These pages are a quick and dirty conversion of my Ph.D. thesis into HTML. The files can be viewed individually here or downloaded as a lump in either .zip (220K) or .sit.hqx (304K) formats.

My thesis can also be obtained conventionally through the University of Cambridge.

Dan Hillman
hillman@quahog.org

Table of Contents


Abstract

The role of language in education

- The nature of classroom language
  - Lecture
  - Recitation
  - Discussion
- Language and new technologies
- Characteristics of FTF classroom interaction
  - Social status
  - Sex issues
  - Social apprehension and withdrawal
- Characteristics of CMC interaction
  - Asynchronous
  - Reduced social presence
  - Reduced social cues
  - Reduced social identity and deindividuation
Comparing FTF with CMC

- **Data collection**
  - Courses
  - Modes of delivery
  - Teachers
  - Students

- **Transcription**
  - Collecting the data
  - Transcription procedure

- **Database**
  - Description of the database
  - AppleScript
  - FTF transcripts
  - CMC transcripts

- **New coding system**
  - Bellack et al.'s system
    - Why use Bellack et al.'s system?
    - Description of Bellack et al.'s system
      - Speaker
      - Type of pedagogical move
      - Substantive meaning
      - Substantive-logical meaning
      - Instructional meaning
      - Instructional-logical meaning
  - New system
    - Development
    - Description
      - Purpose
        - Organising
        - Eliciting
        - Responding
        - Lecturing
        - Humanising
        - Idling
        - Not Clear
      - Mechanism
        - Fact-Stating
Discussion

- Analysis of data
  - Extracting and plotting
  - How much did participants speak?
  - FTF interruptions
- Testing for recitation behaviours
  - Predominant speaker
  - Typical exchange
  - Overall pace
- Testing for CMC-specific behaviours
  - Humanising
  - Opining
  - Organising and Repeating
  - (Explaining or Performing) and Procedure

Conclusion (Appendices shall be made available later)

- Appendix A: Course and class attendance
- Appendix B: Instructions for transcriptionists
- Appendix C: Random Student Selection
  - Purpose and requirements
How the script works
Shortcomings of the script
Random Student Selection

Appendix D: Transcript to Database
Purpose and requirements
How the script works
Shortfalls of the script
Transcript to Database

Appendix E: Metadata Extraction
Purpose and requirements
How the script works
Shortcomings of the script
Metadata Extraction

Appendix F: Extract Large Sentences
Purpose and requirements
How the script works
Shortfalls of the script
Extract Large Sentences

Appendix G: CMC to Database
Purpose and requirements
How the script works
Shortfalls of the script
CMC to Database

Appendix H: Select Random Records
Purpose and requirements
How the script works
Shortfalls of the script
Select Random Records

Appendix I: Extracting course data
Appendix J: Expected probability
Student utterances
Expected probability of FTF interruptions

Appendix K: Who Interrupted Whom
Purpose and requirements
How the script works
Shortcomings of the script
Who Interrupted Who

Appendix L: Analysis of code distribution
Appendix M: Count Contiguous Utterances
Purpose and requirements
How the script works
Shortcomings of the script
Count Contiguous Utterances
References

hillman@quahog.org 1997

**Abstract**

The author created tools to facilitate the analysis of large amounts of discourse data, using commonly available Macintosh software and hardware. He also developed a coding system, based on Bellack et al.'s (1966) system of pedagogical moves, to study patterns of interaction.

Using these new programs and coding system, the text of all spoken or written discourse from four face-to-face (FTF) courses and two courses taught via computer-mediated communications (CMC) was analysed. This represented the equivalent of 130 hours of classroom discourse, or over 52,000 sentences.

The subjects for this study were the teachers and students at New York University's School of Continuing Education and New York University's Virtual College.

The interaction patterns in the CMC courses resembled discussion whereas the patterns in the FTF courses resembled recitation. Although researchers have viewed FTF classroom discussion and asynchronous CMC as potentially effective ways to foster collaborative learning environments (e.g., Berge & Collins, 1995; Mason & Kaye, 1989; Moll, 1990), it had been difficult to compare discourse across different courses and modes of delivery. With the creation of these programs, however, it is now possible to perform such analyses on a large scale.

[continue]
"Miss Kelly said that when you talk to somebody it's like you're playing ball. First the somebody asks you a question, and that means they throw the ball to you. But you have to do more than just catch a question like you catch a ball. Here's the important part. You have to throw the ball back. When somebody asks how you are, you can't just say, 'Fine.' You say, 'Fine, thank you, and how are you?'

"What does this have to do with…?"

"Everything," I said. "Miss Kelly said you have to throw the ball back. So I threw it back, and by mistake the ball hit Miss Boland." (Peck, 1974, p. 5f)

Vygotsky (1978) writes that "…children solve practical tasks with the help of their speech, as well as their eyes and hands" (p. 26). In Vygotsky's view, speech is an extension of intelligence and thought, a way to interact with one's environment beyond physical limitations:

…the most significant moment in the course of intellectual development, which gives birth to the purely human forms of practical and abstract intelligence, occurs when speech and practical activity, two previously completely independent lines of development, converge (p. 24).

This higher level of development enables children to transcend the immediate, to test abstract actions before they are employed. This permits them to consider the consequences of actions before performing them. But most of all, language serves as a means of social interaction between people, allowing "the basis of a new and superior form of activity in children, distinguishing them from animals" (Vygotsky, 1978, p. 28f).

The ability to use language to help solve problems is a tool. Rather than trying to understand the world alone, a child can enlist the help of older children, adults, or other authorities. As a result, Vygotsky believed that a child's potential should be measured not merely in terms of what a child already understands, but should include the child's capacity to profit from what others can help the child to understand (Spencer, 1988; Vygotsky, 1962). This difference between what one can do and one's potential to engage the help of others and profit from it Vygotsky called the zone of proximal development, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). The more children take advantage of an authority's support, the wider is their zone of proximal development and, ultimately,
For example, I have never studied Japanese. If I were tested on the subject today, I would do very poorly. One might infer, based on those results, that my Japanese ability was very poor. However, if I were to enrol in a Japanese course -- enlist the help of others to make me a better Japanese speaker -- another test might indicate that I am rather good at the language. My ability to learn Japanese is the same as it ever was. What is different is the inclusion of my zone of proximal development -- my use of the knowledge of others to change my understanding. On the other hand, even with the help of others, I might still be unable to grasp the language. If this were the case, my zone of proximal development (at least for Japanese) would be small; my ability to use an authority's support to learn Japanese would be near zero.

Vygotsky "viewed intelligence as the capacity to benefit from instruction, with language having a powerful developmental role" (Spencer, 1988, p. 170). In this sense, language is a tool for learning and an aid to understanding. Writes Vygotsky (1978), "human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (p. 88). As such, language acts as a vehicle for educational development and is important for the apprehension and acquisition of knowledge.

Vygotsky (1978) maintained that the zone of proximal development is an "essential feature of learning" (p. 90), in which one builds on one's knowledge through interaction and co-operation with one's peers. In this sense, the authority or teacher in all learning situations acts as a collaborator and coach, in which he or she "provides scaffolding to lead the student to increased understanding" (Hawisher, 1994, p. 44). In this respect, the basis of education is people interacting with other people (Daniels, 1996; Shale, 1988; Shale & Garrison, 1990).

In the educational context, language is important for comprehension and making use of knowledge. Shale (1988) describes the role of the teacher in the "ideal educational process" (p. 28) in four parts: First, the teacher and the student determine and validate what the student knows. Second, on the basis of what is determined, the teacher may provide additional declarative knowledge. Third, the teacher and the student negotiate the meaning of what is taught. The assumption is that the teacher will clarify points for the student, but in the best exchanges the teacher also gains understanding (Shale & Garrison, 1990). Fourth, through repetitions of steps two and three, both the teacher and the student advance in their knowledge, and the student's knowledge is validated by the teacher.

The zone of proximal development is observed during this third step of the schooling process, in which teachers help "others to gain consciousness and reach higher ground intellectually, transforming the meaning of the lower order concepts" (Spencer, 1988, p. 176), also (Schaffer, 1996; Vygotsky, 1962). In this step there is "room for the negotiation of meaning and the prospect of mutual learning through dialogue and discussion" (Rowntree, 1975, p. 284). In an ideal form of education, the teacher and student engage in what King and Brownell (1966) refer to as "The Great Conversation."

Unfortunately, a great deal of actual schooling time is spent conveying information, rather than ensuring
comprehension. This often precludes the formation of an interactive learning environment in which learning is an ongoing process shared between the teacher and students. Hodge (1993) notes that in schooling the difference in knowledge between teachers and students is so great that it simultaneously justifies and impedes the educational process. In the limited amount of time in a class, teachers conveying information do so at the expense of negotiation of meaning. However, when teachers are negotiating meaning, they are not providing declarative knowledge. To use Shale's (1988) description of the educational process, steps two and three are in opposition; one may have more of one, but only by having less of the other.

In the last 30 years, a number of educational researchers have begun to emphasise the role of language in learning, particularly the role of talk in the classroom. The disparity between the amount of talk performed by teachers and students was often seen as an hindrance to learning (Barnes, 1971; 1976; Bellack, Kliebard, Hyman & Smith, 1966; Britton, 1970; 1971; Brown, Anderson & Shillcock, 1984; Bullock, 1975; Cazden, 1988; Flanders, 1970; Hodge, 1993; Sinclair & Coulthard, 1975). As Kingman (1988) noted:

In addition to encouraging the development of speech for communication, teachers need to encourage talk which can be exploratory, tentative, used for thinking through problems, for discussing assigned tasks, and for clarifying thought: talk is not merely social and communicative, it is also a tool for learning (p. 43).

Despite these concerns, however, the nature of teacher-student language in the classroom has remained largely the same (Dillon, 1985; 1994; Hodge, 1993; Jones, 1988).

The nature of classroom language

Within the realm of education, there are three basic types of formal classroom discourse. Over time, it is possible for any given course to include all three of these forms of interaction. It is possible for a course to be taught by means of any of these modes of interaction, or by any combination of them. Each mode has its own distinctive traits, as well as advantages and disadvantages.

Lecture

The first and least-interactive mode of teaching is the lecture. In a lecture, material is conveyed in what is intended to be one-way uninterrupted discourse, as though delivering a speech (Hills, 1979). Although it is seen in face-to-face (FTF) situations, this is also used to describe the delivery of content which cannot be questioned or altered, such as books, radio, television, audio tape, videocassettes, and some forms of multimedia. In a classroom, lecturing by a teacher would be performed by reading a lesson while soliciting no interaction from the audience.

In this form of teaching, there is no overt negotiation of meaning with the teacher. Rather, students
participate in an "internal didactic conversation" (Holmberg, 1986) during which they interact with course materials and "talk to themselves" about this new information and ideas. Lewis (1975) explains that when people ponder what they have learned in solitude, they are actually having a conversation with themselves. In the realm of distance education, this interaction with the course content is described as learner-content interaction. In his analysis of different kinds of interaction which must be acknowledged in distance education, Moore (1989) places it as the "defining characteristic" of education: "Without it there cannot be education, since it is the process of intellectually interacting with content that results in changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (p. 2). Although researchers -- myself included -- have acknowledged the importance of this intrapersonal communication between a student and the instructional content (Dillon & Gunawardena, 1995; Hillman, Willis & Gunawardena, 1994; Holmberg, 1988; Moore, 1989; Wagner, 1994), it does not and cannot replace the teacher for validation and negotiation of learning.

Although the lecture format is effective for disseminating information, it does so at the expense of validating this knowledge and making it meaningful to the student (Shale, 1988; Shale & Garrison, 1990). Although interaction appears to be occurring between the student and the content, it is actually a counterfeit form of interaction (Button & Sharrock, 1995) aping a collaborative environment. In a Vygotskian sense, the zone of proximal development may be entered by the use of lecture-style means, such as books or television programs, but the limitations of the medium restrict the amount of guidance and collaboration that can occur. Holmberg (1988) observes that although pre-packaged materials for distance education can represent a kind of "simulated communication," it is the interaction between humans that "represents real communication" (italics in original, p. 116).

Recitation

The most typical form of classroom interaction is recitation, which has two predominant characteristics. First, the teacher is the predominant speaker. Although students are now permitted to interact with the teacher, the teacher will guide and control the class by means of asking questions, giving instructions, and giving information (Edwards & Furlong, 1978; Hodge, 1993; Sinclair & Brazil, 1982; Sinclair & Coulthard, 1975).

In most schools, on average the teacher speaks for 59% to 69% of the time (Dillon, 1985; 1994). Kramarae and Treichler (1990) report that it is typical for teachers in college classrooms in the United States to speak for 75% of the time. Bellack, Kliebard, Hyman & Smith (1966) found in their experimental social studies classes, taught to seventeen-year-olds, that teacher speech varied from 60% to 93% of all classroom discourse, with the median at 73%. These numbers are similar in the United States (Dillon, 1985; 1994) and the United Kingdom (Barnes, 1976).

This classroom domination is evidenced in the artificial interactions that take place in the classroom. Edwards and Furlong (1980) describe the educational process as a performance, in which the students' collective attention is focused on the teacher. Adams and Biddle (1970) explain that "...despite the presence of thirty or more potential communicators, what has been called a 'central communication
The role of language in education system' is frequent and often prolonged." This invariance inspired Flanders (1970) to devise the "two-thirds" rule: two-thirds of every class is made up of talk, and two-thirds of the talk comes from the teacher. This centralised communication is reinforced and maintained by means of rhetorical techniques such as responding to questions by asking another question, traditionally a technique used by teachers (Gere & Stevens, 1985).

