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REAL EDUCATION IN NON-REAL TIME: THE USE OF ELECTRONIC MESSAGE SYSTEMS FOR INSTRUCTION

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ABSTRACT

Education in different communication media takes place with functional differences that have consequences for the course of instructional interaction. In this paper, we examine instructional interaction among people using a computer-based electronic message system, contrasting it with conventional face-to-face discussion in a college level class. Interaction via the non-real time message system contained multiple "threads of discourse," a higher proportion of student turns to teacher turns, and other deviations from the "initiation-response-evaluation" sequences usually found in face-to-face classroom interactions. Based on the results of our contrast, we describe ways to organize instruction using electronic message systems to take advantage of new properties and to avoid shortcomings of these new instructional media.

Electronic message systems are possibly important new media for education because advances in microelectronics have lowered the cost of computing dramatically and made the cost of telecommunications increasingly independent of distance. The uses of these new media for instruction raise several issues. The initial uses of any new media almost always follow the forms of usage of existing media, even though these uses may not be well suited to the properties of the new media. We have compared the differences between instruction in non-real time interaction inherent in an electronic message system and real time interaction found in face-to-face interaction. The results of this comparison are used both to propose ways that the new non-real time media can be fruitfully used for instructional interaction and to illuminate the social organization of existing face-to-face instructional interaction.

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The Use of Electronic Message Systems for Education

Two common types of electronic message systems are text teleconferencing and electronic mail. Text teleconferencing systems are modeled on face-to-face meetings, and can be used to conduct meetings in "real time." Each participant types on a computer terminal, and sees the text typed by other participants. Messages generally are seen by all participants (unless the sender specifies otherwise), and the system is designed so that a message can get an immediate response.

Electronic mail systems are modeled on letters and memos typed or written on paper. In these systems, a person addresses a message to another person and transmits it, and then sometime later may receive a return message. Generally the sender does not expect to receive an immediate response. Thus, a key difference between text teleconferencing and electronic mail systems is whether the interaction is in real time (with immediate response expected) or in non-real time (without immediate response expected).

However, it is possible to add features to allow electronic mail systems to be used for real time interaction, and to add features to teleconferencing systems to allow non-real time interaction. For example an electronic mail system can immediately inform a user whenever a new message arrives and can easily send a message to a whole group of people simply by specifying the name of that group. With the addition of an immediate notification component, two or more people can use an electronic mail system for real time interaction. With the group list feature, large groups of people can engage in interaction.

Similarly, text teleconference systems, originally designed for large groups of people to interact in real time, acquire features that allow for non-real time use. Many teleconference systems have the capability of storing messages to be viewed by the other participants at a later time. In this way, the prefix "tele" takes on the added meaning of remote in time as well as remote in space (Bretz et al., 1976). The two models of "mail" and "meeting" have merged, as electronic message systems have emerged to become a communication medium with properties of its own.

Costs for electronic message systems have already been shown to be competitive with other forms of communication, and in some cases more cost-effective (Panko, 1977). The educational possibilities of non-real time message systems include spatial and temporal separation of the participants in an educational interaction, enabling participants to interact at their convenience, allowing people with radically different schedules and locations to further their education. In this study, we examined the educational costs and benefits of using an electronic message system.

Instruction in Real and Non-Real Time

A course by one of the authors (H.M.) at the University of California, San Diego served as the setting for a comparison of instruction in real and non-real time. The course, "Classroom Interaction", is routinely conducted in a discussion format. For the purposes of this study, the Spring 1980 class was divided into two groups. One group participated in face-to-face discussions in the regular classroom setting, while the other group participated in discussions via an electronic message system known as MSG (Black and Levin, 1980). The same course instructor led the electronic message discussion and the classroom discussion for the three week period of the study.

