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# NEW JERSEY INSTITUTE OF TECHNOLOGY

THE VIRTUAL CLASSROOM: BUILDING THE FOUNDATIONS

STARR ROXANNE HILTZ, PROJECT DIRECTOR

RESEARCH REPORT FOR THE 1985-86 ACADEMIC YEAR
"TOOLS FOR THE ENHANCEMENT AND EVALUATION OF
A VIRTUAL CLASSROOM"

RESEARCH REPORT 24
COMPUTERIZED CONFERENCING AND COMMUNICATIONS CENTER
NEW JERSEY INSTITUTE OF TECHNOLOGY
SEPTEMBER 1986

c/o Computer & Information Science Department
New Jersey Institute of Technology
Newark, N. J. 07102

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## ABSTRACT

This is a report on the first year of a three-year project concerned with the development and assessment of new types of software capabilities designed to support university level courses. A "virtual classroom" or "university without walls" is being created within a computerized conferencing system. During the first year of the project, students in twelve courses at three universities completed part or all of their coursework online. Pre and post-course questionnaires and automatic monitoring of their computer-mediated communications are the main sources of data. Independent variables include the expectations and attributes of the individual students; characteristics of the particular hardware and software which they use; and variations among classes in the nature of the assignments and activities required or facilitated by the instructor. Intervening variables include the amount and type of use of the system by the students, and the extent to which "group learning" takes place. Dependent variables are course outcomes and judgments by the students about the relative value of traditional and "virtual" classrooms.

There is considerable variance in outcomes, particularly in student assessments of whether the virtual classroom is a "better learning experience" and whether they "learned more" or learned less. There was also extreme variation in measures of activity levels by students. For instance, the mean number of student sessions online was 41, but the standard deviation was 61; and the mean number of "comments" (contributions per student to the class discussion) was six, while the standard deviation was eight. Variations in measures of online activity and outcomes were significantly related to course, pre-use expectations of the students, sex, and system access variables including workstation hardware and response time. However, the strongest relationships are for measures of process vs. outcome. Those students who actively participated (by making comments rather than just reading the comments of others, and by engaging in private communication online with a number of other students as well as the professor) and those students who experienced "group learning" (learning from peer-group activity rather than one-way transmission of "knowledge" from professor to student) reported the most positive outcomes.

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## FOREWORD

Ten years ago, I was fortunate enough to win a National Science Foundation Faculty Fellowship, which enabled me to spend a year as a post-doctoral fellow at Princeton University and the Institute of Advanced Study. One of the courses participated in was Suzanne Keller's seminar on the Sociology of Architecture. This was concerned with the way in which the architecture of buildings and communities influence social behavior. Near the end of the course our assignment was to design a classroom: an environment to support learning.

First, I started sketching a very large space that was broken down into different kinds of rooms for different purposes. There would be a kind of "conversation pit" for small group discussions; I thought of that first. It would be a circle of couches for 10-15 people to comfortably talk for a long time; in this space, all would be equal. A lecture hall, with a lectern and audio-visual aids, could allow a teacher or visiting expert to make formal presentations to others. There would also be a library for reading; a typewriter room for writing; and a room full of microcomputers for computer-assisted instruction.

And then I realized an environment for different types of learning activities did not have to be physical. It could be virtual; it could be located within a computer-mediated communication system.

The "door" to the virtual classroom consists of a microcomputer with a modem, connected to the international networks. Software could be created to support various types of individual and group activities and communications. Some of these communications structures already existed within EIES, (the Electronic Information Exchange System at N.J.I.T.) and other computerized conferencing systems. Others could be added, such as the ability to use simple graphics as if you were drawing or writing an equation on a blackboard.

Initial approaches to such traditional funding sources as the National Science Foundation elicited a response that such a project did not fit within the bounds of any existing programs. By 1984 some new competitive programs to support research related to new technologies were established. Full proposals were developed at the invitation of the Annenberg/CPB project and the New Jersey Department of Higher Education Computers in Curricula project. Neither was funded. Feedback indicated that some reviewers considered the idea of a virtual classroom promising but many thought it sounded crazy and impractical. Without funding we began experimenting and gathering data about online classes. I kept refining the plans for a virtual classroom and it kept getting more and more expensive to construct and evaluate.

In 1985 I wrote three different versions of the virtual classroom proposal and submitted it to three sources of funding: the New Jersey Telematics program of the Governor's Commission on Science and Technology; the NJDHE Computers in Curricula Program; and the

Annenberg/CPB project. Apparently, the time had come when the idea no longer seemed crazy to reviewers. All three proposals were selected for funding. Not in the amounts requested: for instance, under the Telematics program I had requested $150,000 and received $25,000. Under NJDHE I had requested about $200,000 and received $90,000. These two projects together were sufficient to support some initial software and evaluation tool development and testing. With the additional $700,000 to be awarded by Annenberg/CPB, the virtual classroom should be a reality by the fall of 1986.

The software developments and results of use of evaluation tools during the 1985-86 year are described in this report. Though the NJDHE and Telematics funds were treated separately for budgetary purposes, it is not possible to separate the results. For example, a large part of the Telematics funds went to support my time while the time of the people I was supervising and the costs of the accounts being used by the students I was observing were from the NJDHE account. On the other hand, Annenberg/CPB money began being used late in the Spring to support an Advisory Board to give me advice about the project.

This first year was focussed on building the foundations: designing special software, evaluating student reactions to courses which were offered partially online and partially in a traditional classroom, and building the experience of core faculty members who will teach totally online courses in the future. During the second year, we will put up what might be considered a rough temporary structure, as entire courses are offered online using prototype software. Based on feedback from the participating faculty and students, we will then make final design decisions. During the third year, the software will be produced in final form, for national distribution. It will be written in C and will be an advanced applications module for TEIES, the Tailorable Electronic Information Exchange software which will run on any mainframe that uses the IBM-VM operating system.

In this project, my role as Principal Investigator is something like that of an orchestra conductor. I have a vision of what the final product should be like. To achieve it, however, requires the skill, hard work, and cooperation of hundreds of people. The project described here is the evolving creation of many people working together. Some of them are mentioned by name in the acknowledgments on the title page. The cooperation of the participating students is also fundamental, and I am grateful to each one who has filled out questionnaires, sent a bug report, or shared an idea for improvement in procedures. The full Advisory Board is listed in the Appendix. In addition, scores of my colleagues at NJIT and Upsala have cooperated in supporting the project, and to each of them, I am grateful.

# OBJECTIVES OF THE VIRTUAL CLASSROOM PROJECT

The goal of this project is to develop and evaluate a major new means of educational delivery for college-level education. We plan to create, implement, evaluate, refine, demonstrate, and disseminate the results of our work on a "virtual classroom:" a teaching and learning space located within a computer-mediated communication system. Its components include class conferences where teachers and students can discuss course material seminar-style; a message system for private communication between student and teacher and among students; and special software for activities such as tests and graphics creation and display.

The objective of the "virtual classroom" is not only to replicate the forms and modes of interaction and activities available in the traditional classroom. In addition, we hope to use the power and characteristics of the computer to produce interactive, didactic group learning activities which improve on the traditional classroom in three major ways:

- Convenience of access to educational opportunities- Each student can participate at a time and place which is most convenient. He or she enters the virtual classroom by dialing its number and connecting via a home or office microcomputer or computer terminal. The classroom is brought to the student, rather than the student travelling to the class. Correspondence courses are the only other means of educational delivery which allow complete freedom of time and place, and they do not provide for the constant interaction among the students and timely feedback from teacher to student which the "virtual classroom" encourages.

.More active participation- In this medium, the student may be encouraged and prodded into more active participation than in the traditional classroom. A faculty member can use the computer to force individual thinking and responses and group discussion and processing of ideas and concepts; the student can be prevented from being merely a passive listener or watcher. We intend to develop software structures which, like simulation-games in Computer-Assisted Instruction, force active learning and active participation. However, unlike CAI, the forced interaction will be not just with a computer program, but also with the other students and the teacher. Thus, a goal of the virtual classroom is to facilitate and combine "active learning" and "peer-group learning" (Collier, 1980; Bouton and Garth, 1983).

.Self-pacing- Because the material is stored and mediated through a computer system, each student can proceed through the material at an optimal pace for him or her. Material can be skimmed quickly; optional units not of interest skipped. Conversely, a student may choose to print material that seems difficult and to review it several times; to take an hour to compose a contribution that others will receive in less than a minute; to choose to participate in remedial or enrichment units and activities made available as options. The only other technology that comes close to the user's ability to speed up or slow down the pace of receipt of material in Computer-Mediated Communication is video-disk, and that medium allows only receipt of fixed material, rather than the opportunity for social interaction and student contributions in a classroom-like communication environment.

There are four inter-related major activities which represent the immediate objectives of the project:

- Modifications and enhancements to the text-based conferencing capabilities now existing on EIES (the Electronic Information Exchange System), providing alternatives to the simple linear discussion mode. Tentatively called "branching," a number of required or optional activities will be able to be attached to a conference. The sequence of completion can be specified by the instructor. These will include enhanced capabilities for the delivery of lecture-type material, question-and-answer assignments, CAI, a "switcher" routine to permit execution of programs, and surveys and tests.

- Development of a conferencing-oriented color graphics capability, so that equations, diagrams, and other non-text materials may be transmitted online.

- Development and application of evaluation tools. The evaluation is both "formative" and "summative." In terms of formative evaluation, the objectives are both to provide feedback for an iterative design process, and to document implementation problems and share solutions to such problems. As a summative evaluation, the objective is to assess the relative effectiveness of different modes of educational delivery for various types of courses and students. A version of the major evaluation tools must be built into the conferencing software itself, to take advantage of unique opportunities offered by Computer-Mediated Communication to accurately and unobtrusively collect data on the processes occurring.

.Integration of the most effective software to support and evaluate a virtual classroom into a new version of EIES which will be written in C and can be installed on a wide variety of IBM and IBM-compatible computers. This will facilitate dissemination and use of the software developed. (The current version of EIES runs only on Perkin-Elmer hardware. The new version is called TEIES, Tailorable Electronic Information Exchange System, and is pronounced "ties.")

The ultimate objective is to create a new medium of educational delivery that will provide a higher quality as well as more conveniently obtained educational opportunity, for at least some types of students and course materials. We do not assert that the "virtual classroom" will be better for everyone and everything. For example, in a recently completed project comparing current modes of Computer-Assisted Instruction with traditional classroom instruction in sociology, the project director found that the students who benefited most, by their own estimation, were those who had a large "span of control" (ability to plan and control the events of their lives) and minority students (Hiltz, 1985). Analogously, in the proposed project, we expect that the product developed will provide a superior educational experience for certain types of students and selected types of course materials.

The entire project will take three years. This is a report on the first year's activities. During this year, we developed and tested some initial versions of "branching" and graphics software enhancements. We also administered pre- and post course questionnaires to students who were involved in taking part of their undergraduate courses online through Upsala or NJIT, and to students in the totally online courses offered by Connected Education through the New School.

During the second year, a quasi-experimental design will be used to deliver three undergraduate courses (Introductory Sociology, Introduction to Computer Science, and Basic Statistics) entirely online. The IBM-VM version of the software will be started in the Spring of 1987 and should be ready for release for Beta-testing by Spring 1988. The final six months will be devoted to data analysis, reporting, and dissemination activities.

The intended long-term outcome of these activities is to make available virtual classroom software that will allow any university to use a dedicated computer to offer courses in this new mode. These offerings of courses via the new medium might vary from a single course offered via a version of TEIES that runs on a super-micro (such as the IBM-AT) with only a few ports, to an entire "electronic university," running on a dedicated mainframe that could accommodate up to 10,000 students. The goal of the project is thus to take advantage of the spread of computers into homes and offices to make them the means of delivery of higher education, especially for adult learners; a means that is potentially both lower cost and more effective than any current alternatives.

For this project, software development and evaluation are co-equal goals. That is, we think that it is at least as important to gain an understanding of the conditions under which computer-mediated communication is more or less successful as an educational delivery medium as it is to develop and disseminate new software.

LEARNING IN THE VIRTUAL CLASSROOM

Students who take courses in a "virtual classroom" are expected to learn the course material in a variety of ways. Much of the learning of concepts and skills should occur independently, from reading texts or assigned articles and/or using other computer tools such as Computer Assisted Learning software on a PC or mainframe software to run large programs. For instance, students in Introduction to Computer Science have an assigned text, and learn to write PASCAL programs which they run on a large computer.

In the class conference, the instructor presents supplementary "electures" (electronic lectures) and leads a discussion. Here, the students must put what they have learned into their own words, answering questions about the material raised by the instructor and responding to the contributions of other students.

