<tr>
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<th>SD</th>
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<td></td>
</tr>
<tr>
<td></td>
<td>agree</td>
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</tbody>
</table>

38. The sysop did a good job.

<table>
<thead>
<tr>
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<td></td>
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<tr>
<td></td>
<td>agree</td>
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</tbody>
</table>
39. The sysop did not know what he was doing.

<table>
<thead>
<tr>
<th>SA</th>
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<th>SD</th>
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</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

40. There were mechanical problems with my computer.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
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<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
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</table>

41. The phone line was often busy when I tried to call the BBS.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
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<th>SD</th>
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</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
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</table>

42. I sometimes had difficulty logging on to the computer.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
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<th>SD</th>
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</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

43. I love computers.

<table>
<thead>
<tr>
<th>SA</th>
<th>A</th>
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<th>SD</th>
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</thead>
<tbody>
<tr>
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<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>

44. My computer teacher encouraged me during this project.

<table>
<thead>
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<th>SA</th>
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</thead>
<tbody>
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<td></td>
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</tbody>
</table>

45. My computer teacher helped me when I had problems with the computer.

<table>
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<th>A</th>
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</table>

46. My science teacher encouraged me during this project.

<table>
<thead>
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<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>strongly agree</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
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</tbody>
</table>
47. I enjoyed having an alias.

<table>
<thead>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>agree</td>
<td></td>
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<td>disagree</td>
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</tbody>
</table>

48. I wish I could have had more than one alias.

<table>
<thead>
<tr>
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</tr>
<tr>
<td>agree</td>
<td></td>
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<td>disagree</td>
</tr>
</tbody>
</table>

49. My alias is very different from how my friends at school think of me.

<table>
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</thead>
<tbody>
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<td>disagree</td>
<td>strongly</td>
</tr>
<tr>
<td>agree</td>
<td></td>
<td></td>
<td>disagree</td>
</tr>
</tbody>
</table>
APPENDIX G

Post study questionnaire results
Table 13.
Post-Study Student Questionnaire Results.

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Strongly Agree=3</th>
<th>Agree=2</th>
<th>Disagree=1</th>
<th>Strongly Disagree=0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>9</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>9</td>
<td>4</td>
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*=Questions not relevant to Battellites and therefore responses are missing.
APPENDIX H

Post-study interview protocol
Introduction, pleasantries to set interviewee at ease.

1. Did you enjoy this project? Why or why not?
2. What did you like the most?
3. What did you like the least?
4. What kind of problems did you have with the computer hardware?
5. What kind of problems did you have with the BBS program?
6. How would you improve the BBS program?
7. What would have encouraged you to send more messages?
8. What kind of messages did you like to read most? least?
9. Describe your personality to me as your friends at school would.
10. Describe your alias' personality.
11. What went through your mind when you first met the Battellites/students face-to-face?
12. Were you surprised when you met the Battellites? Why or why not? Were they different from what you expected?
13. Do you think this is a good idea, sending messages to people through the computer? Why or why not?
14. If you could leave me a message now on the BBS about this project, what would it say?
APPENDIX I

Results of the Post-Study Interview
Figure 69. Post study question one "Did you enjoy this project? Why?"
Communicate w Scient 4
Using computers 4
Trip to Battelle 8
Receiving mail 1
Meeting Battelites 3
Sending messages 2

Figure 70. Post study question 2 "What did you like the most?"
Figure 7.1. Post study question 3 "What did you like the least?"
Figure 72. Post study question 4 Problems with computer hardware

- None: 15
- Not enough time: 1
- Modem problem: 1
- Glitches with Mac: 2
- Didn't know phone #: 1
Figure 73. Post study question 5 Problems with bbs program
Figure 74. Post study question 6 "How could you improve the bbs program?"
Figure 75. Post study question 7 What would encourage more messages?
Figure 76. Post study question 8a Messages you like to read most
Figure 77. Post study question 8b Messages liked least
Figure 78. Post study question 9 Describe your personality
Figure 79. Post study question 10a Alias' personality different?
Figure 80. Post study question 10b Your alias' personality
Figure 81. Post study question 11 First impression of Battellites
Figure 82. Post study question 12a Surprised when you met the Battellites?
Figure 83. Post study question 12b Surprised when you met the Battellites? Reasons

- Pers didn't fit name: 3
- Thought Batt. Afr Am: 2
- No Afric. Americ.: 1
- Some silly, crazy: 2
- White lab coats?: 3
- Thought age different: 3
- Thought no joking: 2
- Nice, no sci jargon: 3
Figure 84. Post study question 13 Is CMC a good idea?

Reasons
Figure 85. Post study question 14 Leave messages on bbs about project
APPENDIX J

Computer Anxiety Scale Short Form (CAS-SF)
**CAS-SF Inventory**

Three statements are about you and computers. Mark each statement by circling the number that tells how much you believe the statement is true.

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1. Most of the time, I would feel good about trying to use a computer.
2. I'm not good with hard things like computers.
3. I would feel okay in classes where I used a computer.
4. I will not use computers very often in school.
5. Classes where computers are used would be my worst classes.
6. I'd be happy to get good grades in classes where computers are used.
7. I don't think I could learn how to use a computer.
8. Even if I tried hard, computers would be hard for me to use.
9. I will use computers in many ways when I grow up.
10. I'm not the type of person to do well on computers.
11. I get scared when I think about working with computers.
12. I think I could handle hard computer problems.
13. Knowing how to use a computer will help me make money someday.
14. It would bother me to use a computer in class.
15. I would have problems with classes that use computers.
16. I would have a hard time learning to use a computer.
17. I'll use computers someday when I get a job.
18. I can't work with computers because I'm not smart enough.

To score the instrument:

1. Record the responses to items 1, 2, 3, 4, 9, 12, 13, and 17 so that responses of 1 are recorded to 6, 2 are recorded to 4, 3 are not recorded, 4 are recorded to 2, and 5 are recorded to 1.
2. Total the student's marked responses to the items not recorded in step 1 and the seven

---

**Figure 86.** The computer anxiety scale short form.
LIST OF REFERENCES


Bales, Robert, F. (1988) A new overview of the SYMLOG system: Measuring and changing behavior in groups. In Richard Brian Polley et al. (Eds.), *The SYMLOG practitioner applications of small group research* (pp. 319-344).


Graddol, David. (1989). Some CMC discourse properties and their educational significance. In Robin Mason & Anthony Kaye (Eds.), *Mindweave communication, computers and distance education* (pp. 236-241)


Myers, David. (1987). "Anonymity is part of the magic": Individual manipulation of computer-mediated communication contexts. *Qualitative Sociology* 10(3), 251-266.