The second characteristic of recitation is that the interaction between the teacher and students will follow a regular pattern. The teacher will initiate some form of action, usually a question, the student will respond, and the teacher will acknowledge the student's response (Atkinson, 1981; Dillon, 1985; 1994; Hodge, 1993; Mehan, 1978; Sinclair & Brazil, 1982; Sinclair & Coulthard, 1975; Stubbs, 1983b). This mode of interaction is described by Sinclair and Coulthard (1975) as Initiation-Response-Feedback. They propose that it is the quintessential teaching exchange: (teacher's) initiation, (student's) response and (teacher's) feedback (Stubbs, 1983b). The last stage is also known as evaluation (Mehan, 1978).

These two characteristics of recitation are interrelated. Since the teacher is controlling the class by means of initiation and feedback -- two-thirds of the turns -- he or she will necessarily do most of the talking (Atkinson, 1981). When the student asks a question, however, the structure is reduced to initiation-response since students do not "overtly evaluate teachers' answers" (Stubbs, 1983b).

From a Vygotskian viewpoint, recitation is better than lecture because it includes "the provision of two-way communication so that the student may benefit from or even initiate dialogue" (Keegan, 1986, p. 49). This permits the student to enlist the help of the teacher to negotiate meaning of the course content (Cennamo, Abell, Chung, Campbell & Hugg, 1995; Gunawardena, 1991), and thus more fully engage his or her zone of proximal development.

**Discussion**

The third form of classroom interaction is discussion. Like recitation, discussion has several observable characteristics (Dillon, 1994). The first attribute of discussion is that rather than being dominated by the teacher, the students do most of the talking. Unlike a lecture or recitation where the teacher will do all or two-thirds of the talking respectively, the students in a discussion will generate half or more of the talk (Dillon, 1985; 1994).

The second characteristic of discussion is that although the students are participating in the discussion, it will not follow the initiation-response-feedback model of recitation. Rather, there will be a mix of statements and questions by a mix of teachers and students (Dillon, 1994). For Shale (1988), this form of interaction is the ideal educational process for it permits the student to validate his or her "emerging knowledge through collaborative and sustained interaction with a teacher and other students" (Shale & Garrison, 1990, p. 29f).

Discussion is rarely used in classrooms, however. Although teachers believe that they are doing so, as indicated by self-report, external observation indicates that this is not the case (Alvermann, O'Brien &
Dillon, 1990; Connor & Chalmers-Neubauer, 1989). This is unfortunate, because from a Vygotskian perspective, discussion is the best method of teaching. It fosters co-operative learning between all of the participants (Fowler & Wheeler, 1995), and reinforces the idea that the teacher's role is that of an active, communicative partner in learning, not merely a provider of a certain learning environment or one who enforces correct behaviours (Jones & Mercer, 1993).

The relevance of this form of communication supports the research of Amidon and Giammatteo (1967) who found that superior elementary-school teachers [1] were interrupted more by questions from students, were more accepting of student-initiated ideas, tended to encourage these ideas more, and also made more of an effort to build on these ideas than did the average group of teachers. Overall, there was about 12% more student participation in the classes of the superior teachers.

This increase in student participation also reflects the findings of Gabriel & Davey (1995), who interviewed student nurses who were taking their classes by means of distance education. They found that the students could learn elementary facts with no trouble with the lecture materials (self-study packs). For abstract or complex ideas, or issues other than facts, however, the students found FTF interaction with other students important and "particularly necessary when the work involves challenges to existing values and attitudes" (p. 500).

Language and new technologies

Although research has examined the role of peer collaboration in FTF environments (Gallimore & Tharp, 1990; Newman, Griffin & Cole, 1988; Nunes, Schielmann & Carraher, 1993; Tharp, 1993), only recently has appropriate technology become available to enough people to examine the role of peer collaboration via computer-mediated communication (CMC) in educational contexts.

Historically, distance education was based on a one-to-one (teacher-student) model of correspondence study. This was primarily a response to the limitations of the instructional delivery systems (Barker, Frisbie & Patrick, 1989; Garrison & Shale, 1987; Shale, 1988; Shale & Garrison, 1990; Sherow & Wedemeyer, 1990; Verduin & Clark, 1991). Newer forms of technology have helped to change this, however, permitting the addition of student-to-student interactions (Moore, 1989).

Although research has been performed to examine the effects of peer collaboration via CMC (Hartman et al., 1995; Hiltz, 1990; Hiltz & Turoff, 1978; Hunt, 1995; Kiesler & Sproull, 1992), what has been missing is a tool to examine and compare classroom interaction across modes of delivery, as well as within, while taking into account the characteristics of each mode of interaction. With such a tool, one would be better able to study these modes of delivery's abilities, and to determine how they can best be used to promote interaction and encourage collaborative learning.

New technologies and software have allowed me to construct such a tool. By using commonly available Macintosh software and the AppleScript programming language, one can now handle the large quantities
The role of language in education

of data necessary to study the differences between the two major forms of interaction, FTF and CMC. First, however, one must know what one is looking at.

**Characteristics of FTF classroom interaction**

It is not the purpose of this work to describe inequalities of students in terms of learning per se. This section examines the differences between students in terms of things which in an ideal world would not matter in an educational environment: innate talents or natural abilities in interpersonal interaction. For the purpose of examination the following attributes have been separated, though they are often interrelated. Although they may occur in both FTF and CMC contexts, they have been placed in the sections in which they are most likely to affect interaction.

**Social status**

In classroom interaction, teachers are always in a high-status position of power. Although this may not be desired it always exists due to their role as teacher (Ellsworth, 1989; Harrington, 1992; Wilshire, 1990). This mirrors other forms of FTF interaction. Social interactions are dominated by participants with high social status, such as managers in business settings. Bales, Strodteck, Mills and Roseborough (1951) report that in many groups, participation is unequal and the proportion of the participation can be predicted by group members’ social position and personal competencies. In corporate settings, for example, supervisors speak more often than subordinates, males speak more than females, and people in the front of the room speak more than those in the back (Berkowitz & Bennis, 1961; Kiesler, 1986; Kiesler & Sproull, 1992).

People transmit information about their social status by means of physical communication and social artefacts, such as what they wear, how they stand and how loudly they speak. This information subsequently affects how much influence they will have with others (Dubrovsky, Kiesler & Sethna, 1991; Edinger & Patterson, 1982; Humphreys & Berger, 1981; Ichiyama, 1993; Kiesler, 1986; Kiesler, Zubrow, Moses & Geller, 1985; Patterson, 1982).

Reporting observations of brainstorming exercises done by executives in both FTF and CMC environments, Nunamaker, Applegate and Konsynski (1987) noted that the group members who participated in the CMC brainstorming session spent most of their available time entering comments into the computer conferencing system. During FTF interactions, however, discussions tended to be dominated by a few individuals. This was reported similarly by Dubin & Spray (1964) who found that in FTF interactions the amount a person talks has a high correlation with his or her prestige and social status.

**Sex issues**

An aspect of social interaction which is related to social status is that of sex [2] issues. Unlike the relative
The role of language in education

anonymity of CMC interactions that shall be discussed later, an individual's personal characteristics, such as physical appearance, race, and sex are apparent and potentially relevant in FTF interactions. As Bellman (1992) wrote, these are "metacommunicative properties of the meaning-contexts used for interpreting the value and validity of another's talk" (p. 60).

In the classroom, sex-based inequality manifests itself and is reinforced through two means. The first is through unequal interactions with the teacher. LaFrance (1991) explains that sex inequality comes about and continues by means of verbal and non-verbal messages in the interactions between teachers and students. Boys, for example, having called out answers without raising their hands were acknowledged whereas girls exhibiting similar behaviours were reprimanded. Teachers also interact more with boys than girls (Berk & Lewis, 1977; Etaugh & Hughes, 1975; French & French, 1984; Leinhardt, Seewald & Engel, 1979; Morse & Handley, 1985; Swann, 1992).

According to Sadker & Sadker (1990), women are less likely to be called on in college courses and when they do participate, they are more likely to be interrupted and less likely to be accepted or rewarded. This sort of unequal interaction reinforces differences between the sexes, "nudging" female students into "passivity, dependency, and silence rather than activity, autonomy, and talk" (LaFrance, 1991, p. 10).

The second manifestation of inequality is apparent through interactions with other students in the classroom. Stern glanz and Lyberger-Ficek (1977) explain that:

…it has come to be taken for granted by many faculty and students alike that men will usually dominate in college classrooms and many researchers have confirmed that women students are less likely to be verbally assertive in co-educational settings (p. 5).

This domination by male students prevents female students from having an equal opportunity to present ideas for discussion. It also means that the women have a less than equal chance to critique ideas warranting such treatment.

These findings are similar to those of Kramarae and Treichler (1990), who interviewed students at a graduate-level humanities course at the University of Illinois. They found that female students complained that the teachers "dominated" the course, and were "judging" one's point of view. They conclude that female students are less apprehensive in environments in which learning is a communal activity shared fairly by the teacher and students.

One form of domination which appears to occur between males and females in FTF interaction is interruption. Besides merely displaying rudeness and a lack of respect for the speaker, interruptions permit interruptors to control the topic or flow of the conversation and thereby to control or dominate others (Greif, 1980; Zimmerman & West, 1975).

The research suggests that when conversing with females, males do more than their share of the interrupting (McMillan, Clifton, McGrath & Gale, 1977; Natale, Entin & Jaffe, 1979; Octigan &
The role of language in education (Niederman, 1979; West & Zimmerman, 1983; Willis & Williams, 1976). When conversing in same-sex groups, however, males interrupt males as often as females interrupt females (Beattie, 1981; LaFrance, 1981; Marche & Peterson, 1993; Roger & Schumacher, 1983; Rogers & Jones, 1975).

Social apprehension and withdrawal

Anxiety is a cognitive and affective response characterised by apprehension about an impending, potentially negative outcome that one thinks one is unable to avert (Schlenker & Leary, 1985, p. 172). In the case of social anxiety, the potentially negative outcome is an undesired evaluation. Grint (1989) notes that a "critical block to participation" in the FTF classroom appears to be this fear of public ridicule. This supports the literature which concludes that people who are highly anxious in social environments are less likely to initiate conversations with other people, speak less often and for a lower percentage of the time. They are also less likely to break silences in the conversation or to disagree with others, while they are more likely to avoid topics and factual matters that might reveal their ignorance, and to reveal less information about themselves. (Arkowitz, Lichtenstein, McGovern & Hines, 1975; Borkovec, Fleischmann & Caputo, 1973; Cheek & Buss, 1981; Glasgow & Arkowitz, 1975; Held, 1987; Leary, 1983; Leary, 1988; Mansbridge, 1983; Murray, 1971; Pilkonis, 1977; Slivken & Buss, 1984; Sniderman, 1974).

High levels of social anxiety are associated with social withdrawal, the avoidance of social situations that "portend possible self-presentational difficulties" and with "prematurely leaving such situations when they are encountered" (Schlenker & Leary, 1985, p. 179). Unfortunately, in a classroom environment, this behaviour may manifest itself as a reluctance to engage in classroom dialogue, or even removing oneself from the class altogether (Brown, 1970; Brown & Garland, 1971; Cheek & Buss, 1981; Grint, 1989; Phillips & Santoro, 1989; Pilkonis, 1977; Twentyman & McFall, 1975; Zimbardo, 1977).

In an experiment of social interaction (Alden, 1986), subjects were asked to talk FTF with a confederate under low-self-awareness conditions (unaware of being observed) and high self-awareness conditions (told that they were going to be observed as well as having a video camera visible). Subjects were instructed to indicate when they had completed their tasks by pressing a button. Subjects that reported themselves as manifesting low-efficacy traits withdrew from interactions more quickly than did high-efficacy subjects when self-awareness was heightened.

CMC, however, appears to be a way to circumvent these difficulties (Grint, 1989; Mabrito, 1991; Sproull & Kiesler, 1986; Sproull & Kiesler, 1991; Zuboff, 1988). Phillips and Santoro (1989), comparing FTF with CMC interactions in a classroom environment, observed a significant difference between the types of interaction in that students could ask questions via CMC without "publicly embarrassing themselves" (p. 159f).

Characteristics of CMC interaction
CMC differs from FTF interactions by means of the characteristics and capabilities of the medium itself. As a result, the nature of the interpersonal interactions that develop as a function of those characteristics is often changed.

Asynchronous

In interpersonal interactions, not all people are created equal, and subsequently neither are the nature of their communications abilities. Grint (1989) explains that participation in discussion and decision-making groups "tends to be dominated by those embodying institutionalized power, or by the more articulate and less inhibited participants" (p. 189).

These more articulate participants have been described by Sproull and Kiesler (1991), who quote a laboratory director who categorises his scientists into two groups: "leapers" and "plodders." The leapers tend to dominate FTF meetings "because they think quickly on their feet, are witty, and love the punch and counterpunch of intellectual debate." Plodders are less likely to contribute ideas in the FTF interactions, as they prefer to "go back to their offices and think through the implications of an idea" (p. 16). If this were this a classroom situation, it is probable that these scientists' voices would not be heard; they surely wouldn't be viewed as active participants. With asynchronous CMC [3], however, the plodders are able to share their analyses with everyone in the lab using a laboratory-wide e-mail distribution list, and in this way are "just as influential" (p. 16) as the leapers [4].