For individual questions, the student may communicate with the instructor or other students by private message. For individual or team writing assignments, an online notebook may be used to create and edit material, with the results being shared with the instructor and/or other students in the class.

The virtual classroom also offers some special opportunities:

.Pen names may be used in contributing responses to questions or assignments. This may enable the student to share ideas and experiences without embarrassment or revealing confidences. For instance, in a Sociology course during the Spring of 1986, students used pen names in applying concepts of different types of socialization to their own childhood, and in applying concepts about factors related to interpersonal attraction to one of their own relationships.

- .Students may learn by taking the role of teacher, being responsible for summarizing the key important points about a topic or "outside reading" for the benefit of the rest of the class.

- .Students may be forced to think and respond for themselves rather than passively listening to the instructor or other students. For instance, in one variety of the "response branch" (see below), students must independently answer a question before they can see the answers of the other students.

- .Putting questions and answers into a written form may aid comprehension for some students. It may also improve their writing skills.

The specific types of learning activities online vary a great deal from course to course, depending on the subject matter and the skills and preferences of the teacher. Included in the appendix is a narrative description of the online activities for each of the classes which used the "virtual classroom" during the Spring of 1986. These were prepared by the instructors and explicitly include "lessons learned" about effective and ineffective procedures and assignments.

## Measuring Outcomes

Shavelson et. al. (1986, p. vi.) state that

> Telecourse evaluations must ultimately focus on outcomes and address the <u>exchangeability</u> of these outcomes with those attained by students in traditional courses. By "exchangeability" we mean the extent to which the knowledge, skills, and attitudes acquired by students from a telecourse are interchangeable with the knowledge, skills, and attitudes that are: (a) valued by faculty and administrators, and (b) acquired by students enrolled in the same course offered as part of the traditional curriculum.

Several different outcomes of the learning process may be measured. The most obvious is objective tests of mastery of the material in the course. If there is no difference in test scores for material presented online vs. material presented in traditional face-to-face courses, we may consider this a criterion for minimal "success" of the virtual classroom. However, it is possible that other skills or beneficial outcomes may also be supported by classes conducted in this medium. We are still trying to develop methods to measure these outcomes. These less tangible or higher level skills are those which appear after the first educational objective in the list below.

- .MASTERY of facts, concepts, and specific techniques or skills (such as programing in PASCAL or doing a regression analysis using SPSS).
- .Improved WRITING skills
- .Improved ability to apply the material of the course and EXPRESS their own independent IDEAS relating to the material.
- .Improved ability to communicate with and learn from other students (GROUP LEARNING).
- .Increased level of INTEREST in the subject matter, which may carry beyond the end of the course.
- .Improved ability to SYNTHESIZE or "see connection among diverse ideas and information" (Davis, Dukes, and Gamson, 1981). Kraworth et. al. (1964) define "synthesis" as "The putting together of elements and parts so as to form a whole, arranging and combining them in such a way as to constitute a pattern or structure not clearly there before."
- .COMPUTER COMPETENCE- more comfort with the use of computers and greater knowledge of the use of computers.
- .CRITICAL THINKING.

Critical or rational thinking is a set of skills. The critical thinker evaluates statements and assertions, considers seriously other points of view than his own, withholds judgment when evidence and /or reasons are insufficient.

Not all courses will share all of the above goals. For instance, critical thinking is an essential part of sociology (Baker, 1981), but may not be an objective of skills-oriented courses. Faculty will be asked to specify which goals are important for their courses, and to help design and implement procedures to measure the extent to which these goals are attained by the students.

# RELATED RESEARCH

There is an extensive literature on the effects of medium of communication on learning; on educational innovations in general; and of the instructional uses of computers in particular. In addition, there are many publications in the area of computer-mediated communication, and a few on the use of computer-mediated communication to support educational delivery. Each of these areas of previous research has relevance for predicting problems, opportunities, and effects in implementing a "virtual classroom."

## Communication Medium and Educational Outcomes

Previous studies of courses delivered by television or other non-computer media tend to indicate "no difference" in basic outcomes. For instance, Schramm (1977, p. 28) states that

> Overall, there is no basis in the research for saying that students learn more or less from television than from classroom teaching. This does not mean that under some conditions of teaching some students do not learn more of a certain subject matter or skills from one medium or channel of teaching than from the other. But the results of the broad comparisons say that there is, in general, <u>no significant difference</u>.

Each medium of communication has its advantages and disadvantages. Outcomes seem to be related more to the particular implementation of an educational use of a medium than to intrinsic characteristics of a medium. Implementations which capitalize on the strengths of a medium and which circumvent or adjust for its limitations can be expected to be successful in terms of outcomes, while other implementations will be relative failures. Certainly, we know that some courses offered in the traditional classroom are more successful than others, and that this can be related to variations in the teaching skill and style of the instructor. Thus, it is not so much that "media do not make a difference" as that other factors may be more important than or interact with communication medium in affecting educational outcomes for students. A primary goal in studying a new medium of communication for educational delivery must be the identification of effective and ineffective ways of using it. Clark and Salomon (1986, p. 10) summarize this lesson on past research on the instructional impact of new media as follows:

> Even in the few cases where dramatic changes in achievement or ability were found to result from the introduction of a medium such as television... it was not the medium per se which caused the change but rather the curricular reform which its introduction enabled.

The "curricular reforms" which the virtual classroom approach may enable are greater utilization of "active learning" and of "group learning."

## The Computer and Active Learning

Development of the computer as an aid in the educational process has thus far focused on Computer-Assisted Instruction (CAI). In CAI, the student is communicating with a program in the computer which may provide a tutorial, drill-and-practice, or simulation and modelling exercises. At least for certain types of students and instructional goals, computer-assisted instruction (CAI) can be more effective than traditional methods alone. In their comprehensive review of CAI, Chambers and Sprecher (1980) conclude that it has many advantages when used in an "adjunct" or supplementary mode within a regular classroom, with class discussion following. Learners are forced to be actively involved in the learning process, and each may proceed at her own pace. Feedback tailored to each individual student provides the kind of reinforcement that will aid learning. However, when used as the sole or "primary" mode of instruction for distance learning, it appears to be effective only if there is also "significant" communication between teacher and student: "...Primary CAI, and distance learning in general, may achieve results similar to those for adjunct CAI as long as there is sufficient human interaction accompanying the use of the CAI materials" (Ibid., p. 336).

Bork (1981) has been prominent among those who have emphasized the possible use of the computer as a "responsive learning environment." Creating an "active learning situation" (Bork, 1985) is the prime consideration in computer applications to education, from this point of view. The "drill-and-practice" CAI approach has been a limiting and negative influence upon developing the educational potentials of the personal computer. Too often, people using computers "tend to transpose books and lectures, and so they miss the component of active learning which is so important" (Bork, 1985).

Anderson et. al. (1979) studied the acceptance or rejection of instructional computing in a survey of over 3,000 secondary school teachers. The basic theoretical issue in that study was whether the adoption of new technology is best characterized by technological determinism or by socio-cultural determinism. Slightly over half the explained variance in adoption was accounted for by technological factors (amount and availability of computer resources). However, social factors at the individual, occupational, institutional, and community levels, including attitudes and values favorable to computing and adequate training, also played an important role.

## The Concept of Group Learning

"Group learning" has also been given many other labels in the educational literature, including "cooperative learning, collaborative learning, collective learning, study circles, team learning..." (Bouton and Garth, 1983, p. 2), and "peer-group learning" or "syndicates" (Collier, 1980). The various forms include a process of group conversation and activity which is guided by a faculty member who structures tasks and activities and offers expertise. Its basic premise is that learning involves the "active construction" of knowledge by putting new ideas into words and receiving the reactions of others to these formulations:

> Students cannot simply assimilate knowledge as it is presented. To understand what is being said, students must make sense of it or put it all together in a way that is personally meaningful... It is as if one were to teach a child to talk by having the child listen in silence to others for the first two or three years of life; only at the end of the period would we allow the child to speak. In reality, the child learns in a continuous process of putting words together and trying them out on others, getting their reactions, and revising speech accordingly... An optimum context for learning provides learners with frequent opportunities to create thoughts, to share thoughts with others, and to hear others' reactions. This is not possible in the traditional classroom (Bouton and Garth, 1983: 76-77).

Collier (1980) summarizes many reports of an increased involvement of students in their courses as a result of group learning structures, including better class attendance (reported by Field, 1973); greater expenditure of time on the work outside of class (Collier, 1966; Rudduck, 1978); greater satisfaction with the course (Beach, 1974;

Goldschmid & Goldschmid, 1976; and an increased wish to pursue subsequent studies on the topic (Beach, 1974). Collier also notes that although most reports show "no difference" between courses based on small-group discussion and courses based on lectures and other more traditional modes of instruction (e.g., Costin, 1972), there are some documented cases in which knowledge gained by students was greater in the small-group setting (e.g., Blunt & Blizzard, 1973; Erskine & Tomkin, 1963; Clement, 1971). Finally, there are many reports that group learning enhances "higher-order" intellectual skills, such as the application of learned principles in fresh situations, critical thinking, and the synthesis of diverse materials (Clement, 1971; Costin, 1972; Ruddick, 1978; Abercrombie, 1979).

## Studies of Teaching Innovations

A number of other teaching innovations to encourage "active learning," "self-pacing," and/or "immediate feedback," involving either teaching techniques or technological devices, have been described in the literature. Many of these innovations have been reported as pedagogical successes, but have not been diffused widely because of the demands made on faculty. For instance, Tarter (1982) describes his use of "group incentive techniques" which divided a class into study groups and based part of the students' grades on the daily quiz averages for the whole group. Though successful in terms of increasing student motivation and performance, the technique was abandoned after five years because it was so labor-intensive to prepare and grade daily exams.

The "PSI" or Personalized System of Instruction (Keller and Sherman, 1974) emphasizes self-pacing, the use of written materials, tutorial assistance for learning from student peers, and "mastery learning." (Students must score 90% or better on a test unit before moving on to another unit.) Malec (1982) reports that the advantages are that students learn more and like the method; the major disadvantage is that the method requires a great deal of precourse preparation and a fairly elaborate administrative apparatus. Though Malec confirms that after nine years of PSI in a statistics course, he was still using the method, he laments that despite presentations, articles, and videotapes, he is not aware of a single other colleague at his institution who had adopted the method.

There are thus many competing and complementary educational innovations. In order for the virtual classroom to be a "success," it must not only "work," but its use must diffuse among educational institutions. In the long run, diffusion of the innovation may be much more difficult and problematic that the technological progress on which it is based.

## Studies of Computer-Mediated Communication Systems

Computer-mediated communication (and/or other forms of teleconferencing) can be used to supply the crucial element that is missing when CAI or written materials are used alone for distance education. The computer can be much more than just a "store and forward" mechanism. It can be used to create tailored structures which are optimized for particular groups and applications, and to integrate other computer resources, such as data bases and computational capabilities, into a group communication system.

The "first generation" of conferencing systems attempted to build general purpose communication structures that could be used for a wide range of communications. (An analogy might be the model-T Ford.) Likewise, much of the early research on the social effects of Computer-Mediated Communication Systems involved attempts to reach generalizations about the impact of this new medium. For example, Johansen, Vallee, and Spangler (1979:180-181) summarize a number of studies with the statement that "computer conferencing promotes equality and flexibility of roles in the communication situation" by enhancing candor of opinions and by helping to bring about greater equality of participation. On the basis of early pilot studies comparing face-to-face and computerized conferences, Hiltz and Turoff (1978:124) conclude that more opinions tend to be requested and offered in computerized conferences, but that there is also less explicit reaction to the opinions and suggestions of others, whether agreement or disagreement. (Note that there are implications of this finding for online classes; faculty must learn how to stimulate not just responses from individual students, but also responses by the students to one another's responses. We think that software can aid this desirable process.) In terms of organizational impacts, Uhlig, Farber, and Bair (1979:306) state that "collaboration of groups of persons, whether on a report or a complex decision, is accelerated by the speed of communication, including distribution and feedback." (See the book by Kerr and Hiltz, 1982, for a summary of all of the generalizations which emerge from the findings of eighteen research and development projects related to Computer-Mediated Communication Systems; a good recent review of research on all forms of teleconferencing is Rice, 1984).