Each student in the electronic message interaction group received both written and verbal instructions on the use of the message system and the location of available terminals. Students also saw a demonstration of the use of the MSG system. Messages could be sent to the course instructor alone, to other students, or to the whole electronic message discussion group. The course instructor could also send and receive messages, as could two assistants (J.L. and S.B.) who helped with any technical problems with the system.

Points of Comparison

At the beginning of the course, all students in the class completed a questionnaire concerning their previous computer experience. All the messages sent to the entire class were directed to a general pool of messages. The time each student in the electronic message discussion spent using the message system was recorded by the message system. These data allowed us to investigate the content, quantity and temporal organization of the electronic message discussion.

The face-to-face instructional interaction was recorded on audio tape. The academic performance of the two groups on the course material was measured by a take-home short essay question examination, given to both groups at the end of the third week of the course.

At the end of the course, each of the students in the electronic message discussion group was rated by the course instructor. This rating reflected the course instructor's evaluation of the students' amount of participation in regular classroom interaction which followed the three week electronic message interaction. With this information, comparisons could be made about the participation of the students when they were in the electronic message discussion and when those same students were in the face-to-face discussion.

A special meeting at the end of the experimental period solicited feedback from the members of the course. The comments obtained were supple-

mented by anonymous comments obtained from a standard university-wide course evaluation conducted at the end of each quarter by students at the University.

Content and Context Differences in Electronic and Face-to-Face Discussions

Our analysis focused on the content and context properties of the electronic message discussion in contrast to face-to-face discussion. The two media exhibit functional differences which affected the interaction between the course instructor and students. One of the differences between these two media is in the spatial relation of the participants. A face-to-face discussion requires the presence of the participants in the same location. In the case of the electronic message discussion, participants may be separated by a considerable distance.

Another fundamental difference is the temporal nature of the interaction. In a face-to-face discussion, the participants must be together all at one time. In an electronic message system discussion, the participants can participate at different times. The constraints of face-to-face conversation provide for little gap or overlap between turns at talk (Sacks, Schegloff and Jefferson, 1974); thus, an answer usually follows a question soon after a question is asked in face-to-face educational interaction. A large gap is disruptive of everyday conversation. However, an answer to a question may be provided at any time after the question that prompted it when an electronic message system is used without disrupting the flow of conversation.

The temporal longevity of the interaction was also different in the two media of instruction. After a given class meeting, the face-to-face discussion has continuing representation only in the minds of the students or in any notes they took. After an electronic message exchange in the MSG system, all the public messages were available for rereading by any participant over the duration of the course.

CONTENT DIFFERENCES

The course grades obtained by students in the two groups were compared. The scores on a course examination given to all students at the end of the third week showed no significant differences between the electronic message discussion group and the face-to-face discussion group (two-sample *t*-test for independent groups).

The distribution of instructor's questions to students in the two groups was compared. Questions from transcripts of the audiotape of face-to-face discussions and texts of electronic message system discussion were compared using the typology in Mehan (1979). This typology divides questions into

TABLE I

Comparison of Course Grades

	N	Mean	S.D.
Message group	21*	37.43	3.76
Classroom group	23	36.78	4.89

* One student's grade was unavailable.
Degrees of freedom = 40
$t = 0.493$
$p > 0.05$

TABLE II

Comparison of Question Types

	N directed to Ss in face-to-face interaction	N directed to Ss in electronic interaction
Choice	9	6
Product	15	21
Process	42	9

three groups: choice questions, product questions, and process questions. Choice questions evoke a response from categories provided in the questions. Product questions require a "factual response." Process questions query the respondent for interpretations or opinions.

Table II shows that the teacher directed more than twice as many questions to students in face-to-face interaction as he did in the electronic interaction. Furthermore, the modal question type in the face-to-face instruction was a process question, while the modal question in the message discussion was a product question. Below is a typical example of an instructor's message sent via the electronic message system [1].

Example 1. Typical example of a message in the electronic message discussion.