One of the advantages of asynchronous interactions is that they can help to narrow the differences between the leapers and plodders. Even for those individuals who would be inclined to present their ideas in a FTF meeting, as Harasim (1987) notes, "...an individual can finish...thoughts without fear of interruption by some keen, more outgoing colleague." Bruce and Shade (1994), describing a course taught via compressed video [5], noted that "chiming in" with a question or comment by the teachers or students "bordered on a competition." This is similar to the findings of Phillips and Santoro (1989), who describe students participating in a course via asynchronous CMC as able to contribute "without having to fight their way into the discussion" (p. 160). Admittedly, this is limited by such confounding variables as a given participant's general speed of thought, access to technology to upload comments, typing speed, and available time, but in comparison to FTF interactions it makes the field a bit more level.

Asynchronous benefits can cut both ways. The technology of CMC permits the quick turnaround of responses and some may be tempted to do so. One may respond immediately, and one's message is transmitted almost instantly. This encourages quick responses that may be more similar to patterns of speech than those of writing (Owen, 1992). On the other hand, since the material is written and thus available for re-reading, plodders have an opportunity to point out the flaws in a poorly-prepared argument that they would not have in a FTF environment. This is not to say that one must take more time to compose a response in a CMC environment. The point, however, is that speed is not a requirement.

Another advantage of asynchronous communications is that participants are free to contribute when it's convenient for them and are not restricted to a certain schedule (Ehrmann, 1989; Harasim, 1989; Hiltz,
The role of language in education (Lewis, Whitaker & Julian, 1995). In an educational situation, plodders can take as much time as they need or want to prepare a response. This increases equality between students, which in turn improves the quality of educational interactions. Learning is an interactive process, and any impediment to classroom interaction is necessarily a barrier to effective instruction. Ellsworth (1989) explains that in optimum learning conditions, "all members have equal opportunity to speak, all members respect other members' rights to speak and feel safe to speak, and all ideas are tolerated and subjected to rational critical assessment against fundamental judgments and moral principles" (p. 314). This mirrors Harrington (1992) who writes that "Communicative competence can only be achieved when dialogue is not dominated" (p. 72).

Furthermore, active participation enhances one's commitment to and satisfaction with group activities. Forsyth (1983) and McGrath (1984) describe a positive correlation between the amount a subject talks and satisfaction with and commitment to his or her group. The more one participates, the greater involvement with the organisation one perceives. Hiltz (1986), in her description of CMC courses offered by the Electronic Information Exchange System at the New Jersey Institute of Technology, reported that the only strong correlations between measures of perceived greater interaction with other students were feeling more involved and the perception of having learned more.

Reduced social presence

Social presence refers to how one is perceived by others. This is often described in fairly vague terms, such as charisma. A strikingly handsome man can often command attention simply by virtue of his physical presence; a very wealthy woman can achieve the same thing by displaying her financial power, and the presence of a teacher can affect students' motivation (Bruce & Shade, 1994; Christophel, 1990; Gorham & Zakahi, 1990; Hackman & Walker, 1990; Sigel, 1991). All of these are forms of social presence. Bales (1950) describes this as the "Actor's range of symbolic manipulation and process of overt action" (p. 44). A decrease in a participant's social presence changes how he or she will be interpreted; an unwashed street urchin has reduced social presence when viewed across the street compared to when he or she is plucking at one's coat. In a similar manner, orators with a mastery of content-free rhetoric may have their limitations pointed out in a computer conference when the social presence -- charisma -- of their oratory is unable to be communicated via CMC.

Short, Williams and Christie (1976) note that lacking the dynamic personal information of FTF or telephone communication, people focus their attention on the words in the message rather than on the messenger. "Group decisions made via CMC are unpredictable, unconventional, democratic, and less constrained by high-status members" (Sproull & Kiesler, 1991, p. 66). Moreland & Levine (1982) note that it's easier to join and be socialised to electronic groups than to FTF ones because physical invisibility decreases the potential stress associated with the newcomer identity.

In addition to increasing the equality of interactions between the participants themselves, CMC thus forces one to focus on the content of a participant's contribution, rather than the person. As is often explained on the USENET newsgroups, "Here on the 'net, you are only what you write." Describing a
The role of language in education

CMC decision-making environment, Nunamaker et al. (1987) noted that "The status, authority, and roles of the group members were divorced from the comments so that each comment was evaluated on its own merits rather than being evaluated in light of the person who made the comment" (p. 11).

This lack of social presence works like alcohol in a social situation -- it relaxes participants and yet it also may lead to impolite behaviour. Felson (1980) proposes that shared cultural norms which encourage politeness in social transactions hinder the direct expression of feedback to others, particularly if it's negative. People do not typically communicate their appraisals of others directly. With the reduction of social presence, however, "there are few reminders of status differences, the fear of evaluation or criticism declines" (Sproull & Kiesler, 1991, p. 88). Siegel et al. (1986) report that in a decision-making task, three-person groups exhibited swearing, insulting, and name-calling behaviour 34 times during CMC sessions, but never in FTF interactions.

Reduced social cues

Schrum (1992) reports that in day-to-day FTF interactions an estimated 90% of interactional information comes from non-verbal cues. Due to the text-based interaction of CMC, however, social cues, the means by which one ascertains another person's status and state, are reduced. This reduction of social cues changes the nature of the conventional distribution of power. As a result, high-status people do not dominate discussion in CMC groups as they do in FTF situations (Harasim, 1990; Hartman et al., 1995; Siegel et al., 1986). Note Kiesler, Siegel and McGuire (1984), "Charismatic and high-status people may have less influence, and group members may participate more equally in computer communication."

In a decision-making experiment, McGuire et al. (1987) found that when groups of executives met FTF, the males in the group were five times as likely as the females to make the first decision proposal. When the same groups met via CMC, the females made the first proposal as often as the males.

Huff & King (1988) performed an experiment in which they examined the interactions of pairs of students, each comprised of an undergraduate and a graduate. They found that when the pairs met FTF to decide the topic of a joint project, the pairs were more likely to choose the topic preferred by the graduate student. When similar pairs of students met via CMC, however, they were equally likely to choose the topic initially preferred by the undergraduate.

Zuboff (1988) reports that participants involved in CMC generate their own status based on both their helpfulness and the quality of their contributions. One participant, comparing the difference between computer conferencing and FTF interaction, explained that "lots of people have power that is not knowledge-based: it is forceful and based on their personality or position." In the CMC environment, however, "the power lies in the ability to communicate and pass on knowledge. I have extended my power base through my knowledge rather than through intimidation or style. It is strictly now the quality of your ideas, the way you put things in words, or your sensitivity to what others say that now determines your influence" (p. 371). One might retort, however, that in CMC one's writing style becomes an important social cue in its own right.
Melody (1981) and Poster (1990) state that communications media alter the forms of social organisation, create new patterns of association, develop new forms of knowledge and often shift the centres of power. In addition, Kiesler (1986) explains that "Because computers break down hierarchies and cut across norms and organization boundaries, people behave differently when using them." Lending support to this hypothesis, McGuire, Kiesler and Siegel (1987) report that in decision-making tasks, less negotiation took place before an initial solution was proposed via CMC, and yet group members were equally confident of choices made in FTF and CMC.

In addition, CMC makes it possible for participants to break free of traditional interactions:

Those who regard themselves as physically unattractive reported feeling more lively and confident when they expressed themselves in a computer conference. Others with soft voices or small stature felt they no longer had to struggle to be taken seriously in a meeting (Zuboff, 1988, p. 371).

The reduction of social cues caused by the limitations of CMC "can be expected to encourage open input of creative ideas, discovery of optimal solutions, and selection of an alternative based on its merits rather than on compromise" (DeSanctis & Gallupe, 1987). Indeed, due to the nature of CMC, ideas must be examined with little reference to their creator for as Boshier (1990) notes, "Nobody cares about or even knows if the originator of messages is wearing a pinstripe, clown or birthday suit" (p. 52).

Phillips and Santoro (1989) describe experiences in which shy students who had previously been intimidated in FTF interactions entered CMC discussions as equal participants. Bellman (1992) notes that "The anonymity in online communication makes physical appearance, accent and other speech characteristics, ethnicity and gender irrelevant." The advantage of this decreased attention to social convention in an educational environment is that it changes previously-established structures of power, encouraging students to "think for themselves" and stand by their thoughts, a prerequisite for an egalitarian dialogue (Harrington, 1992).

This is not to assert that classroom dominance is impossible to achieve via CMC. Bray (1995) notes that modes of intimidation can still be used against CMC participants: "Electronically mediated emotional abuse falls among the same continuum of violence as do physical and sexual assault. Emotional abuse can easily be as harmful as physical or sexual violence" (p. 493). In general, this sort of comparative pain is not useful, however. To say that rude e-mail can damage someone as seriously as forcible rape trivialises the importance and severity of the latter. Nevertheless, although she exaggerates by characterising offensive words or language as "harassment and violence," it could reasonably be interpreted as a means of intimidation. This could in turn lead to classroom dominance.
A more realistic concern of distance education is that it denies students personal interaction, an aspect of the educational process female students, in particular, value. A joint survey administered at Germany's FernUniversität and the United Kingdom's Open University in 1986 by Kirkup and von Prümmer (1990) found that female students value local study centres for FTF interaction more than males. The opportunity to engage intellectually and socially with other students is an important part of learning for women distance-education students.

A later survey of distance-learning students at the FernUniversität by von Prümmer (1995) found that both males and females "lean towards personal interaction" and prefer FTF interaction rather than technology-mediated communications. Her results indicate that males and females express equal preferences in their use of FTF meetings or the telephone. Women, however, are more likely to prefer communicating with written correspondence and group discussion. E-mail was the only mode of communication for which male students had a greater preference.

May (1992) interviewed nine women who had studied at a distance through home study or teleconferencing. All were satisfied with the experience, but were bothered by the solitary nature of the courses and recommended more collaboration and interaction. May recommends an increase in collaborative learning techniques, more interaction between teachers and students as well as among students, and more interactive modes of teaching, such as teleconferencing. These results are similar to those of Gabriel and Davey (1995) who, in interviews of females enrolled in a distance-education nursing program, found that the students preferred "a way of learning that is personal, interactive and acknowledges their life experiences" (p. 501).

It is important to remember, however, that although the social cues are changed, simplified, and reduced, they are not eliminated. Using a post from USENET for example, it is still possible to determine social cues from the available data. From the sender information one may often infer the sex of the poster from which one may make assumptions of what is "appropriate" behaviour (Matheson, 1992). The status of the posting site can also become an issue. In a discussion about supercomputers, for example, username@mit.edu is likely to have more clout than username@psu.edu, yet perhaps less than username@.cray.com.

On USENET in particular, the status differences between posting domains are often argued. One posting from a given domain, be it academic or corporate, is associated with that institution. For example, participants from commercial domains often assume that posters from academic domains are young undergraduates with no understanding of the real world. Even among commercial Internet service providers a status hierarchy exists between those which offer a command-line interface and require a knowledge of UNIX and those which boast of their point-and-click ease for absolute beginners [6].

Even when all CMC participants post from within a single domain, one may still detect social cues. As Hampton (1994) explains in a USENET newsgroup: "We are not egalitarian, we are elitist. We care not for status or rank, nor for income or title -- only skill, intellect, wit, acumen, and ability are of any
The role of language in education

"...it was an editorial decision not to re-print online messages in this book with all their mistakes, misspellings and lack of punctuation. The reader of a conventional text has different expectations of the written word, and uncorrected messages, acceptable in online interactions, simply revert to looking incorrect and being hard to read" (Mason, 1992, p. 14).

The editorial decision to correct mistakes is not unusual. The assumption that these errors are "acceptable in online interactions," however, is rather surprising. In a CMC setting, one's writing style is one's voice and speech; a speaker who makes grammatical errors loses status, and this is true online as well as in FTF situations. People cut each other slack, in both cases, but the errors are noticed. An error remains an error regardless of its medium of delivery. Granted, mistakes, misspellings and lack of punctuation may not immediately cause one to plummet to the bottom of the CMC social order, but they add nothing to one's status. They may, indeed, particularly in the case of electronic submission of a journal article or curriculum vitae, subtract a great deal.

These errors are exclusive of a "typically informal and 'conversational' register of conferencing" (Robinson, 1992, p. 115); the correct usage of "your" and "you're," for example, does not preclude casual written discourse. If letters typed on letterhead convey social context information (Siegel et al., 1986), what do poor spelling, incorrectly formatted software and dubious grammar convey online? Computer conferencing may permit immediate responses, but that does not free the writer from the responsibility of proof-reading and correction. One has only to see the popularity of spelling and grammar flames on USENET for verification of this. An ungrammatical sentence or an incorrectly configured newsreader provide plenty of social cues: ignorance and inability, or, at the very least, inattention to detail.

Finally, information is passed along within the language with which the text is written. For example, Lakoff (1990) describes disparities in the vocabularies of men and women. For a male to exclaim, "What a lovely steel mill!" would be considered "syntactically deviant" (p. 225). Readers would be likely to presume the author of such words was either a female or an effeminate male, and would judge the worth of the contribution with this mental image of the sender in mind. Although Poster (1990) suggests that communication via CMC can be de-gendered, it would still have to be through the use of a common or neutral language.

**Reduced social identity and deindividuation**

When interacting via text-based CMC, one is isolated from social cues and feels safe from observation and criticism. CMC decreases these reminders of a possibly critical audience, providing a sort of mask to overcome factors that inhibit participation. This often encourages people to be more open and less inhibited. It also makes it easier to dispute or confront others' opinions. (Grint, 1989; Sproull & Kiesler, 1986; Sproull & Kiesler, 1991). Harrington (1992) reports a student's remark about a computer conference: "It was easy to say what I really wanted to say because I was uninhibited and no one knew
The role of language in education

who I was" (p. 77).