The second generation, so to speak, of research on Computer-Mediated

Communication Systems seeks a better understanding of the conditions under which the general tendencies of the medium are stronger, weaker, or totally absent. Some of this research focuses on the structure or facilities of the computer-mediated communications system itself. For instance, current work at the New Jersey Institute of Technology focuses on the development and evaluation of a variety of new capabilities for computer-mediated communication systems. The goal is to discover the interactions among task types, communications structures, and individual or group attributes that will allow the selection of optimal system designs and implementation strategies to match variations in user group characteristics and types of tasks or applications. The research program involves a combination of field trials and controlled experiments. (See, for instance, Turoff and Hiltz, 1981; Hiltz, Johnson, and Turoff, 1982; Hiltz and Turoff 1985). Recent work at the Institute for the Future has included development of special tools such as modelling integrated into a computerized conferencing system, to support specific types of collaborative project work. Other "second generation" research focuses on user characteristics and attitudes as they interact with software to create more or less favorable outcomes; for example, Adrianson and Hjelmquist (1985) recently replicated an experiment conducted by NJIT in 1980 to see what differences would occur with experienced Swedish users of the COM conferencing system, as compared to the novice American users of EIES in our original study. The Virtual Classroom project is an example of the attempt to create "second generation" computer-mediated communication systems.

## Virtual Classroom: Status and Promise

There are a number of institutions which have been experimenting with the use of computer-mediated communication to deliver university-level courses. At NJIT, EIES has been used to deliver continuing education courses, to supplement regular undergraduate and graduate courses, and for courses offered through the Western Behavioral Sciences Institute and the New School's media studies program. At New York Institute of Technology, a modified version of PARTICIPATE is being used for course delivery. Field trials are also underway at the Open University in England; with CONFER at the University of Michigan; with electronic mail at the University of California at San Diego; and with COSY at the University of Guelph, among others. Some of the problems and issues raised by these field trials are summarized by Manock (1986).

Electronic mail has been used in an "adjunct" mode to support classes delivered primarily via other media. For instance, Welsh (1982) reports that electronic mail led to a much more "interactive" class. Even grading became interactive, with the students arguing for better grades on specific papers and making iterative changes to their assignments. Quinn et. al. (1983) also documented a "higher proportion of student turns to teacher turns" in messages exchanged via computer than in the face-to-face classroom. In addition, content analysis showed that the length of responses by students was much longer in computer-mediated communication. These observations about changes in the balance and nature of interaction among the instructor and the class members were also documented in pilot studies of earlier online courses on EIES (Hiltz, 1986).

Feedback from pilot offerings of continuing education courses offered via computerized conferencing by NJIT and results of previous comparative media studies indicate that courses can be delivered effectively via computerized conferencing (See Hiltz, 1986). However, we found that experienced teachers, skilled in using the software tools of the new medium, are necessary. We also observed that well motivated students are a pre-condition for success. Finally, we observed that teachers who have presented online courses find the current general-purpose software frustratingly inadequate; they would like a number of improvements, particularly graphics capabilities.

An approach which was confined to the laboratory only a few years ago is currently the object of well-financed commercial enterprises. For instance, TeleLearning offers some 170 courses currently, using a combination of CAI-type software and the ability of students to exchange messages with their instructors, but only at pre-determined times. The National Education Corp., also of California, plans to supplement its mailed correspondence courses with Ednet, which will allow students to submit papers and questions to teachers by electronic mail. (Business Week, March 19, 1984). And Dialcom is currently planning a number of courses to be offered entirely by electronic mail.

The use of computer-mediated communication to support educational delivery should have stayed in the laboratory a little longer, in our opinion. The services being marketed involve the use of simple electronic mail systems which may be fine for the equivalent of inter-office memos but were never designed to support the group communication and learning activities that occur in a classroom. We have asserted for many years that sophisticated structures that do much more than act like electronic pigeons can be constructed to support educational applications (See, for instance, Hiltz and Turoff, 1978, 1985; Turoff, 1982). Besides further software development, careful evaluation and sharing of acquired wisdom on how to utilize these new media effectively will be necessary if their potential in higher education is to be realized.

Teleconferencing is greatly expanding the potential options for lifelong learning. For example, Ryan (1981) has asserted that:

> Choice will underlie the learning process in the age of telematics. The learner of the future will be able to choose: when he or she wants to learn, where he or she wants to learn, and how he or she wants to learn. These choices imply that the future learner will become an increasingly active participant in the learning process... The model of the active learner involved in his own learning process will replace the model of the passive learner receiving gems of transmitted knowledge. (Ryan, 1981: 317).

But the "active learning" teleconference is merely a potential; some educational teleconferences have fit the model of a dull lecture, and others might best be described as empty classrooms. How can we utilize computer-mediated communication systems to support effective, "active" learning? How can we use the computer and telecommunications to construct a "virtual classroom" which is a vital, effective learning environment? Can we provide facilities for the types of activities which usually occur "outside the classroom," such as office hours, libraries, and even extra-curricular activities? This demonstration project seeks to answer these questions and to make available "virtual classroom" software for any educational organization in the U.S., at a reasonable cost.

At the outset of this project, we had some hypotheses which we planned to test. For example, in our pilot classes, we found that the majority of students felt that they learned more from classes that included an online component than from classes taught only in the traditional manner. However, this perception that the virtual classroom is "better" was strongly correlated to measures of interaction with other students. In the pilot studies, one type of assignment used by many instructors was to assign each student to critically review a book or article on the topic of the course and present it to the class. Those students who read the reviews contributed by others were more likely to consider the online format superior. Secondly, students were encouraged in some online classes to form project teams and do joint papers or documents; those students who used the system for work in student groups were more likely to feel that the online mode is superior to the traditional classroom.

In other words, our working hypothesis is that software and instructors' use of that software to create assignments and structure interaction, should be oriented toward encouraging the students to work with and learn from one another, not just from the "teacher." The virtual classroom project represents an attempt to apply the concept of "group learning" in a new technological context.

In sum, what is needed now is a systematic development of some augmentations to general purpose computer conferencing software specifically for educational purposes; and the coordinated development of evaluation instruments, methodologies, and results. We need to assess not only the relative effectiveness of this medium in conjunction with other media such as face-to-face meetings and video for delivery of different types of course materials for various types of students, but also how variations in pedagogical techniques, software, and other factors affect outcomes. The new technology is likely to realize its potential for improving educational delivery only if conditions are such that the possibilities for "active learning" and "group learning" are actually present. Adequate, specially designed software is only one of the necessary conditions for an effective virtual classroom. The behavior of the instructors and of the students in using the software is the coequal consideration in determining the outcomes of the innovation.

# SOFTWARE DEVELOPMENT

The two major software developments for the Virtual Classroom are "branching" (alternatives to linear discussion which attach to the main trunk of a class conference), and graphics. Prototypes of both enhancements are being developed, used with students, and then modified based on feedback, within EIES 1. The final design will then be incorporated as a set of advanced or "tailored" communication capabilities that can be added to the basic TEIES system. Separate technical reports have been prepared giving the detailed specifications for branches and graphics. Here, we will review only the basic objectives and design characteristics.

## Branching Activities: Creation, Testing, and Modification

The current structure for BRANCH was arrived at after considerable "trial and error" with the prototype branch software used during 1985-86. It is expected that there will be another round of changes in the design of the software based on feedback from the Fall 1986 classes.

### Branching Objectives and Types

According to the Bouton and Garth book on "Learning in Groups," active learning in groups can "only" take place in small face-to-face groups with a maximum size of about eight. This technology should allow much larger numbers of students the opportunities to learn by "creating thoughts, sharing thoughts with others, and "hearing" others reactions." However, if the group is much larger than about ten, an asynchronous multilogue in which many people are writing about and responding to many different ideas soon gets confusing. The purpose of BRANCH is to provide a structure to allow very large classes-- at least up to 50-- to actively have each individual present his/her thoughts and respond to the ideas of others, without getting disorganized. BRANCH should keep each assignment/discussion organized in one place, off to the "side" of the main class discussion. It should also allow the students to choose to address each topic raised in a branch whenever she or he is "ready" to do so. In addition, it must give the instructor control over the flow of communication activities. Specifically, the instructor must be able to specify that certain activities must be done before others; e.g., that a student must answer an examination question before seeing the answers of others or discussion of the answers by the instructor.

Four types of branches will be present for Fall 1986:

1. A "read" branch, for the presentation of papers or "electures." The material is broken down into sections. A table of contents enables the user to select any subset or order of the material.

2. A "response" branch for discussions. The author of a question has the option of requiring that each respondent first enter their own response before seeing the responses of others, or of allowing people to look at the other responses first. All responses to the question are collected together. For instance, if the question is item 22, the first response would be numbered 22.1; the second 22.2, etc.

The above two types of branches were completed and used in a number of the Spring 1986 courses. The software included a "review" choice to show both the instructor and the student which branch activities were completed or remained to be done. It also included a mechanism to force the order of different "branches" or activities. This was originally implemented in the form of "mandatory" branches which had to be done before optional branches could be completed. As will be discussed below, this proved unsatisfactory, and was replaced with the idea of "sequences" of branches that could be created instead of single units.

3. A "selection" branch for allocating assignments in such a way as to keep everyone up to date on what is "taken." For example, the selection might be a list of 20 books available for a review assignment; As each student makes a selection, it is marked with their name. This is necessary if the online class is to be run on a "seminar" fashion in which students are to cover some of the material and present it to the others.

4. A "test" branch will be implemented for the fall. It will carefully time and track the student through an exam.

Branching: Problems and Modifications

A prototype of BRANCH was used in several of the Spring 1986 courses. The first thing we discovered is that it was full of bugs... the students and faculty members who had not taken part in its design and were therefore likely to respond in unanticipated ways stumbled on lots of things that did not respond correctly. The first two months of the Spring semester were taken up with fixing bugs and adding to and modifying the online documentation. This documentation has attached explanations to every choice point in branch. As in the rest of EIES, the prompt from the system is "?". Now, at any branch prompt, a "?" back to the system gives help information for that prompt. We are still refining and adding to that online documentation, as branch continues modification and additions.

Several major problems were discovered with the initial implementation of BRANCH. This has resulted in a redesign. There were two major problems from the students point of view (besides the fact that it runs very slowly in its prototype form):

1. In the initial implementation, markers were kept on the file of branches just like they are kept on other EIES files. That is, it is like a bookmark. A single marker showed which branch activity you were "up to." This meant that if a student skipped ahead and did a branch activity out of order, it still showed up as "not done" on the queue and review. Unless the "next" new branch was done when presented as a "new" branch waiting, when branch was entered, the marker did not move. Needless to say, students were very unhappy about this. They want to be able to skip around and respond to branches in any order they choose, and have the branch index record this. The solution has been to begin design of separate one-bit markers on each branch item. That is, the bit will show "0" when not done and "1" when done. Thus, the "one marker" system will be replaced by a marker on each individual item, and students will be able to do branch items in any order they choose without invalidating the review status information.

2. We had a single queue of items. Branches could be made "mandatory," meaning that the instructor could indicate that a specific branch had to be completed before any other activities could be undertaken in BRANCH. The objective was to allow the instructor to control the sequence of activities. EG, the student might have to answer a quiz before seeing an item with an explanation of the answer.

The problem was that whenever a new mandatory item was created, its completion had to be recorded before anything else could be done... including work on PREVIOUSLY ENTERED branches. We hit several situations where we had to intervene and change items from mandatory to non-mandatory because of "catch-22" like situations that occurred. For example, suppose some key material for a course was entered as a read branch electure item on March 1 (non-mandatory). Then suppose a week later, the instructor entered a mandatory quiz response item based on that electure. If a student had not PREVIOUSLY read the electure, then the student was forced to try to answer the quiz before being able to view the material on which the quiz was based. Another problem was that in setting up create branch privileges, we had not separated the privilege of creating mandatory branches from the privilege of creating non-mandatory branches. Some students gleefully made their branches mandatory to force other students to do their branches first. Obviously, none of these minor disasters had been intended.

The solution arrived at is to distinguish two types of branch queues, SINGLE branches and SEQUENCED branches. Sequenced branches are two or more branch activities for which the order of completion is specified by the person who creates them. Thus, in the Sequenced queue, sequenced sets of branches will have to be done strictly in entry-date order. In the Single queue, branches can be done in any order. The branch creation routine will also be changed to separate out questions on sequenced and free-access branch creation privileges. The default will be that all conference members have the right to create single branches, but only the moderator (instructor) has the privilege of creating sequenced items which tightly control order of execution.

## Graphical Conferencing Capabilities

"Personal TEIES" is being designed as a software front end to the EIES and TEIES conferencing systems. The initial versions will operate on any IBM-PC compatible personal computer with at least 256k, two disk drives, and graphics display capabilities. It is hoped to subsequently obtain funding to modify the software to operate on other popular PC's and work stations.