To: class
From: mehan
Date: Tue Apr 15 13:11:18 1980
Subject: numbers lesson tape
cc:

Message:
I would now like you to watch the numbers lesson tape. There are copies in the playback center and Room 244. After you watch the tapes, answer the following questions:
1. which model of education do you think this tape represents?
2. What is the role of the teacher in this lesson
3. What is the role of the student in this lesson – what are the students expected to do? What is expected of them?
4. what counts as knowledge in this lesson – that is, what is being taught?
5. describe the process of learnithat is taking place in this lesson?

Here is an example of a turn in the classroom discussion.

Professor: What tells you that the attention of this lesson is focused on the teacher?

Student responses in the message discussion differed markedly from the responses of the students in the classroom discussion. Responses were, on the average, longer in the electronic message discussion than in the computer group. Computer messages were also more complex than face-to-face messages. Responses sent via the message system averaged 106 words in length, while answers provided in class averaged 12 words in length. The following examples show the considerable content and quality differences that exist between the two modes of instruction.

Here is a student's contribution to the electronic message system discussion, in response to the questions asked in Example 1.

Example 2. Student message in the electronic message discussion.

To: class
From: kerry
Date: Fri Apr 18 15:23:43 1980
Re: numbers lesson tape
cc:
Message:
well, i'm finally getting into this discussion! i'm not positive, but it looks to me like this lesson would be classified as cultural transmission. the lesson seems to be kind of a drill, with immediate repetition of the correct reponses. the student is expected to answer, loudly and promptly, with the exact word "first", "second," etc. what counts as knowledge is ability to read the correct

word, pronounce them correctly (". .th"), and to understand the concept of 1st, 2nd, etc, so as to use it when counting. in the process of learning, individuals are asked to come up with an expected reponse. when an individual answers correcdctly, the

others are asked to chime in and repeat the answer one or more times to reinforce it. if a child is wrong, another may be

asked to "help out". there is no discussion or option for any other answer than the expected one.

suggestion to bud – with the number of messages on the ssystem now, it's getting a little confusing to sort them out. would you sign your messages, or "head" them in a way that is unique to "official" messages – e.g. those that contain questions for us to answer?

that's it for now – bye, everybody! guess we'll finally all meet in a week or two –

kerry

This computer message is much longer than the average in-class turn (215 words to about 12). In addition, the student who sent the computer message accomplished six speech acts: she answered four questions, made a suggestion to the teacher (which was accepted and carried out), and sent a general comment. This message is a good example of how this non-real time medium can support "multiple threads of discourse" (Black et al., 1983).

CONTEXT DIFFERENCES

The process by which learning took place in the electronic message discussion was also compared to the ways in which learning took place in the face to face discussion. We considered temporal factors, the influence of previous computer experience on academic performance, the amount of student participation in the electronic message discussion, and the sequential structure of the face-to-face and computer dialogues.

The amount of time to cover a set of questions on one topic was generally longer in the message interaction than in class discussion. Students spent from three to six days on most of the question topics, although one set of topic questions received no answers at all. In the classroom, topics were usually covered within the 90 minute class period. The average response time to questions asked in the electronic message discussion was a day and a half. The range was from roughly twenty minutes to six days. The course instructor usually responded in a day. The longest delay between a question asked by a student and an answer by the instructor was three days.

TABLE III

Comparison of Student Course Grade

	N	Mean	S.D.
Previous exp.	10	37.80	3.82
No. prev. exp.	11	37.09	3.86

Degrees of freedom = 18
$t = 0.423$
$p > 0.05$

Some students complained about this time delay factor in the electronic message discussion. They said the longer time delay in reading responses made it difficult to understand the course material. Other students had the opposite reaction to the temporal factor. They reported that the time separation allowed reflection and time to compose a coherent answer. This factor could contribute to the length of student answers, since responses in the electronic message discussion were, on the average, longer.