In a study of a writing-evaluation class, Mabrito (1991) described the students as high- and low-apprehensive writers [7]. He found that although the high-apprehensive writers generated only 36% of the classroom dialogue FTF when discussing each other's writing, they contributed 45% of the material when the interactions took place via CMC. Perhaps most interesting was the nature of the change of the interactions. Directive comments -- in which the participants advised others how to revise their work -- accounted for only 11% of the high-apprehensive writers' interactions FTF, but increased to 22% with CMC interactions, making the nature of their contributions more similar to those of the low-apprehensive writers (26% FTF and 25% CMC). In a similar manner, Siegel et al. (1986) report that in a decision-making task, CMC three-person groups showed twice as much equality of participation as FTF, and that participants tended to speak for their appropriate one-third of the time in CMC. In FTF, there was a much greater disparity in the amount of talk between the three participants.

CMC also creates conditions which are similar to that of deindividuation, a state of "unself-consciousness and impulsivity" (Kiesler et al., 1985) that describes people caught up in the action of gangs, crowds, or mobs (Diener, 1979; Festinger, Pepitone & Newcomb, 1952; Festinger, Schachter & Back, 1950; Forsyth, 1983; Kiesler et al., 1985; Prentice-Dunn & Rogers, 1980). Festinger et al. (1952) propose that people "obtain release" in groups and as such are "able to indulge" in behaviours in which one would not engage if one were alone:

There occurs sometimes in groups a state of affairs in which the individuals act as if they were "submerged in the group." Such a state of affairs may be described as one of de-individuation; that is, individuals are not seen or paid attention to as individuals. The members do not feel that they stand out as individuals. Others are not singling a person out for attention nor is the person singling out others (p. 382).

This merging of the inward and the outward perceptions of oneself may result in altered behaviours, such as inappropriate language or flaming.

Spears, Lea and Lee (1990) suggest that if the group is considered an aspect of the self, the inward/outward aspect tends to fall away. Communicating via CMC, people feel as though they are interacting with their computers as an extension of themselves, rather than with another person. Mason (1992) explains that even for CMC enthusiasts, this aspect may be unsettling, prompting one to question "...am I talking or writing, am I reflecting or interacting, am I isolated from or connected with others?" (p. 5).

This feeling of disassociation manifests itself in two ways. In one sense, shy people or those with low social status are more likely to participate in situations in which they would normally withdraw or be passive (Johnson & Downing, 1979; Kiesler et al., 1984; Kiesler et al., 1985; Short et al., 1976; Sproull & Kiesler, 1991). On the other hand, this sense of anonymity and increased assertiveness can go too far, leading to antisocial or unrestrained behaviours (Carver & Scheier, 1981; Kiesler et al., 1985; Lea,
The role of language in education


[Continue]
Comparing FTF with CMC

Having defined the relevant characteristics of FTF and CMC environments, I was ready to bring this out of the realm of theory and into practice. To this end, I observed and compared the classroom interactions of FTF and CMC courses.

Data collection

Courses

The data for this case study were taken from courses taught at the New York University School of Continuing Education between the fall of 1994 and the summer of 1995.

Some students were attending the school to qualify for a Certificate in Information Management, designed for non-technical managers and professionals. To receive this certificate, students are required to submit proof of satisfactory completion of four courses: an introductory course, two required courses, and an elective.

Due to technical considerations and time constraints, CMC students were required to take all four of the courses for the certificate. The FTF students, on the other hand, could take any of the four courses individually.

In this work, I observed the two required courses: Systems Analysis and Design and Database Management Systems. Both the FTF and CMC versions of the courses taught the same information. The Systems Analysis courses provided an introduction to the role of information technology in organisations and an overview of the systems development life cycle. The Database Management courses were designed to give students a knowledge of the logical structure and physical implementation of database management systems (Accosta, 1994; Accosta, 1995; Vigilante, 1994).

Modes of delivery

The FTF courses were taught during weekday evenings on New York University's campus. The CMC courses were taught by a section of the School of Continuing Education dedicated to distance education, the Virtual College.

The Virtual College began offering courses in 1991 by means of Lotus Notes groupware and modem...
Comparing FTF with CMC

Connections. Notes is a group information manager which provides an electronic environment in which to collect, organise and share information among PCs [8] which are either networked together or connected to a network via modem. Notes permits asynchronous computer conferencing and e-mail. In addition to text, these communications may incorporate data, graphics, audio, and video. Notes also allows the development and sharing of large databases, within which Notes supports hypertext, search, and report functions. Finally, Notes permits the creation of applications to automate these processes (Vigilante, 1994).

Teachers

In the fall of 1994, I observed and tape-recorded FTF courses in Systems Analysis and Database Management. Each course met once a week, for three hours, ten times. The two courses were taught by different lecturers.

In the spring of 1995, I again observed and recorded the same two FTF courses, taught by the same lecturers.

The same two courses were taught via CMC during the summer of 1995, and I observed these by downloading the Lotus Notes databases. The courses were taught by different primary teachers. In addition to the primary teachers, each CMC course had two or three secondary teachers, and the CMC Database Management course had one guest teacher. By primary teacher I mean the main teacher of the course content. A secondary teacher is different from a primary teacher and often has a more specialised role. For example, in the CMC courses there were several teachers who posted messages throughout the courses, but who were not actually teaching the majority of the course content. These secondary teachers were often specialists or technicians who posted specific instructions or answered questions about the software. A guest teacher is a teacher who makes a single appearance to lend his or her expertise to the class. For example, in the CMC Database Management course, the author of one of the required articles posted a response to students' questions.

<table>
<thead>
<tr>
<th></th>
<th>Fall 1994</th>
<th>Spring 1995</th>
<th>Summer 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systems Analysis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTF (Teacher A)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CMC (Teacher B)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Database Management</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTF (Teacher C)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CMC (Teacher D)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Students
Comparing FTF with CMC

The FTF courses varied between six and 27 students per class with a mean of 17.12 and a median of 18. On average, there were nine males and eight females in each FTF class. For a complete breakdown of attendance by course and class, see Appendix A.

Since the CMC Systems Analysis and Database Management courses were offered as part of a series of four courses [9] for a certificate, the same 19 subjects, 13 male students and six female students, were enrolled in both of the CMC classes. For the purpose of this work, each CMC course was treated as a single class. Even though this is tantamount to ignoring the patterns of a FTF class -- taking attendance at the beginning and summarising the class at the end -- ignoring these is less artificial than arbitrarily dividing a CMC course into sections designed to simulate classes, for CMC has a different social and structural rhythm than FTF interactions (McGrath and Hollingshead, 1990, cited in Sproull and Kiesler, 1991). Although this is confounding, the differences would be barely perceptible in final analyses. For example, the two-to-three minutes of taking attendance in each FTF class would consist of about 1% of the complete FTF course time.

Transcription

Collecting the data

In the FTF courses, interaction between teachers and students was recorded on audiocassette, and was transcribed into Microsoft Word word processing files. For the purpose of transcription, only interaction that took place among all the members of the course was transcribed; interactions between students and the teacher during breaks or after class were not transcribed, nor were discussions which took place among small groups of students [10]. My reasoning was that it was preferable to observe discussion among all course members than attempt to record the in-class interactions of small groups. In each of the courses, one of the sessions was given over to a demonstration of software by vendors. These sessions were not transcribed, as they would reflect the interactions of a sales pitch rather than classroom interaction.

Unfortunately, due to the acoustic properties of the classrooms, some of the words were unclear in the recordings. Although the individual words may not have been decipherable, the number of words spoken and their function in the classroom interaction could often be determined. To permit examination of the classroom talk, these unintelligible words were marked with a tilde (~).

Transcription procedure

To avoid attribution effects, and to ensure objectivity, I ensured that no one who worked on either the transcription, editing, or the coding of the data used in this study had knowledge of all three parts of what was transcribed, which participant said it, and the purposes of this research (Eichler, 1991). I accomplished this in three ways.
Comparing FTF with CMC

First, I ensured that all of the audio tapes were transcribed by transcriptionists blind to the purpose of this research. In addition to transcribing what was said, the transcriptionists also coded the sex and role of the participant who said it.

Second, by means of hiding the text and hiding the coding characters in the FTF transcripts, or, in the case of CMC, using metadatabases [11], I ensured that when I edited the transcripts I could not identify the participant.

Third, I designed the layouts of the database and the hard copy of the transcription so that people coding would not be able to identify the speaker.

Database

Description of the database

In addition to the Word file, I had a FileMaker database which contained all of the text from the transcripts, information about the participant's sex and role, the number of words in each sentence, and metadata about course, class, and term (see Figure 1). If the sentence came from a CMC file, the document's name as well as its date and time would be included. This was unnecessary with data from the FTF transcripts as it could be sorted chronologically by term and class number.
Comparing FTF with CMC

Figure 1: FileMaker Basic Layout

To ensure that the coders did not learn the identities of the speakers from the databases, a layout was created which hid this information (see Figure 2).

![Figure 2: FileMaker CHCQS Layout](image)

To analyse the transcription from these six courses -- 52,081 sentences -- I taught myself a computer programming language called AppleScript and wrote programs to code and transfer all the transcribed data, by sentence, into databases. I designed these programs to use popular word processing and database software with little modification, permitting other researchers to use these techniques to further their own work.

AppleScript

Most people who use computers are familiar with macros. A macro is a step-saving command, usually implemented through the keyboard, that incorporates several actions or commands. In other words, a macro is a shortcut that combines a memorised series of keystrokes (Schrodt, 1987). For example, a macro in a word processor may be used to insert one's address, often-repeated phrases, or formatting commands.
A scripting language is similar to a macro in that it's designed to incorporate several actions or commands. However, unlike a macro, a script is able to evaluate the state of its existence and proceed based on this data. A scripting language is a simple programming language specifically designed for use with an application. Many applications have incorporated the use of their own scripting language to automate complex tasks [15]. For example, the popular telecommunications program, MicroPhone Pro, permits one to write small scripts to dial a number until a host computer answers (or redial if the line is busy), log on to the computer with username and password (when prompted), summon the mail application, download all new e-mail (if any new mail exists), exit the mail program, log out from the host computer, and hang up. Or, one could write a larger script that would encompass all of the above mentioned functions.

AppleScript differs from all of these in that its use isn't limited to a single application; it can work with several applications at a time, even on different Macintoshes across a network (Schneider, 1994). AppleScript is capable of using the objects and commands within applications by means of Apple events [16].

Apple events are System-level commands or messages sent from one application to another. These messages instruct the receiving application to perform an action or return requested information to the sending application, and form much of the foundation on which AppleScript works (Schneider, 1994). For example, Apple events from the Finder communicate with an application by sending an "open" message when one double-clicks the application's icon.

Apple events provide the infrastructure for applications to communicate with each other. Goodman (1994) uses the analogy that Apple events provide the rails and switches and the applications provide the trains. Apple events can communicate between applications on the same Macintosh, several Macs on a local network, or even Macs connected via modem [17] (DiNucci et al., 1994; Goodman, 1994; Schneider, 1994).

From System 7 onward, Apple events are Apple's overall mechanism for enabling communication between applications [18]. Although important in the way the operating system works, this communication between applications is transparent to users. Normally, if an application is Apple event-aware, the user will only know this if he or she views the available Apple events with the Script Editor's dictionary (see Figure 3).
In August of 1994, when I first considered using AppleScripts to export transcript data by sentence to FileMaker databases (see Development on page 50), Apple event-aware word processors were difficult to find. I briefly considered writing scripts to work with XPress [19]. Upon some reflection, however, I thought it would be better to work with an application which was either free or already commonly used by other people, particularly in educational settings. XPress is a specialised application, designed for professional designers and publishers. Although the computer periodicals proclaimed that the about-to-arrive versions of word processors would be Apple event-aware, the only application then available which fit my criteria was Apple's Scriptable Text Editor.

The Scriptable Text Editor is an extremely basic word processor, about as sophisticated as TeachText or SimpleText, but it is fully Apple event-aware. It is also free. There were, however, two problems with using the Scriptable Text Editor as my text input-output application.

The first problem is that, like TeachText or SimpleText, the Scriptable Text Editor can only handle files that are less than or equal to 32K.

The second problem is that sentence is not listed as an object in its Text suite. As a result, for the script to select a sentence, I originally wrote a script that would start at the beginning of a document and examine each character until it came to a character which I had designated as marking the end of a sentence: exclamation point (!), question mark (?), and full stop or period (.).

Initially I decided to work with these limitations. The 32K limitation could be overcome simply by dividing the original word processing files into segments smaller than 32K before opening them in the Scriptable Text Editor. Although this would require more file maintenance, it was not a prohibitive option.

The lack of sentence in the Text suite presented more of a problem. Although it was non-unique to the Scriptable Text Editor, not being in XPress's Text suite either, examining individual characters to determine when sentences ended proved to be a lengthy process. Merely examining the characters in the sentence "How razorback-jumping frogs can level six piqued gymnasts." would require an examination of
Comparing FTF with CMC

58 characters. Even rounding AppleScript's slothlike performance up to a charitable 2.5-character-per-second processing time [20], that sentence would require over 23 seconds just to be defined as a sentence. Extrapolated to the 2,896,498 characters which constituted the transcripts from the FTF and CMC courses, this would have required over 13 days non-stop merely to define their sentences, let alone have anything done with them.