### Goals and Objectives

The objective of the graphics development project is the design and construction of a modern graphics information environment in the form of a software product for creating, editing and telecommunicating graphical documents. The environment is designed to support both individuals and groups in the creation of a graphics document. In addition, due to the wide range of proposed operating environments of the EIES and TEIES systems and their users, the final product should be portable to computing systems comprising micro computers through mainframes.

The graphical information which the Personal TEIES system is being designed to deal with is composed of symbols, icons, and pictures. Symbols include not only linguistic alpha-numeric characters, but also the specialized characters used in mathematics and other technical fields (chemistry, engineering , architecture, etc.). Symbols are used to construct sentences, equations and in general, must be used in conjunction with other symbols to convey information. Icons are symbols that are pictorial representations of higher level concepts and actions. The icons used in Personal TEIES may be pictures that can stand alone or may have textual information attached to it. Pictures are displays that contain symbols, icons and graphical elements created within the system through the use of graphics primitives. Pictures can be a simple page of ordinary text, or a complex free form drawing. A graphical document is the final result of the process. It may be a page of text, several pages of text and graphics, or a visual object, such as a blueprint, consisting of overlays and having its own page size.

Personal TEIES will provide the tools for creating, editing, saving, restoring and communicating a graphics document. The design and integration of these modes within the graphics system is to be done in such a way as to provide a functionality that is powerful enough to avoid frustrating limitations while not being overly complex and clumsy. This functionality is organized into a user interface which is logically and intuitively consistent through the different modes of the system. The graphics system is designed to be easy to learn for the novice while not interfering with the advanced user.

For example, the command structure in the graphics system is implemented both in interpretive mode and through the use of menu picks. A problem encountered in the design of graphics creation systems is the loss of orientation not only within the system, but also within the picture page itself. The first problem is dealt with by continuously providing state information onscreen and through the use of help facilities. The second issue is handled by the use of various visual cues. For example, a unique oriented locator-cursor is provided to aid in navigating throughout the graphics page and to provide a visual cue in the manipulation of images. Thus the interface is the key to the success of the Personal TEIES graphics environment.

Package Description

A detailed overview of the user interface and the functionality to be provided by the graphics package is contained in a separate technical report (Foster, 1986). Appendix. The approach has been to create software on a diskette that will be used as the work station for creating, encoding, decoding, and displaying all graphics. The initial machine on which this is being implemented is IBM compatible micros. EIES or TEIES will be used as the place where the graphics are stored for transmission.

Figure 1 and Figure 2 show some of the picture creating software that was available by the end of the first year of work. Note that with the objective of use by students who will typically have a "low end" PC configuration rather than an expensive work station, our objective is not graphics of great esthetic quality for publication purposes. Rather, the function of the the graphics is communication for educational purposes. Thus, the basic objective is to provide symbols and icons that are recognizable by the receiver as what was intended by the creator. In other words, the pictures will be somewhat "primitive" in most cases.

## Standards

An overriding concern is the portability of the graphics software to a range of computing environments. This is a major problem since there is no standardization of graphics hardware and the hardware environment in which the software will run is not known. Another problem lies in how one should encode graphical information for telecommunications. The solution to these problems lies in universally accepted standards and the hopes that these standards will be implemented by hardware and software manufacturers.

A first step to assure software portability is to use a standardized programming language. For this reason all software development is being done in the C programming language. Since the C language does not contain graphics procedures, it was decided to use the GKS language interface.

The Graphics Kernal System is an international standard (ISO/ANSI) which binds graphics utilities to programming languages. GKS consists of a collection of graphics utilities that interface the application program to the graphic devices. Utilities include polyline, polymarker, text, and drawing primitives. In addition it provides advanced functions for control of the graphics environment. The use of the GKS standard assures the portability of the graphical features of the EIES software.

To solve the problem of telecommunications portability, all telecommunications are encoded using the NAPLPS (North American Presentation Level Protocol Syntax) standard which provides an extremely efficient method for encoding graphics information. In addition, it is also hardware independent. This is a necessary feature for our project.

Software Choices

For a project of this magnitude, it would be desirable to use as much off the shelf software as possible. Aside from the requirements of functionality and efficiency, the project requires software that meets the conditions of the GKS and NAPLPS standards, is not copywrited, and has source code available for modification and maintenance.

Unfortunately, there is no NAPLPS software available so we must write our own NAPLPS encoder and decoder. This package will also include the ability to translate GKS display files into NAPLPS data providing a unique interface between GKS and NAPLPS. In addition, we are writing a telecommunications package which incorporates the decoder and provides for receiving graphical information while online.

A commercial GKS package is available for use with the IBM compatible personal computers. The availability of this package has sped the initial development of the graphics interface. Unfortunately it cannot be used in the final product for several reasons. Firstly, it is copywrited and does not provide source code. In addition, it is a clumsy implementation, being very slow and overly large. Also, several features, such as text display and the pick features, were too limited in both functionality and visual appearance for our purposes. This means that we will have to write our own GKS package. However we will continue to use this package in the development of our prototype and as a testbed for our own GKS implementation.

Status Report

As of June 1986, we were ahead of schedule in terms of our estimated learning curve time. This included training in the C language, full understanding of the letter and spirit of the various standards that were being used and experience in developing applications using these standards.

Several problems arose to slow down the project. First there was the discovery that students were using several different C compilers (including different versions of the same compiler). In principle this should not matter. In practice we soon discovered various inconsistencies which prevented the integration of the different pieces of code.

Also, some of the compilers did not work as stated, and there were incompatibilities even within different versions of the same manufacturers compilers. For example, some compilers were not full implementations of the C language. Some compilers would not link with the GKS library that we were using. Some compilers would not link with assembly language routines written by students, even though the manufacturer's instructions were followed precisely.

Another cause for loss of development time was the extremely slow responsiveness of the GKS package we are using. It was virtually impossible to implement the unique locator-cursor that was a feature of our package. This forced us to deal directly with the hardware through the use of assembly language routines. This meant that students had to fully understand the technical aspects of the graphics hardware and how to access its features. In addition it was necessary to learn how to write the necessary assembly language code and link it with the higher level C language. As mentioned above, this led to unexpected problems between different C compilers.

At this point, we have implemented both the encoder and decoder for the NAPLPS telecommunications. We are currently testing these pieces and have discovered several minor problem areas in the manner in which the students chose to implement certain features. We do not expect any problems in resolving these incompatibilities. The work is proceeding more or less as expected.

The larger package, the interface, has met with many more problems. Most were technical and were described above. Another problem has been personnel turnover. Of the four students on the project during the Spring of 1986, only one continued work through the summer and fall, because of graduations. This is the major problem in relying upon students as the main source of software development labor. At this stage we have implemented the main menu; six icon windows including the error and user input window which overlays the information window; and implemented the functionality for the line, box, circle, arc and quit icons. We are currently implementing the functionality for the remaining icons in the SCRATCHPAD and TEXT modes. What is left to be implemented is the functionality for the files, notifications, remote access and options choices from the main menu. In addition, we have yet to incorporate a text editor for extensive text segments, or a multi-screen continuous item.

Interim Solution

We needed some sort of working graphics system to handle mathematical symbols for the Math 305 statistics course during the spring, and a limited solution was implemented.

The IBM computer system has a set of graphics primitives that allows for crude, but serviceable, graphics to be sent on the screen. The problem was storing these graphics on EIES. EIES only accepts ASCII characters, codes 0 - 127. The graphics codes were 128 - 255. BJ Gleason obtained a terminal program from the public domain group, PC-SIG, and modified it slightly. This package would now convert the sequence "|xx", where xx is the hex value of the graphics characters, into the proper graphics character on the IBM screen.

Using a graphics editor, SG, also from PC-SIG, the user could create a screen of information, and send it to EIES. The terminal package would automatically convert the codes 128 - 255 to the "|xx" form, and when the text was printed on eies, it would appear just as it had when the person created it. Thus, as long as an IBM-compatible computer loaded with the conversion software was used, equations using mathematical symbols could be used.

Welcome to

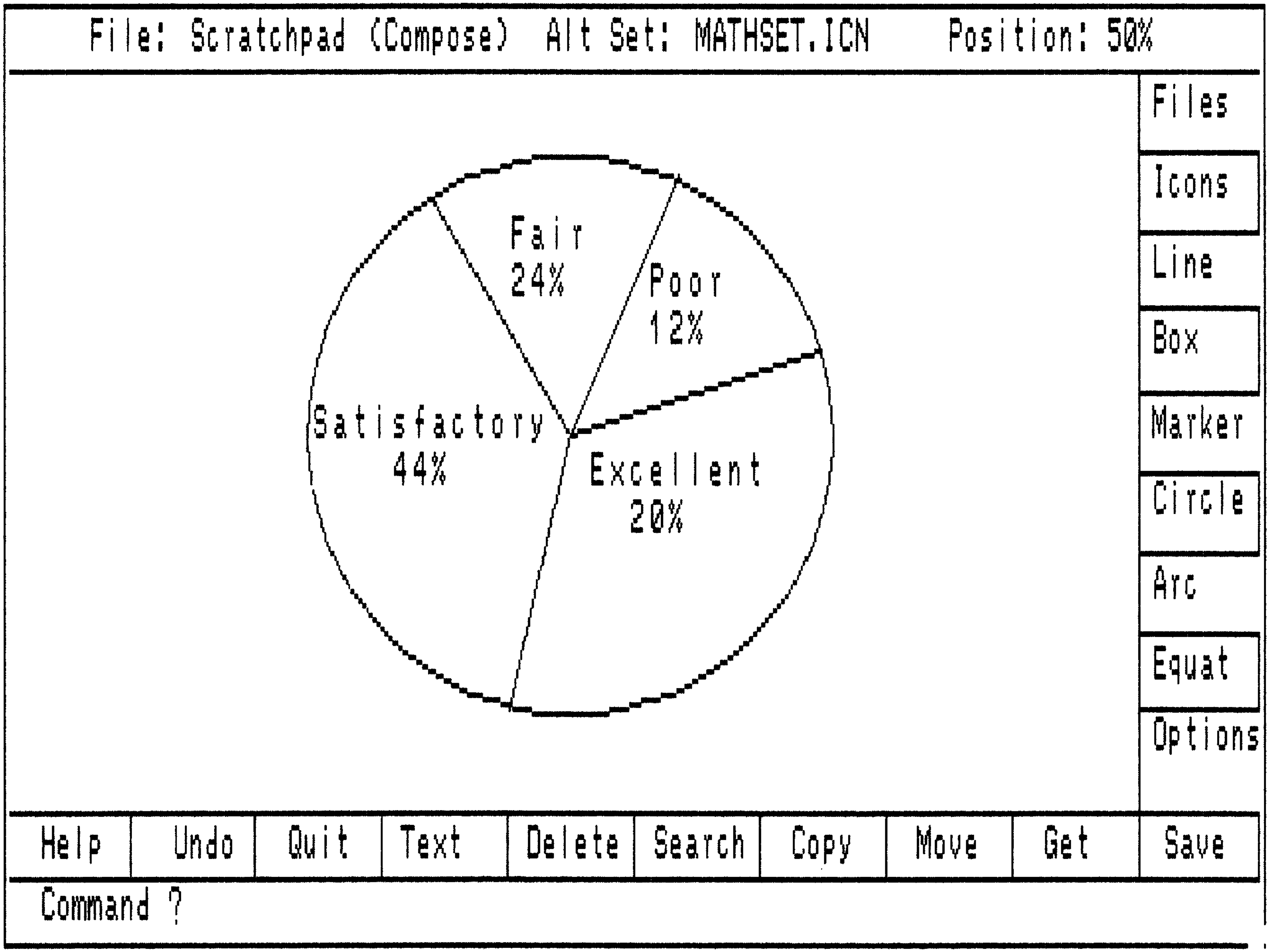
Personal TEIES (Version 1.00; 8/12/86)