In addition, students spent an average of 19 minutes on the computer when reading, but an average of 47 minutes on the computer when sending a message. The difference of 28 minutes indicates how much time was spent, on the average, composing a message. The average could even be higher, as some students composed answers while not on the computer, then used the computer to send a complete message. In contrast, the average time spent in answering a response in the classroom was more on the order of seconds.

Students' previous experience with computers did not influence their contributions to the electronic message discussion. Exactly half of the participants indicated they had computer experience prior to the course. Three measures of performance on the computer were tested against previous computer experience: scores on a take-home short essay question examination testing mastery of the material covered during the study, the number of messages sent, and time spent on the computer. The grades of the electronic message discussion students who had prior knowledge of computers were compared with the grades of those students who had no previous experience. There was no significant difference between the two groups.

The second measure of performance was the number of messages sent by each student in the computer group. Again, a *t*-test showed that there was no significant difference between the number of messages sent by those students with previous experience and the number sent by those students with no previous experience.

The amount of time spent on the computer also was not dependent on previous experience with computers. No significant difference in time spent

TABLE IV

Comparison of Number of Student Messages Sent

	N	Mean	S.D.
Previous exp.	11	1.18	1.17
No. prev. exp.	11	1.91	2.21

Degrees of freedom = 15
$t = -0.964$
$p > 0.05$

TABLE V

Comparison between Previous Experience and Amount of Time on the Message System

	N	Mean	S.D.
Previous exp.	11	3.68	1.82
No. prev. exp.	11	3.28	1.90

Degrees of freedom = 19
$t = 0.505$
$p > 0.05$

on the computer could be attributed to having previous computer experience.

The lack of difference is particularly interesting as some students expressed the contrary opinion that previous experience with computers was a prerequisite to successful performance in the electronic message discussion group.

The amount of participation of students in the electronic message discussion differs from the amount of participation of those same students in classroom situations. The course instructor rated each student on a scale of 1 to 5 to indicate the amount of participation in face-to-face classroom interaction during the seven weeks following this comparison. These participation indicators for in-class performance were correlated with the number of messages sent and with time using the message system. There was a moderate degree of correlation. The Pearson product moment correlation coefficient between the participation in class and number of messages sent was 0.32; the correlation between in-class participation and time on the message system was 0.47.

We also compared the structure of discussion in the electronic and the

face-to-face media. There were changes in both the location of procedural matters and the presence of evaluation. Also, the manner in which students responded was different in the electronic message discussion than in classroom interaction. The pattern of face-to-face interaction was not found in the electronic message interaction. The number of answers to each teacher question was also different in the message system discussion.

Mehan (1979), in his analysis of face-to-face classroom interactions, found that matters of procedure were clustered at the beginning and end of classroom lessons. The interiors of lessons are concerned primarily with instructional matters. In contrast, procedural matters in the electronic message discussion were scattered throughout the interaction. There were an equal proportion of procedural matters in the beginning, middle and end of discussions.

Another difference between the electronic message discussion and in-class interaction is in the structure of discussion. A number of investigators (Sinclair and Coulthard, 1975; Mehan, 1979) have shown face-to-face interaction in the classroom to consist of a sequential arrangement of initiation, response and evaluation acts. A typical sequence involves a teacher presenting a question, a student providing a response, and the teacher then providing an evaluation of the response. Various alterations can occur in the sequence, notably when incorrect responses are prompted by the teacher until a correct response is obtained, at which time a positive evaluation is given. Such variations reinforce the view that the sequential organization of classroom lessons is one of initiation, response, and evaluation (I–R–E).

Here is a typical I–R–E sequence from our study:

> Initiation. Teacher: . . . so where would you put that in this categorization scheme? Is that a comment on the teacher, student, learning, knowledge, maybe all four? Go ahead.
>
> Response. Student: She's reinforcing speed.
>
> Evaluation. Teacher: Okay, okay. So the process of learning is concerned with repetition recall and definitely speed, that is, very quick learning.