With this in mind, I decided to find an Apple event-aware word processor that included sentence in its Text suite. Since version 5.1 of Microsoft's Word for Macintosh permits one to select sentences by means of the keystroke -mouse click, I suspected that the new version would include sentence in its Text suite. A friend who was beta-testing the application confirmed my suspicion and when the new version of Microsoft's Word was released for the Macintosh, I took advantage of an impressive educational discount and bought it.

This is not the forum in which to express my disgust with the Macintosh implementation [21] of Word 6, its hardware requirements [22], or its interface guideline atrocities [23]. However, the reader should be aware that superior word processors with sentence in their Apple event suites may soon -- if not already -- exist.

FTF transcripts

The audio recordings of the FTF courses were given to professional transcriptionists. During the audio tape transcription, each paragraph was prefaced with a coding character to indicate its speaker: "t" for teacher, "m" for male student, and "f" for female student. As an example, an excerpt from the first class of the Fall 1994 Database Management course was coded:

mThe uh, the back of the projector. The overhead projector is on fire.

mOh.

mIt's really smoking.

In addition, in instances where a speaker was interrupted, the sentence was marked with two hyphens as the final character. (For the complete instructions given to the transcriptionists, see Appendix B.)

The transcripts were given to me in WordPerfect for DOS format which I converted to Word 4/5 for Macintosh by means of DataViz's MacLinkPlus [24].

Once I had converted the files, I checked each paragraph to ensure that it was prefaced with a valid coding character. I did this by first replacing the strings which should have been unique to the coding system with red characters, using Word's Replace function. Then, to ensure that I would be ignorant of the content of each speaker's paragraph, I made the text window as narrow as possible. Using my default...
font of Adobe Palatino at a 12-point size, this permitted me to see a window width of only ten characters --
the coding character as well as the following nine characters of the line. While not as effective as some
methods would have been for preserving my ignorance [25], it was adequate. The red letters stood out
dramatically from the black text, allowing me to scroll through the file and quickly determine whether
valid coding characters had been used.

If an improper coding character had been used, or if a valid coding character was missing, I replaced it
with a valid coding character by the following system:

a) If it was obvious that the participant was the teacher I coded it as such (the FTF courses only had one
teacher). Giveaway behaviours took the form of calling on students, questioning their answers, and
lecturing the course content. Otherwise, I coded it as a student in the manner described in the next
paragraph.

b) If the participant was not the teacher, I used my Random Student Selection AppleScript (described in
Appendix C) to select "male" or "female" randomly as a function of their class representation [26].
Admittedly, this maintains speaker blindness at the expense of potential validity, as opposed to simply
going back to the tape, but for the few sentences this policy affected (approximately three per class)
maintaining the integrity of speaker blindness seemed more important. In order to compare FTF and
CMC participants fairly, it was important to be blind to who was doing the talking, rather than risk being
influenced by my own attributions.

Once I had established that every paragraph began with a valid coding character, I again used Word's
Replace function to replace the initial coding character's style from the proportionally-spaced red Palatino
to monospaced white Courier. Thus, one could not tell the slim space of an "t" from the wide space of an
"m". Having done this, the coding character was hidden, concealing the identity of the speaker [27], but
the text remained visible. Now, safely ignorant of the speaker, I was able to edit the transcripts into a
consistent format. I began by using the following table and Word's Replace function.

<table>
<thead>
<tr>
<th>Replace this string</th>
<th>With this</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two hyphens used to mark an interruption (--)</td>
<td>A single em dash [28].</td>
</tr>
<tr>
<td>A paragraph mark followed by a coding character (&quot;i&quot; or &quot;m&quot; or &quot;f&quot;) and a space</td>
<td>A paragraph mark followed by the coding character to avoid paragraphs beginning with a space.</td>
</tr>
<tr>
<td>Colon, used in instances when transcriptionists wrote &quot;one-to-one&quot; as &quot;1:1&quot;</td>
<td>Written out, i.e., &quot;-to-&quot;.</td>
</tr>
<tr>
<td>A hyphen surrounded on both sides by spaces, used as a dash or an em dash preceded by a space</td>
<td>The same thing, but removed the leading space so that the hyphen or em dash would not be counted as a word by itself.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Two tildes</td>
<td>Two tildes with a space between them, so that each tilde would be counted as a word.</td>
</tr>
<tr>
<td>Three paragraph marks in a row</td>
<td>Two paragraph marks in a row. This permits a single blank line, but not two.</td>
</tr>
<tr>
<td>A comma followed by an em dash</td>
<td>The em dash only. One is interrupted between words, not punctuation.</td>
</tr>
<tr>
<td>A space followed by a paragraph mark</td>
<td>The paragraph mark only. This removes excess space at the end of lines.</td>
</tr>
<tr>
<td>A space followed by a full stop, comma, or question mark ( .)( ,)( ?)</td>
<td>The same less the initial space to ensure that the punctuation will not be counted as a word.</td>
</tr>
<tr>
<td>Two consecutive spaces.</td>
<td>A single space to remove excess space.</td>
</tr>
<tr>
<td>case</td>
<td>CASE, if talking about CASE tools.</td>
</tr>
<tr>
<td>main frame, data base, work station, spreadsheet</td>
<td>mainframe, database, workstation, spreadsheet to ensure a consistent word count.</td>
</tr>
<tr>
<td>tab</td>
<td>Removed these by replacing them with nothing.</td>
</tr>
<tr>
<td>gooey, sequel</td>
<td>GUI (Acronym for Graphical User Interface), SQL (Acronym for Structured Query Language).</td>
</tr>
<tr>
<td>PC's, ID's, GUI's</td>
<td>PCs, IDs, GUIs.</td>
</tr>
<tr>
<td>schemer</td>
<td>schema</td>
</tr>
<tr>
<td>SS, db</td>
<td>Social Security, database</td>
</tr>
<tr>
<td>No., vs., v., spec., specs., e.g., i.e., i.d., I.D., etc., ... (three full stops used as an ellipse), -unspecified digit</td>
<td>Number, vs, v, spec, specs, eg, id, ID, etc, … (ellipse character [29]), -point-number written out. This prevented the punctuation from falsely indicating the end of a sentence.</td>
</tr>
</tbody>
</table>
Once I had completed the relatively automated aspect of preparation, I read through the transcripts and ensured that the punctuation would not cause the AppleScripts to malfunction. I also corrected incidences in which the transcriptionists had inserted homophones due to unfamiliarity with the subject matter. As a result I changed items like "A is 400" to "AS/400," "alda rhythm" to "algorithm," "megadata" to "metadata," and "repressive relationships" to "regressive relationships." When I had completed these tasks, the transcription was ready to be run through the Transcript to Database script (described in Appendix D).

After the FTF and CMC AppleScripts had run, I was left with a very large Word file. It contained all of the exported text, participant sex and role information, and the record numbers for the sentences said within a given paragraph. Using the example from before, the Word file looked like this:

```
The uh, the back of the projector. The overhead projector is on fire. (Male Student [875-876])
Oh. (Male Teacher [877])
It's really smoking. (Male Student [878])
```

To hide the participants' identity from coders, yet still show the record numbers to aid access, I made a copy of the file in which the speaker was hidden by replacing "(Male Student ", "(Female Student ", and "(Male Teacher " with nothing, leaving only the record number. For the CMC transcripts I expanded this to include the more extensive coding of "Male Primary Teacher," "Male Secondary Teacher" and "Male Guest Teacher." I was then left with:

```
The uh, the back of the projector. The overhead projector is on fire. [875-876]
Oh. [877]
It's really smoking. [878]
```

I printed a hard copy of this file for the coders to view.

**CMC transcripts**

Although the CMC transcripts were already in computer files, they still had to be put into a form with which AppleScript could work. The participants in the CMC courses communicated via Lotus's Notes. Unfortunately for my purposes, the Macintosh version of Notes we used, 3.30, was not Apple event-aware and all text had to be exported manually from Notes format before I could manipulate it.

To simplify the management of the files, I needed to assign them new file names before exporting the
Comparing FTF with CMC

data. To do this, I first exported the list of files from Notes (Figure 4) as text.

![Figure 4: List of CMC files in Notes](image)

I then imported that text as an Excel spreadsheet and added a column in which I assigned each file a numeric filename (Figure 5).

![Figure 5: List of CMC files in Excel](image)

I then went through the list, opened the files in Notes (Figure 6) and exported them in Word format with their new numeric names.
Comparing FTF with CMC

Once all of the files had been saved, I removed information about the authors from them to simulate the blind editing conditions I used in the FTF transcripts. To accomplish this, I opened each file in Word and removed the header information, including the author, so that the first line remaining was the date and the second line was the time of posting (see Figure 7). If no time information was included with the file, 12:00 AM was assigned to it. In addition, if the author had signed his or her name at the bottom of the post, it was removed at this time.

If the stripped-down file contained quoted text from another author, it was printed, the quoted text was highlighted, and the printout was set aside. This last step was done so that once the transcripts had been run through the AppleScripts, the quoted text could be marked in the output transcript. It was necessary because in Notes the students indicated that text had been quoted from another source by making it italic or bold. Unfortunately, Word lacks the ability to export styled text via AppleScripts, so everything in the output file is the same style, and the distinction would have been lost.

When all of the files had been stripped of author identification, I created the CMC metadata database by means of my Metadata Extraction AppleScript. This program opened each file in turn and copied the file
Comparing FTF with CMC

name, date and time information to individual records in a FileMaker Pro database (Figure 8). (For a complete description of the Metadata Extraction script, see Appendix E.)

![CMC Metadata database](image)

**Figure 8: CMC metadata database**

From the spreadsheet shown in Figure 5, I added information about the file author's sex to the database. I also verified the creation date extracted from the file against the posting date indicated on the spreadsheet, since this occasionally conflicted. In instances of conflict, the posting date was substituted for the creation date to reflect when other participants would have seen it.

In addition, to reflect the varying roles of the various teachers in the CMC courses, the coding character for teacher was expanded to include primary teacher, secondary teacher, and guest teacher.

If necessary, these three categories of teacher could be combined in FileMaker to create a single "teacher" or "not-student" category later. In the FTF database, "Teacher" was recoded as "Primary teacher." In the future, if necessary, FTF transcript coding characters could be revised to include "p" for primary teacher, "s" for secondary teacher, and "g" for guest teachers. More than one sex of any of these, however, would require a more complex coding system.

Also, information about the file's course, term, and whether or not the file included quoted text that had been highlighted and printed out was noted in each record.

Formatting each file in Word was a straightforward affair. Starting with a file set-up like Figure 7, the rest of the document was set up so that line three was blank, and the text -- the original title or subject line of the file -- was on line four. Then, using the -mouse click keys to check sentences, the text was cleared of punctuation, primarily full stops, that would cause the AppleScript to malfunction. Emoticoms were replaced with "<smile>" for ":) " and ">grin>" for ";) " or ";-".

Once the Word files were prepared for the AppleScripts, I ran them through the Extract Large Sentences
script to copy sentences containing more than 254 characters to a text file and replace them with dummy sentences in the original Word files [32]. The transcription was now ready to be run through the CMC to Database script (described in Appendix G).
Discussion

My research examined the transcripts of four FTF courses, each consisting of nine classes which met for three hours, for a total of 108 hours of transcription. With the inclusion of the CMC courses [37], this resulted in the equivalent of about 130 hours of classroom dialogue.

Thanks to the scripts, I was able to examine nearly three times as much data as Bellack et al. and nearly 26 times as much as Sinclair and Coulthard's (1975) five-hour initial sample [38].

Analysis of data

Extracting and plotting

Once all of the sentences had been coded and the reliability of the coding determined, the data could be analysed. Each code had a certain number of records corresponding with each participant for each course; these were counted and converted to percentages as described in Appendix I. This process could be automated with an AppleScript, should one wish to perform a similar search among several databases; however, I was only examining one database, so it wasn't necessary.

Once the figures had been extracted from the database, I converted these amounts to percentages for comparisons across each course. So, for example, in Figure 11 one may view the percentage of teacher talk (ordinate) as a function of time (abscissa) for the average of the FTF courses. In the FTF Systems Analysis courses, much of the grade was based on a group project to be presented at the end of the course. Consequently, as the figure illustrates, the first 50% of the course indicates the teacher doing most of the talking. After this point, the students began using their new knowledge to ask questions and make their presentations. The grades in the FTF Database Management courses, however, were based on exams. As a result, although the quantity of teacher talk decreases 20% during the first 50% of the sentences of the course, in which students demonstrate their homework problems on the blackboard, it rebounds to build up for the final exam, and decreases slightly at the end for a discussion of the exam results.
Figure 11: Amount of teachers' talk in the FTF courses

The data for Purpose, Mechanism, and Subject were first entered into an Excel spreadsheet and then plotted on graphs, as in Figure 11. They were then examined for differences between teachers and students, modes of delivery, and the courses themselves. To minimise fluctuations and simplify each graph, the spreadsheets were reduced to ten-percent increments. These graphs permitted examination of the data by the dimensions of both quantity and time. This allows a detailed look at the nature of the classroom discourse.

How much did participants speak?

As I described earlier, the coding is designed to look at discourse at the sentence level. To be thorough, though, I also analysed the average number of words in each sentence for all of the participants. Of course, one should keep in mind that any computer-generated word count will vary with the software used to obtain it. The text of the FTF teachers, for example, contained 401,571 words in FileMaker 3.0 (using the WordCount text function). This same text, when exported, contained 413,845 words (according to Word 5.1a) and 412,161 words (according to Word 6.0.1). The difference between FileMaker’s sum and either of the Word programs occurred primarily because FileMaker ignores the dummy word character "~", rather than counting it as a word. The differences between the two versions of Word were probably due to different word-counting algorithms. For the sake of consistency, all word counts described in this work were derived from Word 6.0.1.