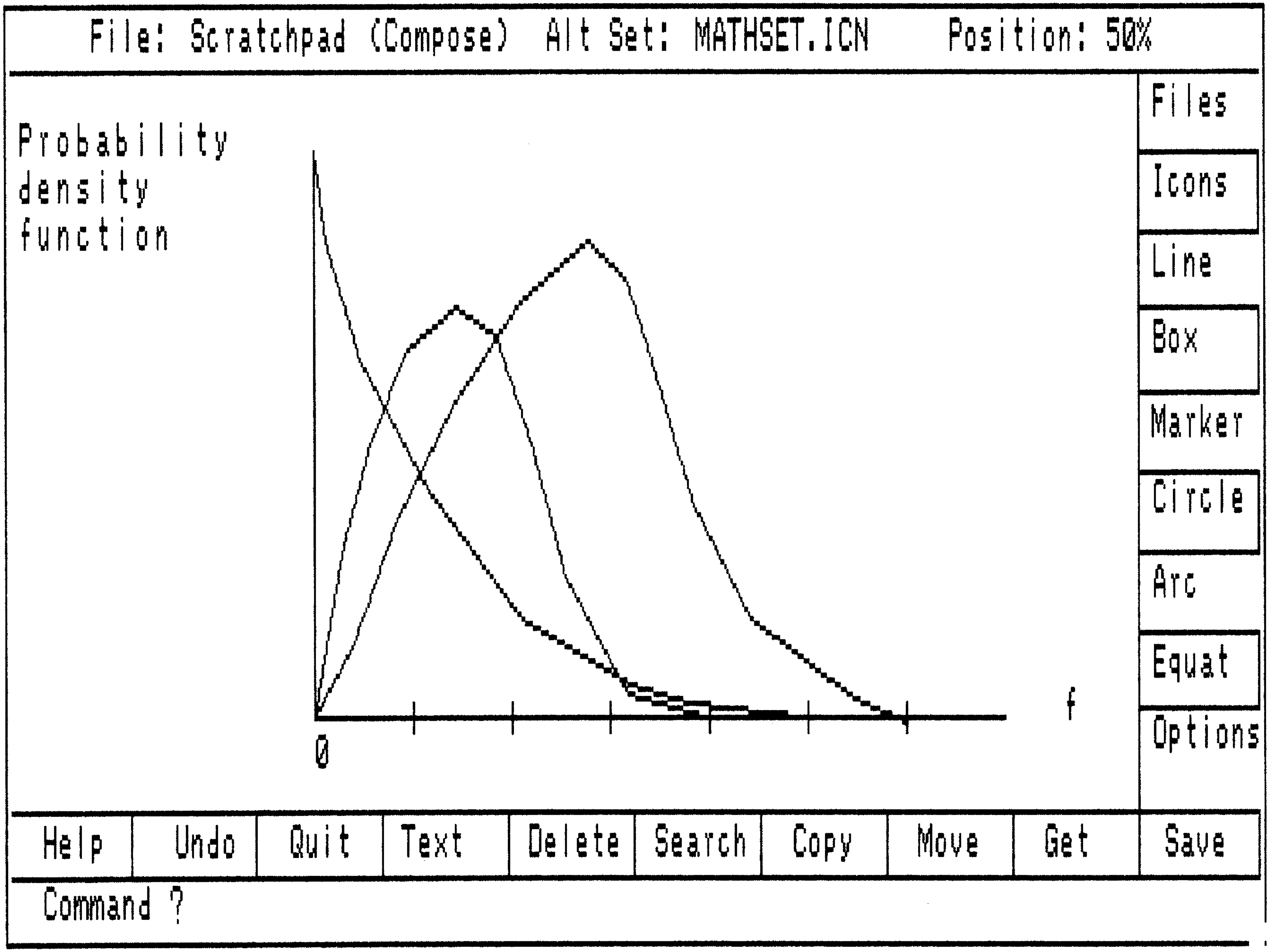
**ACTION CHOICE**

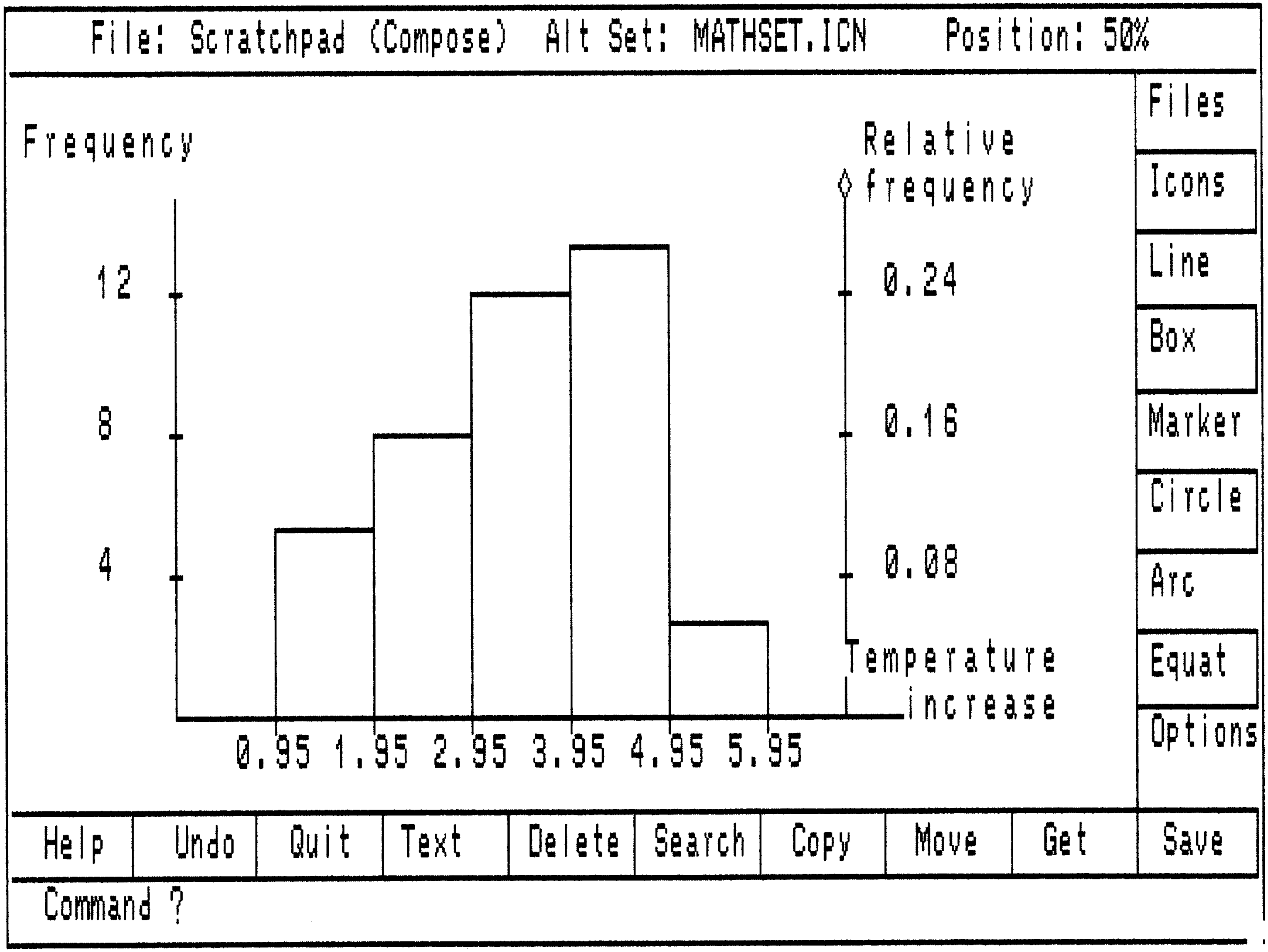
| | |
|---|---|
| Connect | 1 |
| Get Items | 2 |
| Create | 3 |
| Modify | 4 |
| Find | 5 |
| Review | 6 |
| Do (Utilities) | 7 |
| Housekeeping | 8 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Help | | Quit | | | | | | | |

Command ?


File: Scratchpad (Compose) Alt Set: MATHSET.ICN Position: 50%
Fair
24%
Poor
12%
Satisfactory
44%
Excellent
20%
Files
Icons
Line
Box
Marker
Circle
Arc
Equat
Options
Help
Undo
Quit
Text
Delete
Search
Copy
Move
Get
Save
Command ?


File: Scratchpad (Compose) Alt Set: MATHSET.ICN Position: 50%
Probability density function
0
f
Files
Icons
Line
Box
Marker
Circle
Arc
Equat
Options
Help
Undo
Quit
Text
Delete
Search
Copy
Move
Get
Save
Command ?


File: Scratchpad (Compose) Alt Set: MATHSET.ICN Position: 50%
Frequency
Relative frequency
12
8
4
0.24
0.16
0.08
Temperature increase
0.95 1.95 2.95 3.95 4.95 5.95
Files
Icons
Line
Box
Marker
Circle
Arc
Equat
Options
Help
Undo
Quit
Text
Delete
Search
Copy
Move
Get
Save
Command ?

File: Scratchpad (Compose) Alt Set: MATHSET.ICN Position: 50%

$$\sum (Fi + Fj + Fk) = m(ai + aj + ak)$$

$$\sum F(x) = ma(x) \qquad \sum F(y) = ma(y) \qquad \sum F(z) = ma(z)$$

$$m = \frac{W}{g} = \frac{200Lb}{3.2ft/s} = 6.21\ Lb.s(2)\ /ft$$

$$a = \frac{W \cos 30}{2W + W \sin 30}\ g = \frac{(12Lb) \cos 30}{2(30Lb)+(12Lb)\sin 30}(32.2ft)$$

Files | Icons | Line | Box | Marker | Circle | Arc | Equat | Options

| Help | Undo | Quit | Text | Delete | Search | Copy | Move | Get | Save |
|---|---|---|---|---|---|---|---|---|---|

Command ?

Space Bar returns you to scratchpad

LINE : The first line you draw when you pick LINE mode will need two points. Successive lines need only the end point, the last point for the previous line will be the first point for the next one

BOX : The two points assigned should not have the same x and/or y coordinates.

MARKER : If you want to change the marker type, you must go and pick the same icon again, then choose another type.

CIRCLE : The two points assigned should not have the same x and y coordinates.

ARC : The distance between the first and the central point should be the same as the distance between the last and the central point.

HELP : This is a priminary help screen; later however, this help icon will provide a separate screen for each primitive.

QUIT : This icon will take you back to the main menu.

TEXT : This is also a priminary TEXT facility. Later, you will be able to use the cursor with each moving character.

DELETE : If two segments overlap, you will be allowed to delete only the last segment created.

GET : This icon will get all the graphics images and text that you previously saved under a file name.

SAVE : You can save the present scratchpad in MS-DOS file. 8 characters are allowed for the file name.

## IMPLEMENTATION PROBLEMS

The project is currently behind schedule and facing some serious problems. They are not insurmountable, but the total effect was to make the first year less effective than would have otherwise been the case, and to put the entire project 3-6 months behind the original schedule. Because these problems affected the reactions of the students and faculty who participated during the Spring of 1986, and because other institutions who wish to implement a virtual classroom may encounter similar problems, they are described briefly here.

### 1. Late Funding

The project was funded with 25,000 from Telematics beginning July 1, 1985; 90,000 from DHE (nominally beginning Sept. 1; but the signed budget was not received until November and we were not allowed to spend any money until December); and a voted 700,000 from Annenberg/CPB which was to pick up additional funding for the Spring of '86 and continue through December of 1988. A draft Annenberg/CPB contract has been received as of July 1986, but no payments have yet been made, pending NJIT's signing the contract.

These delays meant that we lost the Fall semester of 1985 for anything except planning and some software development. Putting classes online, receiving equipment, and hiring a full time systems analyst were all delayed six months.

### 2. NJIT Facilities

NJIT is to provide the facilities as its contribution on the DHE, Telematics, and Annenberg/CPB projects (none of them allow overhead charges; this is to be the contribution of the institution). However, although the project supposedly began on July 1, 1985, no project headquarters were available at NJIT until July 1986. It still does not have air conditioning, which makes it too hot to use on many days. The lack of a project headquarters where staff could work together and where NJIT students could come to use microcomputers to access their online classes severely hampered both student access and staff work during the 1985-86 academic year.

We also had less adequate than hoped for facilities at Upsala. NJIT still has not run the dedicated phone lines that were requested in January 1986; and we did not have sufficient equipment to place any at Upsala to augment their facilities.

3. Personnel

The personnel time which was supposed to be devoted to software development just has not been there, and the software development is behind. A particular problem is the preference (actually insistence) of the New Jersey funding that both graduate and undergraduate students be used as much as possible, rather than full time employees. We are budgeted for the equivalent of two full time systems analysts and about ten graduate and undergraduate students. It takes several months for a student to become productive on the project; just about that time, most of them graduate and leave.

There is an intrinsic conflict between the goals of giving students valuable experience and income for working on a research project, and efficiently conducting a major software development project.

4. EIES1 is Overloaded and Slow.

Twenty four percent of the students in the project during the Spring of 1986 said that slow EIES response is a "serious problem." The current hardware is insufficient to give adequate response time when special subsystems such as written in INTERACT (such as the prototype BRANCH system); are being interpreted and executed. Major hardware upgrades are necessary; these were not approved by the NJIT administration until the summer of 1986. Hopefully, the hardware upgrades will be in place by the beginning of classes in September 1986.