The structure of the electronic message discussion differs in a number of ways from the I–R–E pattern found in classroom interaction. In electronic message discussions, an initiation may be followed by multiple student responses. This leads to a pattern of I–R–R– with the number of student responses varying after each initiation. Little overt evaluation occurred in the electronic message discussion, although the presence of "covert evaluation" (Griffin and Humphrey, 1978) can not be discounted, as the act of going on to the next phase in a lesson can signal that the previous action was acceptable to the teacher.

An example extracted from the electronic message discussion of an extended I–R–R– sequence follows.

> Teacher: . . . I still need to know, in more fundamental terms, what "ethnography" means? . . .
>
> Student 1: . . .ethnography is the task of describing a particular culture. it involves the cultural experience, entering the field, doing field work, and describing a culture. it involves really getting in their and and experiencing it. . .
>
> Student 2: . . .In response to and in addition to Laurie, I would add that characteristics of ethnography would include the cultural scenes, informants, categories, and meanings in relation to participants in a cultural situation. These things would also be important in describing a particular culture. . .

The absence of overt specific teacher evaluations in the electronic message discussion stands in contrast to face-to-face interaction. In classroom situations, the evaluation by the teacher almost invariably follows a student's response; in the electronic message discussion, few evaluations of individual answers occurred at all. A total of three individual evaluations were supplied by the course instructor over the three weeks of this experiment. These consisted of one or two word references in messages initiating further questions ("insightful", "perceptive", having taken a "good look").

The course instructor did provide two general evaluations. One came at the end of a topic of discussion: "The first set of questions that I asked seemed to generate an interesting array of answers, and dialog among class members." The other example of evaluation was another general comment: "the discussion. . . . has been very sophisticated, i think".

However, students in the electronic message discussion evaluated each others' responses with a higher frequency than seen in the classroom discussions. Student messages would refer to each other's comments: "In reponse to and in addition to Laurie . ."; accept each other's answers: "I thisnk that bill's answer is realy good. and I don't have anything to add."; comment on the overall discussion: "everyone appears to be doing well intellectualizing . . ."; and admire one another's insights: "i also wantt tto say 'good point' to patti about . . .".

The linear pattern of sequential organization observed in classroom discussion is not recapitulated in the message interaction. In face-to-face interaction, there is generally one main topic on the floor with that topic controlled by the teacher. In the message discussion, a number of discussions were taking place concurrently with course material. Often many topics were

discussed in the same message (see Example 2). Even though the course instructor used sequential questioning, students' discussions were overlapping and intersecting. Answers to questions superseded by the teacher's new topical questions continued to appear after the teacher informally closed the discussion: "Now I'd like to move on . . . ." The presence of multiple threads of discourse is documented in Black et al. (1982).

In face-to-face discussions, two recurrent turn-allocation procedures involve the selection of students by name to respond to a teacher's question, or, students are allowed to "bid" for the change to answer. In the electronic message discussion, turn-allocation was more open. Any student had the option to answer the teacher's question. Self selection of next speaker was the rule in computer discourse. The teacher never specifically asked a student to answer a given question, with one exception. In that one instance, the teacher was requesting the student to continue her exploration of a particular facet of the implications in a certain videotape: "Perhaps you could look at tape again to see if there is anything systematic happening there."

Computer Anxiety

Many adults in our society currently suffer from "computer anxiety". Whether because of previous experiences with computerized billing, faulty computer reservations systems, or the agonies of batch processing, many adults are intimidated by any system called by the name "computer." This stands in marked contrast to children, who show no such anxiety. In three years of studies with elementary school children using computers, we have failed to see a single child showing any of the anxiety that we see in a substantial number of adults (Levin and Kareev, 1980; Levin, Boruta and Vasconcellos, 1982). We found that this "computer anxiety" existed for a number of the students in this university course.