That said, an analysis of the amount of talk generated by participants is given in the following two tables. Table 1 indicates that of all of the FTF participants, the teachers say the longest sentences, with an average of 13.01 words per sentence. Both the male and female students utter shorter sentences, averaging 10.36 and 9.39 words per sentence, respectively.
Table 1: FTF participant words/sentence

<table>
<thead>
<tr>
<th>Role</th>
<th>n words</th>
<th>n sentences</th>
<th>words/sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>412,161</td>
<td>31,689</td>
<td>13.01</td>
</tr>
<tr>
<td>Male Students</td>
<td>69,035</td>
<td>6,661</td>
<td>10.36</td>
</tr>
<tr>
<td>Female Students</td>
<td>46,493</td>
<td>4,950</td>
<td>9.39</td>
</tr>
</tbody>
</table>

Table 2 indicates that the CMC participants used longer sentences. The teachers, male students and female students increased the number of words in their sentences to 15.72, 13.79 and 13.89, an increase of 21%, 33% and 48% respectively. In addition to this increased quantity of words, the number of words in male and female students' sentences achieved more equal levels. Whereas in FTF interaction male and female students' sentences contained 80% and 72% respectively of the number of words in the teachers', in CMC these both increased to 88%.

Table 2: CMC participant words/sentence

<table>
<thead>
<tr>
<th>Role</th>
<th>n words</th>
<th>n sentences</th>
<th>words/sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>66,530</td>
<td>4,232</td>
<td>15.72</td>
</tr>
<tr>
<td>Male Students</td>
<td>34,170</td>
<td>2,478</td>
<td>13.79</td>
</tr>
<tr>
<td>Female Students</td>
<td>28,793</td>
<td>2,073</td>
<td>13.89</td>
</tr>
</tbody>
</table>

In terms of sentences, the teachers still did most of the talking. In the FTF courses, the teachers uttered a total of 31,689 sentences (73%), compared with the male students' 6,661 (15%) and the female students' 4,950 (11%) [39]. In the CMC courses, the teachers provided an appreciably smaller percentage of the utterances, yet still wrote the most. Teachers wrote a total of 4,232 sentences (48%), compared with the male and female students' 2,478 (28%) and 2,073 (24%) sentences respectively.

**FTF interruptions**

An aspect of FTF interaction to be examined, specifically when discussing the nature of interpersonal interaction in the classroom, is the use of interruptions. Having coded sentences of the FTF transcripts in which interruptions were marked with an em dash, described earlier, it was a straightforward matter to search for the em dash in the text box of the database as well as by sex and/or role. This gave me the raw number of FTF participant interruptions, from which I was able to determine the percentage of interruptions (see Table 3).

Table 3: FTF participant interruptions

<table>
<thead>
<tr>
<th>Role</th>
<th>n interruptions</th>
<th>in n sentences</th>
<th>amount</th>
</tr>
</thead>
</table>

Although overall the teachers were interrupted more times than the students -- 1,418 -- the greater number of sentences spoken by them made this proportionally rare, occurring only four percent of the time. Both the male and female students were interrupted far more often, 15% of the time. Despite the difference in the number of interruptions they experienced, they were interrupted equally, due to their different numbers of sentences.

This discrepancy in the amount of interruption between the teachers and the students may be a result of the roles of turn-taking in classroom discourse (Atkinson, 1981), in which the options for the student are not the same as those of a teacher, for example, to interrupt. The fact that the teacher was interrupted less frequently might suggest the greater power the teacher has in the classroom, or there might be other elements at work.

Merely examining the extent to which FTF participants were interrupted only tells part of the story. The other side of the story is knowing by whom were these participants interrupted. This is important, for two reasons. First is the question of power dynamics; the students may have been interrupted by the teacher, or by other students. Second is the question of possible sex bias. It's one thing to know that both male and female students were interrupted 15% of the time, but it would be quite another to learn that a particular group was being interrupted by the teacher, or by another group.

To this end, I wrote the Who Interrupted Whom AppleScript. Given the record number of a sentence during which a class participant was interrupted, the script opens the database and determines the sex and role of the speaker of the next record, determining who interrupted whom. (A complete description of the script is given in Appendix K.)

An examination of the raw data (Table 4) indicates that the teachers interrupted male and female students about equally, at 84% and 80% respectively. This is not surprising, considering that the role of the teacher often embraces the privilege of interrupting students for the purpose of guiding dialogue.

<table>
<thead>
<tr>
<th>Role</th>
<th>n Teacher</th>
<th>n Male Student</th>
<th>n Female Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>--</td>
<td>762 (.54)</td>
<td>656 (.46)</td>
</tr>
<tr>
<td>Male Students</td>
<td>827 (.84)</td>
<td>66 (.07)</td>
<td>96 (.10) [40]</td>
</tr>
<tr>
<td>Female Students</td>
<td>595 (.80)</td>
<td>90 (.12)</td>
<td>59 (.08)</td>
</tr>
</tbody>
</table>

Although it is to be expected that teachers will interrupt students more than students interrupt students,
things tend to be more fair in inter-student interruptions. Male students were interrupted by other male students seven percent and by female students 10% of the time. Conversely, female students were interrupted by male students 12% and by other female students eight percent of the time. However, before any conclusions can be drawn about the nature of inter-student interruptions, the number of interruptions must be viewed in terms of their expected probability.

Although it is explained more fully in Appendix J, the basic idea of expected probability used in this example is that an examination of inter-student interaction must take into account the students' representation by sex. For example, if the Who Interrupted Whom AppleScript revealed that 75% of the interruptions of female students were done by a male student, it might be indicative of male students dominating the classroom. However, unless this is viewed with knowledge of the proportion of males in the courses, the information is inconclusive. If about 50% of the students in the course were male, then this would indicate that the male students were interrupting female students disproportionally often. On the other hand, if 99% of the students in the course were male, the contrary would be true (Paulos, 1995).

An analysis of the overall FTF course attendance records (see Appendix A) and the number of sentences uttered by students in each class appears in Table 5. In the courses observed, based on the ratios of males to females in each class of each course and the number of sentences which were uttered by students in each class, the expected probability of a male student interrupting another male student is .53. In a corresponding manner, the expected probability that a male student would be interrupted by a female student was .47. Since there were fewer female students overall, the expected probability that a female student would be interrupted by a male student was higher -- .61 -- and the expected probability that a female student would be interrupted by another female student was .39.

<table>
<thead>
<tr>
<th>Table 5: Expected probability of student-student interruptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Student</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>Male student interrupted by a</td>
</tr>
<tr>
<td>Female student interrupted by a</td>
</tr>
</tbody>
</table>

The actual percentages of student-student interruptions, seen in Table 6, matched the expected probabilities in two of the four cases. The results indicate that female students were interrupted by other students in proportions which were closely tied to those students' representations in the FTF classes. Based on the distribution of student sex throughout the FTF courses, interruption of female students would be expected to have been performed by male students 61% of the time. In actuality, male students performed 60% of the interruptions of female students. In a complementary manner, female students interrupted other female students 40% of the time when it would have been expected to be 39% based on their populations within the FTF courses.

<table>
<thead>
<tr>
<th>Table 6: Actual student-student interruptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Student</td>
</tr>
</tbody>
</table>

The largest discrepancy came between the expected probabilities and actual results of who interrupted the male students. Based on their class representation, one would expect that 53% of the time that male students were interrupted it would have been by another male student. In actuality, though, this only happened 41% of the time.

Overall, female FTF students interrupted male FTF students more often than would be expected as a result of their sex's representation. The female students would be expected to interrupt male students 47% of the time when actually it turned out to be 59%. With regard to the other groups, the female interruptions matched expectations: One would expect that a female would interrupt another female student was 39% of the time when it turned out to be 40%. The expectation was that a female student would interrupt the teacher 44% of the time and it turned out to be 46%.

In a reciprocal manner, male FTF students interrupted male FTF participants less frequently than was expected based on their sex's representation. Male students would be expected to interrupt the teacher, female students or other male students 56%, 61% and 53% of the time respectively, when their actual results were 54%, 60% and 41% respectively.

What does this mean? It means that female students interrupted male students somewhat more often than would be expected based on their population in the FTF courses. And, correspondingly, male students interrupted other participants less than would be expected. By itself this does not reveal very much. These interruptions may be symptomatic of either the quick, interactive dialogue of a good discussion or rude interruptions of boorish monologues. To determine this, further examination of the results of the coding was performed to compare the results with the previously discussed models of interaction.

**Testing for recitation behaviours**

Since, as was discussed earlier, the recitation model is the norm for FTF classroom interaction, I shall examine the transcripts in terms of what one would expect to observe over the duration of the courses. (For an analysis of the average code distribution over the courses, see Appendix L.) Although some differences in the modes or interaction are to be expected due to the nature of the modes of delivery, these shall be addressed later.

**Predominant speaker**

There are several observable characteristics of talk which distinguish recitation from discussion. One characteristic of recitation is that the predominant speaker will be the teacher, who does two-thirds or more of the talking (Dillon, 1994; Flanders, 1970; Graddol, 1989). This was already addressed earlier in...
this work, in which it was revealed that FTF teachers ($\bar{x} = .73$, $sd = .06$) spoke more than the CMC teachers ($\bar{x} = .49$, $sd = .10$). However, this merely indicated the quantity of talk, rather than its quality. An analysis of classroom interaction should reveal differences in the nature of the interaction as well. If the recitation model were being used, one should be able to observe other indications of teacher dominance. One would expect to see teachers using the Purposes of Organising, Lecturing, and Idling more than students. In addition, one would expect teachers to use the Mechanisms of Filler and Rhetorical Device more than the students.

First, let's examine the use of Organising in the transcripts. In the recitation model, Organising fits squarely within the realm of the teacher. Quite simply, if one is reduced to a role of primarily answering questions, one has neither a need nor an opportunity to explain what one is going to say or do.

Pedagogically, Organising is used to indicate what the speaker intends to say. At its most basic level, Organising demonstrates control, for only a situation in which one has the freedom to speak or write in several possible ways requires the use of signposting or an advance organiser. Although one might argue that the statement "Tomorrow I shall do my homework" is Organising, in the context of the classroom it would most likely be a response to a teacher's Eliciting move.

**Figure 12: Organising**

Overall, due to the nature of CMC interaction, one would expect to see 6.5% more Organising from CMC participants [41]. The differences, however, were much greater (see Figure 12). Overall, CMC participants used Organising more ($\bar{x} = .22$, $sd = .06$) than the FTF participants ($\bar{x} = .01$, $sd = .00$). This difference between FTF and CMC uses of Organising may be, in part, due to the lack of non-verbal interaction. Whereas in FTF much can be communicated nonverbally, in CMC it has to be, quite literally, spelled out.
As expected, in both modes of interaction, the teachers used Organising more, with the FTF teachers ($\bar{x} = .02, sd = .01$) slightly higher than the FTF students ($\bar{x} = .00, sd = .00$) and the CMC teachers ($\bar{x} = .25, sd = .10$) higher than the CMC students ($\bar{x} = .18, sd = .05$). Although there is a slight increase in FTF student use of Organising in the last 20% of the courses, this is a result of the student presentations in the Systems Analysis courses.

Second, one should be able to observe other indications of teacher dominance, including a preponderance of Lecturing. As I defined it earlier, Lecturing is talk about the course content that is neither Organising, Eliciting, nor Responding. Like Organising, Lecturing requires one to have the control to be able to make statements. For example, a student Responding to a teacher's Eliciting move is neither Lecturing nor asking a question. In FTF classrooms, the teacher controls the dialogue, and may use his or her role to cut people off to prevent digressions -- such as students going off on long lectures. As a result, one would expect both the FTF and CMC teachers to have uttered most of the Lecturing sentences.

Figure 13: Lecturing

This, however, was not the case (see Figure 13). Although the FTF teachers used Lecturing more ($\bar{x} = .37, sd = .07$) than the FTF students ($\bar{x} = .07, sd = .09$), they were both surpassed by CMC participants. On average, the CMC teachers used Lecturing about as much as the FTF teachers, although with a great deal more variability ($\bar{x} = .40, sd = .17$). The CMC students, however, used Lecturing the most ($\bar{x} = .59, sd = .08$), ranging between 49 and 74 percent of the Purpose of their sentences.

These results suggest that the FTF courses approximated the recitation model, but the CMC courses, on the other hand, did not. This is most likely a result of the asynchronous nature of the CMC courses. These students were able to write about the course content for as long as they wanted before the teacher or other
students saw it. They were not interrupted, nor forced to share a limited amount of class time. This freedom manifested itself as an increase in Lecturing. FTF students' largest use of Lecturing (which ranged from zero to 26 percent of their sentences) was in the last 30% of the course, a direct result of their Systems Analysis presentations.

A third indication of teacher dominance that would manifest itself according to the recitation model would be the use of Idling. In a FTF setting, Idling is mainly a reflection of a teacher's status, because, quite simply, teachers are more likely to get away with it. A teacher interested in having his or her questions answered is likely to interrupt a student who is blathering and pass the task to another student. The same teacher, however, is free to blather, as students are unlikely to challenge or interrupt. In the FTF courses, therefore, one would expect to see the teacher uttering more Idling sentences than students.

The asynchronous written discourse of CMC, on the other hand, should allow equal use of Idling by teachers and students. Both would have an equal amount of time to prepare, organise, and revise their thoughts. As such, one would expect to see a "cleaner" transcription from the CMC people, with fewer Idling sentences [42].