Space problems for a new project are probably not unique to NJIT. Like many older universities with rapidly expanding programs, NJIT has no unutilized space in existing buildings. To obtain project space means that the sapace must be "lost" by some current occupant. Territory is not readily ceded in the feudal empires which comprise the university. Nor is air conditioning such a minor matter; scores of other spaces are on the waiting list. Since facilities improvements are not funded by any of the grants or contracts for this project, they are not likely to receive high priority in the university.

We also had problems with an insufficient number of 1200 baud access lines; this has now been slightly alleviated. However, during the Spring semester, 10% of students reported a problem with busy access lines.

5. Strike at Upsala

A bitter six week strike by maintenance personnel at Upsala, complete with picket lines, disrupted classes there. Many students refused to cross picket lines for at least part of the time; using the microcomputer laboratory required crossing the picket line.

6. Low enrollments

There is a high probability that the experimental (online) sections will have low enrollments during the fall of 1986. Introductory Sociology has had declining enrollments, and has been replaced as a "standard" Freshman course by a new lower-level required social science course. At NJIT, the registrar set course limits to zero to prevent students who had not signed a consent form from enrolling; many students who had intended to enroll were turned away before the mis-communication was discovered. We are obviously also having problems with publicity and recruitment of students in general, and with integration of special new procedures into the standard operating procedures of universities.

7. Equipment

Too little, too late is the story here. We had sufficient equipment funds to provide a work station for key personnel on software development. It has taken approximately six months from the time purchase orders are issued until all parts of a configuration have arrived (micro, modem, printer, etc.) We had hoped to receive about $100,000 in microcomputer donations from IBM or another partner, but so far, no donations have been forthcoming. As a result, only two of the faculty members have been provided with equipment, and even it is not fully adequate; there is no equipment to provide a sufficient number of student work stations; and there is no equipment for advisory board members.

# EVALUATION METHODS

## Objectives

As a formative evaluation, the results for the exploratory use of the system during the 1985-86 academic year will be used to determine any desirable changes in software support or course implementation in the virtual classroom course delivery techniques for the remainder of the project. Data from the first year will also be used to explore and refine hypotheses about factors related to the relative effectiveness of the virtual classroom for different types of students and subject matter. As a summative evaluation in the second year, the online course offerings will be assessed in order to determine how effective they are in comparison with traditional face-to-face classes. The results of this quasi-experimental offering of full courses online will enable potential adopters to understand the advantages and disadvantages of this mode of delivery compared to traditional classes.

## Subjects

The objective of this year's evaluation activities was to obtain feedback from students in a wide variety of courses, as a way of assessing the prototype software developed and testing the evaluation instruments. A number of courses were taught at NJIT and Upsala partially in the traditional classroom and partially online. The students had not known ahead of time that their courses would be partially online. They learned this the first day of the course, when they were also asked to fill out pre-use questionnaires. These courses included:

1-2: Courses in math-statistics. (Sections offered by instructors at both Upsala and NJIT).

3: Introductory Sociology (Upsala only).

4: The second-level Computer Science course (CIS 213), for which the prerequisite is a programming course. This course surveys the field of computer science as a discipline, and includes some programming assignments. (NJIT only)

.A upper level CIS course (Computers and Society), taught by the project director, was also taught partially online in the Spring of 1986, so that the project director could have direct experience trying to use the new software prototypes to conduct a class. In addition, students in two sections of a graduate level computer science course (Design of Interactive Systems) used the system in adjunct mode and completed pre and post questionnaires. The latter students had only "class 2" or free and slow internal NJIT accounts. They were included in order to have more subjects for analysis of relationships among questionnaire items.

Several courses were offered completely online by Connected Education, Inc., through the New School. These students had purposely selected an online course. Though many Connected Education students took two or more online courses during the year, pre and post-course questionnaires were collected only for the first online course. The instuments currently being used are not designed for replications by the same student.

The purpose of the strategy of using courses from three different institutions was to obtain as wide a variety of educational contexts as possible, in terms of type of subject matter and type of student. The five NJIT and Upsala courses represent a range of subject matter, from the largely qualitative courses in Sociology and Computers and Society to the very quantitative statistics courses. The types of software needed to support these courses is also likely to be very different. NJIT's students major in engineering and science, while Upsala's students tend to major in business and the social sciences, and include about 25% minority students. The New School students are older adults, mostly working full time. If we should find that the virtual classroom is not effective for particular types of subject matter or students, we can modify our plans for the second year accordingly.

The characteristics of the students who actually participated in the courses this year may be discerned by looking at the distributions of responses to the pre-use questionnaires, in the Appendix. Almost half had never or only occasionally used a computer before. On the other hand, about a third used computers in their professional work, and had used computer-mediated communication before. Thus, levels of previous experience vary widely. Almost a quarter had only "hunt and peck" typing skills. 45% had a microcomputer at home; the rest had to rely on access at work or school. 30% are female, and a little over half are foreign students. It terms of academic standing, a little over half are undergraduates. In sum, the participating students are quite diverse in terms of their characteristics.

During the second year (1986-87), experimentation with the software will continue on an adjunct basis with several new types of courses at Upsala (a freshman writing course, a lower level anthropology course, and a lower level French course). In addition, we plan to use the refined "virtual classroom" capability to offer completely online sections of each of the first four courses in the above list. A quasi-experimental design will be used to determine the effectiveness of the "virtual classroom" as compared to the traditional classroom. The same teacher will teach the same course, using the same text and the same tests, in the traditional classroom.

Scores and reactions of the students in the two "matched" sections can then be compared.

## Evaluation Procedures

An Evaluation Panel is serving to advise the project director and to assure objectivity of the data collection and analysis procedures. Data collection and analysis is being conducted under "protection of human subjects" guidelines, whereby all participating students are informed of the goals and procedures followed in the project and confidentiality of the data is protected. A variety of methods is being used for data collection, including questionnaires for students, automatic monitoring of online activity, participant observation in the online conferences, and use of available data such as grade distributions or test scores for participating students.

### Questionnaires

Pre and post-course questionnaires completed by students are the most important data source. During the second year, we will add online surveys conducted during the course itself. The development of instruments for this purpose and the accumulation of data on a large number of courses will provide the basis for a significant amount of new basic research on the effectiveness of telematics for education. The pre and post questionnaires used for the first year and the overall distribution of responses are included as appendices to this report.

The pre-use questionnaire measures student characteristics and expectations. It was distributed in class at the beginning of the term to NJIT and Upsala students. Thus, most completed the pre-use instrument before using the system, as intended. However, students who were absent that day were asked to return it by mail. Connected Education students received the pre-use questionnaire with their access material in the mail, and were asked to complete and return it immediately. This did not always occur; some may have used the system for awhile first, so that their responses were not always "pre-use."

The post-use questionnaire focuses on detailed evaluations of the effectiveness of the online courses or course segments and on student perceptions of the ways in which the virtual classroom is better or worse than the traditional classroom. It was distributed in class near the end of the term to NJIT and Upsala students. However, absences are high in the late spring; many of those who were absent failed to subsequently mail back the questionnaire. Thus, our response rate is disappointing; we need to improve procedures for obtaining post-use measures next year. Connected Education students all received the post-use questionnaire by mail.

The dimensions of effectiveness and their measures were developed on the basis of a review of the literature on teaching effectiveness, particularly Centra's (1982) summary. Copies of the available student rating instruments described in that book were obtained and permission was requested to use items from these standard questionnaires. Effectiveness was conceptualized as being related to four dimensions: course content, characteristics of the teaching, course outcomes, and comparisons of process in the virtual and online formats. These were presented as separate sections in the post-course questionnaire, with the hope that the responding students might keep these dimensions separate in their ratings. Not all institutions were willing to give permission to use items from their teaching effectiveness instruments; for instance, Educational Testing Service will not allow others to use its items. Among those from whom permission to use items for measuring effectiveness were obtained and from which items were used are:

- .Center for Research on Teaching and Learning, University of Michigan (Many items borrowed from their "catalog" of questions available for instructor- designed questionnaires).
- .Evaluation and Examination Service, University of Iowa, Student Perceptions of Teaching (SPOT) test item pool (many items used or adapted).
- .Endeavor Instructional Rating System, Evanston Ill. (a few items adapted).
- .Instructor and Course Evaluation (ICE), Southern Illinois University at Carbondale (a few items adapted).

Course evaluations by students are admittedly a controversial means of measuring course outcomes. They have been observed to vary with many things besides teacher competence and student learning, such as an interaction between faculty status and class size (Hamilton, 1980). Student evaluations are strongly related to grades received in the course. There is argument about which is the cause and which is the effect. If grades are "objective" measurements of amount of learning, then we would expect that students with higher grades in a course would also subjectively report more positive outcomes. However, it may be that a student who has a good grade in a course rates that course and instructor positively as a kind of "halo effect" of being pleased with the course because of receiving a good grade. If the latter explanation were true, we would expect to see that student ratings on various dimensions are somewhat homogeneous and do not discriminate well among items measuring different aspects of the process or outcome (e.g., students with a D or F would rate everything about the course as poor, while students with an A would rate everything about a course as excellent.) Such distortions of teaching evaluations are probably more prevalent when the student raters know that their responses are being used as input for evaluating faculty in personnel decisions. In this case, the participants knew that their ratings would be used only in this research project.

Despite the limitations of subjective ratings, the students are probably in a better position than anyone else to report on the extent to which they have or have not experienced various positive or negative outcomes from a course.

## Automatic Monitoring

We are using and refining software built into the current EIES system for measuring the amount and type of online activity by participants. There is a routine on EIES called CONFerence ANalysis (CONFAN) which permits the tabulation and display of the number and percentage of lines and items contributed by each member of a conference, for a specified part of the conference or for the entire conference. This automated analysis was run for each class conference. We will need to extend this capability so that measures of participation in the "branches" can also be gathered and displayed. Another automatic monitoring capability which we need to develop would measure the amount of communication among the members of a class conference outside of the conference, in messages. A "who-to-whom" matrix will be output for private message activity among the members of each class. This capability is necessary in order for us to test the hypothesis that students will communicate with one another as well as with the instructor online, and that such communication is helpful.

Lacking these detailed counts of activity outside the main trunk of the class conference for this first year, we have used "billing group" data for measures of overall level of activity. These include

- .Total number of conference comments contributed. This is not a complete measure of student activity related to the class, since it excludes contributions made in "branches" (which were numerous for some courses), or in notebooks or private messages. The latter is separately measured (see below).
- .Total hours online during the course
- .Total Number of Logins to the system during the course
- .Total number of private messages sent during the course
- .Number of different addresses for private messages sent during the last full month of the course. This is a rough measure of the number of different communication partners with whom students were exchanging information online by the end of the course.

A description of each of the specific courses in terms of the uses made of the system and "lessons learned" by the instructor on "how to do it better next time" is included as an Appendix.

Other Types of Data

Besides standard questionnaires that will be developed for use in all courses which include a component offered via EIES during this project, and the monitored data on participation, the following types of evaluative data were gathered whenever possible:

1. Direct observation of students using the software, with a subsequent focused interview about aspects of the software that were confusing or annoying in any way.

2. Student performance- final grade in course; performance on specific tests or assignments. In one course (the NJIT statistics course taught by Rose Dios) a good method of within-class evaluation

was devised. Tests were split into parts that tested mastery of material presented in the online and the regular class segments, and the scores on the two parts of the tests compared.

During the 1986-87 year, measures of general verbal ability and level of academic performance will be obtained from college records for each student, if the student agrees and signs a formal release.

3. Logs of teacher activity were developed and tested during the year. It is hoped that the instructors will be more diligent about filling them in daily during the quasi-experimental phase of the project. Their purpose is to measure and compare the amount and type of teacher effort involved in offering the online and traditional classes.

## Content Analysis

Transcripts of the first year's classes and of classes offered online during the Spring of 1986 by Western Behavioral Sciences Institute are being used to develop and test alternative content coding schemes for the interaction within class conferences. The most appropriate content analysis schemes will be identified and tested during this project. One objective is to determine how the communication style of effective teachers differs among different delivery modes.

## Feedback from Faculty

An online conference for faculty, messages exchanged with the project director, and periodic day-long face-to-face faculty workshops are being used to exchange information about experiences in trying to conduct classes in the virtual classroom. For the second year, it is planned to add a more formal directed or "depth" interview with each faculty member during the middle and at the end of each course. This feedback from faculty along with direct observation of the classes will be used to generate the mostly qualitative data that serves as the basis for a "Teacher's Manual for the Virtual Classroom." A first draft of this manual is being drafted as part of the first year's work.