In an attempt to control for the "Hawthorne effect" of introducing any educational change on performance, we split the class into two groups. Our original plan was to switch the two groups at the end of three weeks, having the message group then meet face-to-face and the in-class group use the message system. This would have allowed us powerful within and between group comparisons.

As the time to switch approached, we encountered resistance from some of the students in the class, which culminated in a meeting of the entire class. At that meeting it was decided to make the use of the message system optional: all students were free to come to class meetings and use the message system at their choice. The bulk of the resistance arose *not* from those students who were currently using the message system, but instead from those students who were *about* to be introduced to the system. These

students had three weeks to build up anxiety about using a computer system, without any direct experience on which to ground their feelings. "Computer anxiety" is currectly a significant factor to face when introducing new computer-based media to adults.

Recommendations

How can electronic message systems be used for instructional purposes? Based on our experience in this project and others, we make the following recommendations:

(1) The course outline should be structured to take advantage of the multiple threads of course discussion possible in non-real time media. Non-real time media can support interaction consisting of multiple threads of discourse. However, by the very nature of the medium, interaction turns are separated by much larger time spans, thus stretching out a discussion over a longer period. These two features trade off against one another: course material can be covered in the same time as in face-to-face media only if the material is presented to the class with multiple threads of discourse, rather than the traditional sequential course organization. Thus, instruction in these new media benefits from a substantial re-organization of the course outline. Presenting multiple threads also can help students to consider the relations among the multiple topics.

(2) The non-real time instructional interaction should be organized by using message headers. How can this "skein" of simultaneous multiple threads be organized to keep it from becoming so tangled that the participants lose track of the interactions? A recommendation made by a student in our study turned out to help. She asked that participants indicate in the "subject" header of a message whether it addressed course substance or course procedure, and for substantive messages, which of the teacher's questions it was responding to. The message system itself can assist in this organizational work, as any message that is "answered" using the automatic answer command picks up the subject header of the previous message, carrying along the organizational label.

(3) The introduction of an electronic message system should encourage early use. For use as an auxiliary instructional medium within a campus education setting, we recommend that the message system be introduced as an optional medium, but that each student be required to use the system at least once at the start. This approach, used successfully by Ron and Suzanne Scollon at the University of Alaska, Fairbanks, fits into a middle ground between the two approaches we have used here at UCSD. In the study reported here, students were forced to use an electronic message system, with little choice or justification. This led to anxiety and resistance from

some students. In other courses, we have made the use of the same system completely optional. In these courses, it was difficult to get an ongoing discussion going, as many students waited weeks before starting to use the system.

For use as a major medium in a non-centralized educational setting, we recommend that the system be introduced during an introductory face-to-face session if possible, where each student is required to send at least one message.

Both of the above suggestions deal with the issue of how to start such an educational interaction from scratch, with a large number of people who have never used electronic message systems before. It is much easier to introduce one new member to an ongoing discussion, since the messages from others serve as important models of how to use the new medium.

In either case, it is important that a "help" mechanism be available, for when things go awry. A simple mechanism that worked in our experimental use is to have a person available (other than the teacher) to give help concerning the computer system. This "computer consultant" can be used through the message system itself, as illustrated in the helping examples presented in this paper.

Summary

Our study of the use of an electronic message system for non-real time instructional interaction points to important differences between this kind of interaction and face-to-face interaction. Interaction via a non-real time message system showed multiple threads of discourse, a higher proportion of students' responses to teacher's initiations, and few teacher evaluations. However, students not yet initiated in the use of this system for instruction, expressed considerable "computer anxiety." Our experience with this new instructional medium leads us to make a number of recommendations about how it can be used for education. We believe the recommendations presented here for using the new non-real time media for education are valuable both for further research and for real educational applications.

Note

1 The messages appear essentially as they were generated. Typographical errors have not been removed. The course instructor, to focus the intent of the students on the course material, not on writing particulars, wrote in his first message "(note that I can't type – so you shouldn't worry about that either)".

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