![Figure 14: Idling](http://www.quahog.org/thesis/discussion.html (9 of 25) [7/20/2004 10:44:53 AM)]

As Figure 14 illustrates, Idling was used relatively little in any of the courses, peaking at 4% for what is said by teachers in the first tenth of the FTF courses. As expected, the FTF participants used Idling more ($\bar{x} = .01$, $sd = .00$) than the CMC participants ($\bar{x} = .00$, $sd = .00$).

A fourth indication of teacher dominance would be the use of Filler. Like Idling, Filler is a manifestation of either hastily-prepared discourse or a means of stalling. Filler is often used to maintain control of the dialogue, so one would be more likely to see utterances coded as Filler from a teacher rather than a
As with Idling, Filler should be more apparent in synchronous than asynchronous discourse. First, teachers need to maintain control on a second-by-second basis, which they do not have to do in an asynchronous environment. Also, in CMC one has nearly unlimited time to think of responses, so stalling becomes irrelevant.

![Figure 15: Filler](http://www.quahog.org/thesis/discussion.html)

This prediction held true. As Figure 15 demonstrates, for the small amounts of Filler coded overall, the greatest amount was generated by the FTF participants. Specifically, the FTF teachers generated the most ($\bar{x} = .03, sd = .01$), followed by the FTF students ($\bar{x} = .01, sd = .00$). The CMC participants, as predicted, had the lowest percentages of Filler. However, the CMC teachers' levels ($\bar{x} = .00, sd = .00$) were slightly lower than those of the CMC students.

A fifth, and final, manifestation of teacher dominance under the recitation model would be a greater use of the Rhetorical Device. Functionally, the Rhetorical Device serves as a means to demonstrate and maintain control, specifically for the purpose of guiding a discussion to a predetermined end. Moreover, there are two specific reasons why one would expect teachers to use Rhetorical Devices more than students. The first is that FTF students, being in a role of responding, i.e., having a lower status than the teacher, are more likely to respond with straightforward statements than by answering a question with a question. The second reason is that the use of Rhetorical Device requires a measure of time in which to speak in which one is confident he or she won't be interrupted; students don't tend to have this, while teachers do. Following this, one would expect to find that teachers use Rhetorical Devices the most and students the least.
This prediction was proven both true and false in Figure 16. The prediction held true within the FTF courses in that Rhetorical Device was used by the FTF teachers ($\bar{x} = .03$, $sd = .00$) the most and by the FTF students the least ($\bar{x} = .00$, $sd = .00$). However, between these two extremes, the CMC teachers and CMC students used them the same amount, with ($\bar{x} = .01$, $sd = .01$) and ($\bar{x} = .01$, $sd = .01$), respectively.

It is possible that the increased use of Rhetorical Devices by the CMC students is caused by two factors. First, since the interactions were asynchronous, it would be impossible to interrupt a student. Second, in this asynchronous communication they would need to supply their own question and answer to have any form of immediate dialogue (Riedl, 1989). This would explain why CMC teachers and students use Rhetorical Devices the same amount.

It is also possible that some sort of threshold exists at which the more one talks -- or is permitted to talk -- the more one has an opportunity to become not merely a speaker or a classroom contributor, but an orator. And as an orator, one uses Rhetorical Devices. If this were the case, this would explain why the population uttering the largest percentage of sentences, the FTF teachers, would also use the Rhetorical Device mechanism the most. This, however, may simply be a function of oral discourse.

**Typical exchange**

A second, fundamental characteristic distinguishing recitation from discussion is the nature of the exchange. In a recitational exchange, the teacher initiates with a question, the student responds, and only the teacher evaluates the response. This initiation-response-evaluation is the hallmark of conventional classroom interaction. In a discussion-oriented exchange, however, either the teacher or another student
Discussion may also respond or evaluate. Continuing with the examination of the recitation model, one would therefore expect that the Purpose of most sentences from the transcripts should be either Eliciting or Responding.

Eliciting serves many purposes in the educational realm, including initiation of feedback "Did anyone have problems with the homework?" and commanding attention "Christopher, pay attention", but in the broadest sense, the underlying use of Eliciting is to get others involved. In the recitation model, since the teacher asks questions of the students, one would expect to see a great deal of Eliciting from teachers. In a similar manner, one would expect to see the least amount of Eliciting from the students.

![Figure 17: Eliciting](image)

This, however, was not the case, as Figure 17 illustrates. Overall, the FTF participants used Eliciting about five percent more than the CMC participants. Although the CMC teachers used Eliciting slightly more ($\bar{x} = .13$, $sd = .04$) than the CMC students ($\bar{x} = .10$, $sd = .03$), the FTF students used Eliciting the same amount more ($\bar{x} = .18$, $sd = .06$) than the FTF teachers ($\bar{x} = .15$, $sd = .02$).

Before dismissing the comparison to the recitation model, one should also examine the use of Response. In a typical exchange in a recitation, notes Dillon (1994), the teacher asks a question, a student answers it, and the teacher follows this with an evaluation and another question. In this traditional model of classroom discourse teachers ask a large number of questions, and students do a great deal of answering (Atkinson, 1981). As a result, one would expect to find Responding the most-used Purpose of students.
Although Figure 18 proves the prediction true for the FTF participants, the results were the opposite for the teachers and students in the CMC courses. In the FTF courses, the students used Responding about 17% more ($\bar{x} = .58$, sd = .10) than the teachers ($\bar{x} = .41$, sd = .08). In the CMC courses, the teachers used Responding about 11% more ($\bar{x} = .21$, sd = .14) than the students ($\bar{x} = .10$, sd = .06). It appears that Responding exists in a reciprocal relationship to Lecturing. Within the FTF courses, the teachers do more Lecturing and the FTF students do more Responding. In CMC, where the students do more Lecturing, the teachers do more Responding.

**Overall pace**

A related characteristic of discourse which distinguishes recitation from discussion is the overall pace of student-teacher interaction. Dillon (1994) notes that recitation is characterised by many brief, fast exchanges between teachers and students. In a discussion, however, there are fewer, longer, slower exchanges.

In examining the data to see if the observed classroom interaction follows this recitation model, there are two ways to approach the problem. The first is to examine the amount of teacher talk over time, as was done earlier in the Results section, only at a finer scale. For example, if a single course was composed of 10,000 sentences, one percent of the course would consist of 100 sentences. If students were permitted to speak for many sentences and several students were allowed to talk consecutively, this would result in a decrease in the amount of the teacher's utterances as shown on the scale. On the other hand, if students were restricted to short answers and were not able to respond to other students, then the amount of teachers' utterances would remain fairly constant.
An examination of Figure 19 suggests that the FTF courses followed the recitation model whereas the CMC courses did not. As is evident in the graph, the amount the CMC teacher spoke varied greatly over time ($\bar{x} = .49$, $sd = .27$). This is characteristic of a discussion rather than a recitation, in which the teacher may simply not talk at all for portions of the course. The FTF teachers, on the other hand, did most of the talking and spoke for a fairly consistent amount throughout the course ($\bar{x} = .73$, $sd = .10$). Although they permitted the students to speak, they did not permit their students to speak for very long at any given time.

The second way to determine the overall pace of the classroom interaction would be to tally how many consecutive sentences were said by a teacher or a student in each course and construct a histogram to represent the data as I did with the Count Contiguous Sentences AppleScript (see Appendix M). For example, to illustrate how many contiguous sentences students or teachers uttered, one could construct a histogram in which the number of contiguous sentences were marked along the abscissa and their number of occurrences were plotted on the ordinate, as in Figure 20. A recitation would be revealed by an initial peak by both teachers and students, indicative of short turns. In addition, there would be an observable discrepancy between teachers and students. The teacher, tightly controlling the amount of talk in a recitation, would ensure that most of the students' responses were short. The teacher, however, being under no such controls, would have the option to take longer turns. A discussion, on the other hand, would be indicated by longer turns, primarily a decrease in the height of the initial peak. In addition, the histogram of both teachers and students would be somewhat similar.
As Figure 20 indicates, the expected patterns appeared. There were large differences between the FTF and the CMC participants, particularly in the initial peaks of one- or two-sentence-long turn percentages. The FTF students peaked the highest in one or two-sentence turn percentages at 75 and 14% respectively. In a similar manner, yet not to as great an extent were the FTF teachers at 44 and 16% respectively. The CMC participants, however, had a much smaller percentage of short responses. The CMC teachers' percentages of one- and two-sentence turns were one and five percent respectively, and the CMC students' percentages were one and four percent.

As predicted, teachers in both the FTF and CMC courses took longer turns than their students. However, within their modes of communication, CMC participants took much longer turns than FTF participants. FTF teachers took longer ($\bar{x} = 5.19$, $sd = 11.43$) turns than FTF students ($\bar{x} = 1.66$, $sd = 3.12$), but these were still much shorter than the turns taken by CMC teachers ($\bar{x} = 36.48$, $sd = 43.05$) and the CMC students ($\bar{x} = 22.20$, $sd = 21.06$). Overall, CMC participants seemed to follow the expected pattern for discussion, while the FTF participants followed the recitation pattern.

Testing for CMC-specific behaviours

Although the recitation model is the traditional norm for FTF classroom interaction, certain differences from the model are to be expected when a different mode of delivery, such as CMC, is involved. In other words, one would expect that due to the inherent properties of CMC one would see certain behaviours.

Based on the previous descriptions of the nature of CMC, one would expect to find great differences between it and FTF in several coding areas, specifically the Purpose of Humanising and the Mechanism
of Opining. In addition, one would also expect to find a high agreement between the Purpose of Organising and the Mechanism of Repeating. Finally, based on a CMC model, one would expect to see a strong agreement between the Mechanisms of Explaining and Performing with the Subject of Procedure.

Humanising

The first characteristic of CMC that one would expect to see a great deal of would be the use of Humanising. By my own definition Humanising consists of content-free dialogue used for the sole purpose of making people feel good. Some may consider Humanising as a sort of interactional garnish, decorative and ultimately edible, but hardly a substitute for the main course. Nevertheless, the literature recommends that teachers working at a distance make special efforts to involve students at remote sites or isolated students (Beauvois, 1995; Bruce & Shade, 1994; Monson, 1978). If this is the case, then one would expect to see more Humanising sentences from the CMC participants, particularly from the teachers.

Figure 21: Humanising

The data, as shown in Figure 21, do not completely agree, however. One would expect to find CMC participants using Humanising more than the FTF participants, and of the CMC participants, the teachers should be using Humanising more than the students. Although overall, the CMC participants did use Humanising more ($\bar{x} = .02$, $sd = .01$) than the FTF participants ($\bar{x} = .01$, $sd = .00$), the CMC students used Humanising for their sentences' Purpose more ($\bar{x} = .02$, $sd = .01$) than the CMC teachers ($\bar{x} = .01$, $sd = .00$).

Further examination of the figures indicate that both FTF and CMC teachers do some pure Humanising, about the same amount ($\bar{x} = .009$ and .008, respectively). The FTF students also use Humanising...
Discussion

approximately half the same amount, \( \bar{x} = .004 \). The CMC students, however, appear to making a more concerted effort to use Humanising in their interactions (\( \bar{x} = .023 \)). Although still representing a small percentage of the overall interactions, this is nevertheless used 2.5 to 5.75 times more than the teachers or the FTF students. This may be reflective of an informal and "chatty" style designed to compensate for the lack of non-verbal signals (Gray, 1989) and physical presence.

Opining

The second characteristic one would expect to see in courses taught via CMC would be an increase in opinion statements. In this work, this would be measured by an increase in sentences using the Mechanism of Opining. Based on the hierarchy of power in the classroom, one would expect to find that both the FTF and the CMC teachers, being in a position to give their opinions as they wish, would use Opining more than either of their students. The CMC students, being less constrained by social conventions, however, would be more likely to give voice to their beliefs and more likely to Opine. As a result, one would expect to find Opining used most by the teachers, then by the CMC students, and least by the FTF students.

![Figure 22: Opining](http://www.quahog.org/thesis/discussion.html)

The results, illustrated in Figure 22, reveal that this prediction holds mostly true. On average, the FTF and the CMC teachers do use Opining about the same amount (\( \bar{x} = .04, \text{sd} = .01 \)). In addition, the FTF students do use Opining the least (\( \bar{x} = .03, \text{sd} = .01 \)). While as predicted the CMC students do use Opining more than the FTF students, they also use Opining more than anyone else (\( \bar{x} = .11, \text{sd} = .03 \)). This finding concurs with the literature indicating that shy students, feeling confident to express themselves via CMC (Mabrito, 1991), would be more likely to "express their opinions" (Mason, 1989, p.129).
Organising and Repeating

A third characteristic of CMC which one would expect would be a significant number of sentences coded as both Organising and Repeating. One would expect more of this type of sentence in a CMC context than in FTF, for two reasons. First, the purpose of the quoted sentence would be to establish context, to explain what one is going to talk about. (In my coding system, this is the Purpose of Organising.) Within synchronous communications, such as a traditional FTF classroom, context is provided by the contiguity of utterances. If a student is responding to a teacher or another student, unless he or she is talking about something further back in time, there is no need to establish the context for the response; indeed, it would be redundant and potentially annoying. In asynchronous communications, however, such as those in computer conferencing, one must establish the context to which one is responding. An excellent example of this pattern may be found in USENET newsgroups, where users typically respond to a post not merely by using the same subject line, but also by quoting a section of the previous person's text to set up context. Thus, one would expect to find more of this in the CMC courses. Second, since CMC makes it easy to quote someone else's text verbatim, this is coded as Repeating.