## Theoretical Framework: The Independent Variables

There are almost as many classifications of types of theoretical approaches to the study of social impacts of computers and communication systems impacts as there are classifiers. Among the theoretical and empirical approaches to studying the acceptance and diffusion of computer technology and its impacts on society, three major approaches were identified: Technological Determinism, the Social-Psychological approach, and the Human Relations school. This classification of three alternative theoretical approaches represents a selection and blending of perspectives presented in the work of Kling (1980) and Mowshowitz (1981) on theoretical perspectives on computing and from Zmud (1979) and others who have looked at the effects of individual differences on the adoption of MIS and other technologies.

TECHNOLOGICAL DETERMINISM or the "rationalist" approach spans the ideological range from Marxism to the "human factors" and "scientific management" studies conducted by applied social scientists at high technology corporations. Rob Kling, in his review of theoretical approaches (1980), identifies the "systems rationalists" as those who tend to believe that efficiently and effectively designed computer systems will produce efficient and effective user behavior. Mowshowitz's typology of theoretical approaches to the study of computing issues has a parallel category, the "technicist," who "defines the success or failure of particular computer applications in terms of systems design and implementation" (Mowshowitz, 1981: 148).

From this viewpoint, characteristics of the system or technology determine user behavior. For example, Turner (1984) showed that the form of the interface of the applications system used by social security claims representatives affected both attitudes toward the system and job satisfaction and performance. Applying this approach to prediction of success of the virtual classroom, the technological and rational economic factors which would be expected to be important in explaining user behavior include access to and reactions to particular aspects of the hardware and software and the cost in time and money of using the new system compared to other alternatives for educational delivery. To the extent that these assumptions are correct, we would expect to find that reactions to the particular hardware used would account for a great deal of the variance in success. For instance, we would hypothesize that only students with a microcomputer at home and a 1200 baud modem would be able to fully benefit from this technology.

The PSYCHOLOGICAL or "individual differences" approach to predicting human behavior when confronted with a new technology would emphasize characteristics of the individual: attitudes and attributes, including "personality type," expectations, beliefs, skills, and capabilities (Zmud, 1979). Attitudes consist of an affective dimension involving emotions ("Computers are fun") and a cognitive dimension based on beliefs ("Using this system will improve my education.") As applied to this study, we predicted pre-use expectations about the specific system would be strongly correlated with subsequent use of and reactions to the system. Among the individual attributes which we expected to affect success are ability (measured by such things as the SAT score), sex, and ethnic group or nationality. We did not expect age, previous use of computers, or typing skills to affect use or outcomes, but we included them in order to check for these influences. Measures of these variables are straightforward; the specific questions used and the distribution of subjects on these variables may be seen in the Appendix. The questions used to measure pre-use attitudes toward the system and corresponding variable names, which will be used in subsequent analyses, are shown in Table 1. Generally, the responses are in the neutral to slightly positive range. There is considerable variation in expectations; this is related to the "forced" vs. self-selected or voluntary use of the system for most of the courses.

The HUMAN RELATIONS approach "focuses primarily on organizational members as individuals working within a group setting" (Rice, 1985). The small groups of which an individual is part are seen as the most powerful determinants of behavior. From this perspective, participation in the decision to use the virtual classroom, user training and support, the nature of existing ties among group members, and the style of teaching or group management (electronic or otherwise) are crucial determinants of the acceptance and impacts of a new computer or communications technology. From this perspective, we would expect large differences among the courses in which the students are enrolled, corresponding with differences in social interaction among the groups and in skill and level of effort of the teacher.

Two families of theoretical perspectives are not tested in this study. Kling (1980) refers to them as "organizational politics" and "class politics." The oganizational politics approach will undoubtedly be fruitful in trying to understand resistance to this

Table 1: Variables Measuring Expectations about the System

EASY

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|
| 2% | 6 | 10 | 24 | 20 | 25 | 14 | 4.8 | 1.5 |
| Hard to learn | | | | | | Easy to learn | | |

FRIENDLY

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 4% | 4 | 12 | 14 | 25 | 24 | 17 | 4.9 | 1.6 |
| Impersonal | | | | | | Friendly | | |

NOT FRUSTRATING

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 4% | 8 | 16 | 24 | 18 | 20 | 11 | 4.5 | 1.6 |
| Frustrating | | | | | | Not frustrating | | |

PRODUCTIVE

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 1% | 2 | 8 | 16 | 24 | 33 | 17 | 5.3 | 1.3 |
| Unproductive | | | | | | Productive | | |

INCREASE EFFICIENCY

Do you expect that use of the System will increase the efficiency of your education (the quantity of work that you can complete in a given time)?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|
| 13% | 11 | 18 | 26 | 22 | 7 | 4 | 3.7 | 1.6 |
| Definitely yes | | | Unsure | | | Definitely not | | |

INCREASED QUALITY

Do you expect that use of the System will increase the quality of your education?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 17% | 18 | 24 | 27 | 11 | 2 | 1 | 3.1 | 1.4 |
| Definitely yes | | | Unsure | | | Definitely not | | |

OVERALL EXPECT

Overall, how useful do you expect the System to be for online classes?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 18% | 18 | 30 | 21 | 8 | 5 | - | 3.0 | 1.4 |
| Very Useful | | | | | | Not useful at all | | |

innovation in some organizations. However, it would require sampling organizations and identifying virtual classroom proponents and opponents users within them, rather than sampling users of the system in only three organizations, as we have done. The latter theoretical approach, which is paralleled by Mowshowitz's (1981) category of "radical criticism," is an ideological perspective that views computer technology as a new form of exploitation of the working class by capitalists. The impacts of computer technology are assumed to be harmful to society. We did not include hypotheses and data collection techniques which could test the relative power of this perspective.

We did not expect any one of our three classes of variables to fully account for differences in success of the virtual classroom; all were expected to contribute. Thus, the theoretical approach we took can be equated with what Kling (1980) calls the "package" approach to the social impacts of computing. In Mowshowitz's classification, we are termed "pragmatists," taking the position that "the use made of computers is determined in part by the social or organizational settings in which they are introduced" (Mowshowitz, 1981: 150).

## Dependent Variables: Measuring Success in the Virtual Classroom

This study builds upon previous work on acceptance of computer-mediated communication systems and on teaching effectiveness, in conceptualizing and operationalizing measures of success.

"Acceptance" or "success" of computer systems is sometimes assumed to be unidimensional. For instance, if employees use an interactive computer system, then it may be defined by management as "successful." "Technicists" (see Mowshowitz, 1981) or "systems rationalists" (see Kling 1980) may assume that if a system is implemented and being used, then the users must like it, and it must be having the intended beneficial impacts. However, many social analyses of computing assume that whether or not systems have beneficial effects on users as individuals and on productivity enhancement for organizations is much more problematic (see, for instance, Keen, 1981; Attewell and Rule, 1984; Strassman, 1985).

Three components of acceptance of Computer-Mediated Communication Systems (CMCS) were found to be only moderately inter-related in a previous study of users of four systems: use, subjective satisfaction, and benefits. (Hiltz, Kerr, & Johnson, 1985; Hiltz and Johnson, 1986). The same three dimensions of "success" will be used in this study. It is expected that there will be positive but only moderate correlations between the amount and type of use of the system made by a student; subjective satisfaction with the system itself; and outcomes in terms of the effectiveness of learning. For this first year, outcomes will be measured using adaptations of widely used subjective rating measures of teaching effectiveness. For the second year, we will add "objective" measures of outcomes in terms of grades. We did not include any measures of subjective satisfaction with the system itself during the first year; these will be added in the second year, when the special software is more mature. We have several key measures of amount and type of use: total hours of connect time, number of logins, number of conference comments composed, number of private messages sent, and number of different addressees to whom private messages were sent. The questions used to measure subjective perceptions of outcomes and comparisons between the traditional and virtual classrooms are shown in the following tables, which also include variable names and frequency distributions of responses. Items corresponding to dimensions of ratings of the effectiveness of the course content and of the teacher may be viewed in the Appendix.

## Review of Hypothesized Relationships

The set of variables described above may be summarized as follows. One set of independent variables is "technological:" this includes performance of the central system (which is mainly influenced by the "class" of account on EIES) and access to and nature of the equipment used to access the system. A second set includes pre-use expectations and individual attributes, such as sex and previous use of computers. A third set focuses on interactional differences among courses, determined largely by the amount and style of activity by the instructor. For instance, the instructor may be very active online or may not enter much material or require many online activities. The instructor may use the system to essentially deliver "lectures," or to facilitate group interaction and "group learning" online.

These variables will influence amount and type of use of the system. In turn, amount and type of use will influence course outcomes, and student opinions about the relative value of online and traditional modes of course delivery. Based on pilot studies, we expect that the strongest relationships will occur between measures of "active involvement" and "group learning" processes, and evaluations of the relative value of online and traditional courses.

Table 2
VARIABLES MEASURING COURSE OUTCOMES

| | | SA | A | N | D | SD | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| MORE INTEREST | I became more interested in the subject | 26% | 48 | 21 | 3 | 2 | 2.1 | .89 |
| FACTS | I learned a great deal of factual material | 16% | 55 | 25 | 3 | 1 | 2.2 | .80 |
| CONCEPTS | I gained a good understanding of basic concepts | 28% | 55 | 16 | 1 | 0 | 1.9 | .69 |
| ISSUES | I learned to identify central issues in this field | 20% | 59 | 20 | 1 | 0 | 2.0 | .67 |
| COMMUNICATE CLEARLY | I developed the ability to communicate clearly about this subject | 14% | 51 | 33 | 2 | 1 | 2.3 | .76 |
| CRITICAL | My skill in critical thinking was increased | 14% | 41 | 37 | 7 | 0 | 2.4 | .82 |
| ETHICAL | I developed an understanding of ethical issues | 10% | 23 | 50 | 12 | 5 | 2.8 | .96 |
| INTEGRATE | My ability to integrate facts and develop generalizations improved | 6% | 50 | 33 | 10 | 1 | 2.5 | .80 |
| READ | I regularly completed the required readings | 20% | 53 | 16 | 12 | 0 | 2.2 | .89 |
| ADD READING | I was stimulated to do additional reading | 13% | 36 | 31 | 16 | 5 | 2.7 | 1.1 |
| PARTICIPATED | I participated actively in class discussion | 14% | 42 | 37 | 5 | 2 | 2.4 | .87 |
| OUTSIDE | I was stimulated to discuss related topics outside of class | 15% | 45 | 26 | 14 | 1 | 2.4 | .94 |
| WRITTEN AIDED | The written assignments aided my learning | 23% | 56 | 17 | 3 | 1 | 2.0 | .80 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WRITTEN DONE | I regularly completed the written assignments | 33% | 47 | 15 | 3 | 2 | 1.9 | .90 |
| THINK | I was forced to think for myself | 30% | 51 | 20 | 0 | 0 | 1.9 | .70 |
| CONFIDENT | I became more confident in expressing my ideas | 6% | 41 | 45 | 7 | 1 | 2.6 | .77 |
| FRIENDS | I developed new friendships in this class | 9% | 40 | 30 | 14 | 7 | 2.7 | 1.1 |
| OTHERS VALUED | I learned to value other points of view | 13% | 43 | 41 | 3 | 1 | 2.4 | .79 |
| DID BEST | I was motivated to do my best work | 25% | 34 | 33 | 6 | 1 | 2.2 | .94 |
| SELF | I gained a better understanding of myself | 10% | 22 | 52 | 15 | 1 | 2.8 | .86 |

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NOTE: Instructions for the Lickert scales were:
For each of the following, please circle a response that corresponds to the following scale:
SA= Strongly Agree
A= Agree
N= Neither agree nor disagree (neutral)
D= Disagree
SD= Strongly Disagree
SOURCE: Post- Course questionnaires, N of respondents= 96

Table 3

VARIABLES COMPARING THE TRADITIONAL AND VIRTUAL CLASSROOM

We would like you to compare this online course to your previous experiences with "face to face" courses. To what extent do you agree with the following statements about the comparative process and value of the EIES online course or portion of a course in which you participated?

INHIBITED
I felt more "inhibited" in taking part in the discussion.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 10 | 14 | 32 | 10 | 19 | 12 | 4.4 | 1.6 |

COMMUNICATED MORE
I communicated more with other students in the class as a result of the computerized conference.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 15 | 14 | 23 | 17 | 16 | 11 | 4.2 | 1.7 |

PROF ACCESS
Having the computerized conferencing system available provided better access to the professor(s).