Figure 23: Organising and Repeating

As predicted, sentences containing both Organising and Repeating were used exclusively in CMC by both teachers and students. Whereas not a single instance of a sentence containing both of these codes was found within the FTF sentences, these constituted a measurable amount of the CMC sentences ($\bar{x} = .07$, $sd = .06$). Further analysis of the CMC results indicate that the majority of these sentences were generated by the teachers quoting the students' contributions or questions. This shows the teachers quoting the students' text to establish the context for the answer.
A fourth characteristic of CMC that would be expected to distinguish it from FTF interaction would be the use of the Mechanism of Explaining or Performing coupled with the Subject of Procedure. This is because the basic forms of communication have to be explained.

Although participants in the CMC courses were all relatively knowledgeable about computers, one would still expect to see a measure of Explaining/Procedure used to explain how to do things related to the specific software, as well as use of Performing/Procedure to explain how to do things such as handing in homework or following up to others' posts [43]. This isn't directly related to the course content; this reflects the percentage of sentences used to explain why one does something or how to do something related to specific procedures, not the course content itself.

This prediction held true as illustrated in Figure 24. The CMC participants used Explaining and Procedure or Performing and Procedure more ($\bar{x} = .12$, $sd = .05$) than the FTF participants ($\bar{x} = .02$, $sd = .01$). I predict that as time passes, however, this difference between FTF and CMC participants will decrease, for two reasons. The first is the increasing sophistication of the hardware and software involved. Although there have been certain exceptions, over time hardware and software have generally become easier to configure and operate. Although I imagine it would be overly optimistic to predict that world-wide standards will emerge, I think it would be safe to assume that the trend toward increasing the ease of use in computer technologies will continue.

The second reason why I expect the difference between FTF and CMC participants to decrease is due to
the increased sophistication of users. With continued exposure to the technologies, participants will need fewer sentences of explanation describing how to participate in a computer-based forum. Also, with continued exposure to the technologies, more students will have developed mental models that permit them to better operate and understand their hardware and software.

Conclusion

Vygotsky (1962; 1978) wrote that children use language as a tool to increase their understanding of the world around them and to transcend their physical limitations. Similarly, CMC permits one to transcend physical boundaries. Furthermore, it has the potential to change the role of the teacher from merely a disseminator of information and evaluation to that of a collaborator. Full and active participation in the CMC classroom gives all students an opportunity to validate their knowledge by negotiating the meaning of the course content with the teacher and other students. This negotiation permits the student to make learning a more active procedure, engaging the help of others, increasing his or her zone of proximal development, and ultimately helping him or her to learn.

Nowadays, teachers and students can use asynchronous CMC as a tool to communicate with each other and create a better collaborative learning environment. They will need some patience, since the technology is still in its infancy; fully 12% of the CMC utterances dealt with how-to material, versus only 2% in the more familiar FTF environment. Despite these practical limitations, CMC has a great deal to offer educationally.

From my research, I have found that discussion is one of the hallmarks of CMC. Of course, discussion can also take place in the FTF environment. However, teachers often fail to realise that they have slipped into recitation instead of discussion (Alvermann, O'Brien & Dillon, 1990; Connor & Chalmers-Neubauer, 1989).

To study these and other related phenomena, this case study examined the discourse used in FTF and CMC classroom interactions. The results indicated that, overall, CMC interaction resembled that of discussion whereas the FTF interaction resembled recitation. In the FTF courses, for example, the interaction among participants resembled that of a typical recitation (Dillon, 1994): The teachers uttered 73% of all sentences, and 58% of the students' sentences took the form of Responding. In comparison, in the CMC courses, the teachers generated only 49% of all sentences, and the students used Organising, Lecturing, and Rhetorical Devices in approximately the same percentages as their teachers. In addition, the CMC students took longer turns as measured by their number of contiguous sentences. All of these are elements typical of discussion.

The CMC courses also evidenced another characteristic of discussion, specifically the use of Opining sentences. The CMC students used Opining sentences 11% of the time in contrast to the FTF students, who used Opining the least (3%), and the FTF and CMC teachers (4%). This supports the research saying that due to the decrease in social identification and deindividuation from CMC, one would be more likely
to express his or her opinion (Mabrito, 1991; Mason, 1989; McGuire et al., 1987; Sproull & Kiesler, 1991).

Of particular interest was the difference in the nature of interaction in the courses. In FTF interactions, the students uttered 17% more Responding sentences than their teachers, as would be expected in a recitation environment. In the CMC courses, however, the teachers Responded 11% more than their students. Although on average the FTF teachers said more contiguous sentences than the FTF students (5.19 and 1.66, respectively), these were both much shorter than the average number of contiguous sentences submitted by CMC students (22.20) or their teachers (36.48).

These results may have been due, at least in part, to the restrictions of CMC. In a similar manner in which a straitjacket prevents one from eating his or her salad with the cake fork, the current state of CMC prevents behaviours which are characteristic of recitation, and encourages behaviours characteristic of discussion. I believe that many of the benefits of discussion flow directly from the asynchronous mode of communication. The delay gives the students extra time to respond to the teacher, as well as to initiate an idea, develop an argument, or defend a point of view. This "sustained interaction" (Shale & Garrison, 1990) gives students the time to participate as an equal partner in the educational process. Moreover, the fact that they cannot be interrupted also seems to play an important role, as does the lack of social cues.

Traditionally, research has shown that in FTF environments, female students are dominated by teachers and male students. My research supports this to some extent, but with some important exceptions. In my study, the female students uttered shorter sentences than the male students (an average of 9.39 and 10.36 words, respectively), while speaking for approximately the expected percentage of time (47% of the FTF student population uttered 43% of the sentences). However, the female students interrupted their teachers, male students, and other female students more than expected. Female students were expected to interrupt the teacher, male students, or other female students 44%, 47%, and 39% of the time respectively, when their actual results were 46%, 59%, and 40% respectively.

In the CMC environment, I expected to find fewer differences between the sexes, given the relative lack of social cues. This held true, in that both female and male students' sentences were the same length (13.79 and 13.89 words, respectively), but the female students contributed much more in total volume of utterances than expected (46%), given their 32% representation in class.

Taken together, one might conclude from these results that the female students were simply more verbose than their male counterparts. In the FTF environment, social presence and social cues may have kept female students from participating fully in class discussions, but they seem to have circumvented that to some extent through interruptions. In CMC, where they were free from such restricting influences and were able to contribute as they liked, they spoke proportionally more than expected. Further study comparing FTF and CMC interaction could be used to examine specifically whether female students experience a greater need for involvement and interaction than male students (Gabriel & Davey, 1995), and whether teachers should take this into account when interacting with their students.
To perform this research, I had to develop the tools I used to analyse the data. Rather than restrict myself to writing inflexible, stand-alone programs that would have to be re-written to add features for further analyses, I used AppleScript. In addition to providing a means to compare the environments of FTF and CMC classrooms, this research demonstrates that with the use of multi-program scripts, commonly available software can be used for sophisticated analyses of large amounts of data, and can continue to do so in the future.

This work was a relatively small case study. However, the automated aspects permit much greater amounts of data to be analysed, which might ultimately allow one to make useful generalisations about the nature of classroom interaction. Furthermore, creating the tools to automate analysis permits more data to be created and examined. If researchers made these tools and resulting data sets available on ftp sites or the World Wide Web, more research could be done, including replication and refinement of existing coding systems and tools.

When I first considered working with AppleScripts for this thesis, I was hesitant about their applicability in the future. What would be the use of writing programs that wouldn't work on computers available three years from now? I justified my actions for two reasons. First, even if the AppleScript language changed or Word and Excel ceased to exist, the programs would still be useful. Besides commenting extensively within each AppleScript, I have explained how each AppleScript works. Even if AppleScript becomes defunct, it would not be difficult to convert the scripts to a different language.

The second rationale is my belief that AppleScript or something similar to it will be the next mode of computer applications. Admittedly, anyone who's watched the computer industry in the last decade should hesitate before making any sort of predictions. However, there are some indicators that this may come to pass.

First, Apple Computer are actively supporting future versions of AppleScript. Although few applications support AppleScript presently, Apple appear to "have been impressed by grassroots support for AppleScript by its customers and developers" [44]. This is particularly welcome news for anyone who wishes to do collaborative work with these scripts in international or non-English settings. AppleScripts may be converted to other human languages simply by changing an option within the Script Editor. For example, one could -- if one so desired -- write an AppleScript that would replace the thirteenth word of the third paragraph of a document with "weasel" (see Figure 1):
Figure 25: Basic AppleScript

One could then change the language of the AppleScript to French for use with a foreign colleague (see Figure 26):

Figure 26: Basic AppleScript converted to French

Although AppleScript has not been upgraded since 1993, an update is promised which will add native Power Mac support and links to OpenDoc [45]. In particular, the links to OpenDoc give me reason to believe that these scripts have a bright future.

OpenDoc was included as an optional extension for the System 7.5.3 update for Macintosh in July 1996 (Apple Computer, 1996b; Crotty & Gruman, 1996). OpenDoc and OpenDoc components will form an integral part of future versions of the Macintosh operating system (Apple Computer, 1996a; Crotty & Gruman, 1996; DiNucci et al., 1994; Goodman, 1994; Oakley, 1996; Rizzo, 1996a). OpenDoc is an open, vendor-neutral, multiplatform standard for building modular software components that work together (Apple Computer, 1996a). OpenDoc makes applications available as small pieces of software, called parts, that one can choose to install and combine for their specific features under a common interface (Rizzo, 1996a; Streeter, 1995). These parts work together with the operating system, similar to the way in which plug-ins work in Adobe's Photoshop and Illustrator, Netscape's Navigator, and Quark's XTensions.
While AppleScript permits commands and data to be exchanged between applications, OpenDoc permits commands and data to be exchanged between parts. The difference is that with AppleScript one is required to use an entire application even if one wants to use a single feature of it. With OpenDoc, instead of working with bulky "bloatware" (Apple Computer, 1996a), applications which provide hundreds of functions one may never use, one can select only the desired features from a set of application components. For example, the scripts used in this work require the use of Word, even though it is only being used to open text files and recognise paragraphs, sentences, and words. If there were a OpenDoc part that could serve these elementary functions, the scripts wouldn't require Word, with its large RAM and hard-drive requirements.

OpenDoc parts work with each other the same way AppleScript can work with Macintosh computers across a network. Unlike AppleScript, however, OpenDoc will not be limited to the Macintosh computing platform. Currently, users of Windows and Windows NT operating systems do not have anything comparable to AppleScript available to them (Oakley, 1996; Weger, 1995). Soon, however, OpenDoc will be able to run on Macintosh, Windows, Windows NT, OS/2, and AIX operating systems (Apple Computer, 1996b; Orfali, Karkey & Edwards, 1994), as well as mainframe and midrange operating systems such as AS/400 OS, HP-UX, and MVS (Rizzo, 1995). Furthermore, OpenDoc parts can be scripted using several scripting languages, including AppleScript, LotusScript, and IBM's REXX, on different computing platforms (Rizzo, 1995). Thus, for example, an OpenDoc script could be written on any of these machines that would involve using parts on a Macintosh, a Windows machine, and a UNIX mainframe (Apple Computer, 1996c).

OpenDoc and the scripts I have devised ensure a strong future for this sort of analysis in three ways. First, by permitting inter-application scripting on other computing platforms, the use of the scripts is not limited to users of Macintosh computers. Admittedly, unless AppleScript is ported across platforms or the script is run from a Macintosh computer, my scripts would have to be rewritten in each platform's native scripting environment (Streeter, 1995). However, with a small amount of work, the same scripts could work on a wide variety of operating systems.

Secondly, since the parts required for the scripts are rather simple, they could be given away or sold very cheaply. Rather than having to purchase big, expensive, feature-laden software, one could purchase only the small, simple, necessary parts. In the case of my scripts, for example, one would require merely an extremely elementary text processor capable of understanding paragraph, sentence, word, and character and of copying them to another part. Such a simple text conveyor could be designed as a freeware or shareware addition to the scripts and made available at an ftp site or on the World Wide Web for anyone's use.

Third, since the use of parts rather than large applications decreases the hardware requirements to use the scripts, more people could use them. Besides permitting the use of much smaller applications, this would permit more flexible use of a computer's available RAM. When an OpenDoc document is open, OpenDoc will load the correct component into RAM as needed and unload it when done, based on what
OpenDoc will permit a continuation of this sort of analysis to continue in the future, regardless of which software or computing platform is selected. The adoption of OpenDoc standards and parts would permit these AppleScripts to be used on almost any computer for free or nearly so. This would allow anyone, particularly those in cash-starved educational settings, to use these tools easily and inexpensively.

Although this research and these techniques are useful for examining discourse involving all classroom participants, further research is warranted. For example, the coding system and scripts could be modified to aid the analysis of threaded discourse (Grimaldi, 1995; Levin, Kim & Riel, 1990). Presently, the technology is limited to distinguishing teachers from students and males from females. Additional fields in the databases and minor modifications to the programs could permit one to track patterns of response by specific students to specific sentences. In addition, this would permit a way to determine if a few students (male or female) are monopolising the classroom discussions. Finally, by tracking each participant, one would be able to analyse each student's participation, correlate this with other measures of evaluation such as grades and interviews, and, ultimately, help to determine the effectiveness of specific modes of teaching.
References


http://www.quahog.org/thesis/references.html (1 of 18) [7/20/2004 10:45:17 AM]
competence in males. Behavior Therapy, 6, 3-13.


References


References


References


References


References


Thorpe, M. (1979). When is a course not a course? Teaching at a Distance, 16, 13-18.


hillman@quahog.org

1997