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 16% | 27 | 14 | 18 | 6 | 12 | 7 | 3.4 | 1.9 |

MOTIVATION
The fact that my assignments would be read by the other students increased my motivation to do a thorough job.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 27 | 20 | 19 | 10 | 12 | 8 | 3.7 | 1.7 |

STOP
When I became very busy at work, I was more likely to stop participating in the online class than I would have been to "cut" a weekly face-to-face lecture.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 18% | 16 | 16 | 21 | 9 | 12 | 9 | 3.6 | 1.9 |

BORING

The online or virtual classroom mode is more boring than traditional classes.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 8% | 10 | 10 | 23 | 13 | 23 | 14 | 4.5 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

INVOLVED

I felt more "involved" in taking an active part in the course.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 6% | 17 | 20 | 35 | 7 | 6 | 7 | 3.7 | 1.5 |
| Strongly Agree | | | | | | Strongly Disagree | | |

OTHERS USEFUL

I found the comments made by other students to be useful to me.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 6% | 24 | 27 | 19 | 6 | 7 | 10 | 3.5 | 1.7 |
| Strongly Agree | | | | | | Strongly Disagree | | |

REVIEWS USEFUL

I found reading the reviews or assignments of other students to be useful to me.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 7% | 30 | 22 | 24 | 5 | 5 | 6 | 3.3 | 1.6 |
| Strongly Agree | | | | | | Strongly Disagree | | |

BETTER LEARNING

I found the course to be a better learning experience than normal face-to-face courses.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 12% | 11 | 19 | 26 | 8 | 16 | 8 | 3.9 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

LEARNED MORE

I learned a great deal more because of the use of EIES.

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 10% | 19 | 15 | 17 | 18 | 13 | 9 | 3.9 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

# RESULTS

The mean responses for all student evaluation items rating course content, teacher effectiveness, and course outcomes were positive (Table 2). The former two are not likely to have been affected much by the mode of delivery, and thus the items are included in full only in the Appendix. Without control groups, it is impossible to say how much of the positive outcomes were due to the virtual classroom presentations, and how much to face-to-face presentations and other factors. However, it can be said that the courses which included the use of the virtual classroom approach were successful, as determined by student reports of positive outcomes on a variety of learning objectives.

## Comparison of Face-to-Face and Online Classes

Table 3 contains the distributions for the variables which are of most interest for this project: student comparisons of their experiences in the traditional and virtual classrooms. These items tend to be skewed slightly towards the positive side for the online courses, but there is a great deal of variation, and the modal answer on many items is "neutral" or "no difference." For instance, a total of 57% of the respondents agree but 25% disagree that the system provided "better access to the professor." Only 33% agree and 44% disagree that they communicated more with other students. 51% agree and 30% disagree that their motivation was increased by the fact that other students would read their work. 43% agree but 20% disagree that they felt more involved in taking an active part in the course. About a quarter did not find it useful to read comments from other students. Thus, there is a tendency towards the types of process improvements which were hoped for in constructing the virtual classroom environment, but a great deal of variation in the extent to which the objectives were reached during the first year.

The two key evaluational items are the last two: whether overall, the course was better than "normal face-to-face courses;" and whether the students learned more as a result of the use of EIES. Note that there is a great deal of variation in responses to these key items. The mean for both items is 3.9, or only slightly better than the neutral 4.0 which indicates "no difference" between traditional and online courses. On the question of whether the courses were "better" or not, a total of 41% think so, 26% are in the middle, and 32% disagree.

At least this gives us some variance to explore in coming to understand variations in the effectiveness of the virtual classroom approach. Variance in outcomes was related to differences in amount and type of online activity, differences in student attitudes and characteristics, and differences among courses.

## Variations in Activity Levels

### Use of the System Varies by Course

There were significant differences among the courses in the amount of use made of the system (see Table 4). These differences are not likely to be due to differences in attitudes or characteristics of the students, but rather to differences in the amount of material and number of assignments and activities entered online by the instructors.

Table 4
Variations in Activity Levels by Course
Analysis of Variance

| COURSE | N | TOTAL COMMENTS | HOURS ONLINE | PRIVATE MESSAGES |
|---|---|---|---|---|
| Connect-Ed | 15 | A 20.1 | 21.3 | A 34.5 |
| CIS 213 | 17 | B 4.5 | 11.9 | 8.9 |
| CIS 732 | 41 | B 4.1 | 36.2 | B 7.2 |
| Data Analysis | 10 | B 1.8 | 2.1 | 2.0 |
| Computers & Society | 11 | B 4.6 | 25.5 | 12.5 |
| Math 305 | 8 | B 4.6 | 9.5 | 3.3 |
| Intro Soc | 20 | B 4.6 | 6.5 | B 3.7 |
| Grand Mean or Total | 122 | 5.9 | 20.6 | 10.0 |
| Standard Dev. | | 8.2 | 35.2 | 26.1 |
| F | | 10.7 | 2.9 | 3.0 |
| p | | .001 | .01 | .01 |

Note: Courses with means marked "A" are significantly different from those marked "B," Scheffe Multiple Range Test

The first thing to note in Table 4 is the apparent discrepancy between the two measures of activity, time online vs. conference comments composed. Remember that the Connected Education students were the only ones taking an entire course online, and that they were "remote," dialing into the system though TELENET, using their own microcomputers. These students regularly downloaded and uploaded materials from their microcomputer, in order to decrease connect time and to be able to use the word processing packages available in their own micros to compose and edit their comments. (Responses for the separate Connected Education courses have been combined). On the other hand, remember that the CIS 732 students had "class two," or very slow response. Thus, the apparent inconsistency that the Connected Education students could contribute about one comment to the class discussion for every hour spent online, while the CIS 732 students contributed on the average only one comment for every five hours spent online.

Another reason for apparent discrepancy between the measures of time online and measures of conference comments contributed is that contributions might have taken a form other than conference comments. The Computers and Society students, in particular, made most of their contributions in "branches," which were not counted in the conference analysis routine.

Another variable in understanding the differences in activity patterns among courses is class size. There were 41 students in CIS732, whereas there were under ten students in most of the Connected Education courses (see appendix for Connected Education course breakdowns). The larger the class, the larger the proportion of time online which will be spent receiving and reading material from others.

Students in the Connected Education courses entered by far the highest average number of comments in the class conferences. The overall mean number of comments entered was just under six; the extreme variation in this measure of activity is indicated by the fact that the standard deviation is larger than the mean. Another significant difference among courses was in total hours online during the course. This was highest for the CIS732, Computers and Society, and Connected Education courses. The average time spent online per student was 20.6 hours; once again, the standard deviation (35.2 hours) is larger than the mean. Also note that the total time spent online by students in the Data Analysis course (just over two hours) was so little that it cannot be presumed to have had any impact on the course other than serving as a peripheral exercise.

For total times online per course, the overall mean was 40.5 and the standard deviation was 60.7. Though there were large differences between courses (ranging from an average of only ten logins per student for the Upsala data analysis course to over 50 for the CIS732, Computers and Society and Connected Education courses), a Sheffe multiple range test showed no two courses as significantly different, indicating that the within-course variation was also very large.

For total private messages sent, the mean was 10 and the standard deviation a much larger 26.1. There were significant differences among courses ($F = 3.0$, $p < .01$). Private messages sent were significantly more for Connected Education students than for the CIS 732 or Introductory Sociology courses.

The pattern for the measure of the number of different people with whom participants were privately communicating online ("Different Addressees," the total number of different persons to whom messages were sent during the last month online) is similar to that for the measure of total private message activity. However, the differences among courses are not statisically significant in this case. The mean was 2.6, while the standard deviation was 7.1 ($F=1.8$, $p= .10$) Connected Education students sent private messages, on the average, to seven different people, while the Data Analysis and Introductory Sociology students were sending private messages to only one person on the average (their instructor).

Variations in Conference Activity, by Course

The amount and style of use of the class conferences varied a great deal, as shown in Table 5. The column labeled "Total Active" is the total number of participants who contributed five or more comments, an arbitrary delimiter. These data exclude Branch activity, which may have changed the totals significantly. In addition, the proportion of lines does not include indirectly referenced material accessed through a ".get" on EIES; and for the Introductory Sociology course, the question mark on the number of active participants reflects the fact that 34 comments were entered anonymously (as the students were instructed), thus making it impossible to identify the total number of comments made by any specific student.

Despite the incompleteness of the relative activity rates according to the available measures, the variations are instructive. Total conference comments varied from a low of only 35 in the Data Analysis course to a high of 449 for one of the Connected Education courses. In Introductory Sociology, 90% of the material was entered by students, while in the Data Analysis and Math 305 courses, less than 25% of the material by volume was entered by the students.

Table 5
Activity Level and Proportion by Instructor, by Course

| Course | % Comments by Instructor | % Lines by Instructor | Total Participants | Total Active | Total N Comments |
|---|---|---|---|---|---|
| Math 305 | 68 | 86 | 8 | 3 | 84 |
| CIS 213 | 48 | 69 | 16 | 8 | 126 |
| CIS 350 | 40 | 44 | 15 | 7 | 98 |
| CIS 732 | 18 | 17 | 44 | 18 | 226 |
| Sociology | 7 | 10 | 22 | ? | 132 |
| Data Analysis | 31 | 77 | 14 | 1 | 35 |
| Connect-1254 | 32 | 37 | 11 | 8 | 137 |
| Connect-1347 | 36 | 38 | 13 | 10 | 261 |
| Connect-1994 | 47 | 56 | 10 | 3 | 121 |
| Connect-2802 | 26 | 35 | 14 | 12 | 449 |
| Connect-1895 | 50 | 58 | 7 | 5 | 137 |
| Connect-1983 | 30 | 27 | 13 | 9 | 190 |

Student Expectations and Characteristics vs. Activity

There were moderate levels of correlation between many of the measures of students' attitudes before using the system and measures of level and type of online activity (Table 6). In particular, those students who expected that use of the system would increase the efficiency of their education and who had positive overall expectations signed on more frequently, spent a greater total number of hours online, wrote more private messages, and communicated in private messages with a larger number of different people. And those who expected the system to be "friendly" signed on more frequently and spent more total time online.

On the other hand, it is notable that no pre-use attitudinal item is strongly related to the number of conference comments written by students. Variation in conference comments written seems to be primarily related to the requirements and online conference activity set for a specific course by a specific instructor.

There was a significant relationship between the major reason why a student participated in online activities and amount of time spent online. Those who stated that the main reason was that they had "no choice" spent a mean of 11.1 hours online; at the other extreme, those who participated mainly because of a job- related interest in the course spent a mean of 38.6 hours online ($F_{6,98} = 2.4$, $p = .03$). There were similar relationships between primary motivation for participating in the online course and both number of logins and number of private messages sent. However, there were no significant

Table 6
Correlations Between Student Expectations and Activity Level

| | Number Comments | Total Time | Total Logins | Total Private | Diff Addresses |
|---|---|---|---|---|---|
| Easy | | *20 | *.19 | | .12 |
| Friendly | | **.26 | **.25 | .14 | *.17 |
| Not Frustrating | | .12 | | | |
| Productive | | .15 | .16 | .13 | .12 |
| Increased Efficiency | -.14 | *-.22 | **-.30 | **-.28 | **-.26 |
| Increase Quality | -.13 | **-.27 | *-.19 | | |
| Overall Expect | *-.16 | **-.30 | **-.31 | **-.22 | *-.20 |
| Expected time | | **.25 | **.27 | *.17 | .16 |
| Mean | 5.8 | 20.5 | 40.8 | 10.0 | 2.6 |
| SD | 8.1 | 34.8 | 60.6 | 25.7 | 7.1 |

differences in total conference comments generated related to motivation for participating.

Age is strongly related to the number of conference comments written; the older students wrote more comments ($R= .26$, $p= <.01$). One can speculate that the older students felt more confident about putting their ideas in writing where all could see them.

Other relationships between student characteristics and online activity levels were investigated using analyses of variance. Females were more active online than males. They wrote an average of 8.4 comments each, compared to 4.5 for males ($F$ 1, 107 =5.7, $p= .02$). Surprisingly, they did this while spending only about half as many total hours online. (The mean was 25.3 hours for males, 11.9 hours for females; $F$ 1,118 =3.9, $p= .05$). On the other hand, males sent more private messages (means of 11.8 for males vs. 6.9 private messages written by females; not significant). It is obvious that the female students, in this medium, are less reticent than males about contributing to the class discussion.

Gender is somewhat bound up with typing skills, but there was only one significant difference in activity levels related to typing skills. Those with better typing skills entered more conference comments. The big difference was for those with "excellent" typing skills; they entered an average of 22 comments, compared with about six for those with "good" typing skills, and four to five for those with poorer typing skills ($F= 12.0$; $p= .001$). Poor typing skills do not prevent people from participating, but excellent typing skills evidently let the verbal flood gates loose.

Foreign students spent more than twice as much time online as American students: a mean of 30.8 hours compared to 14.7 hours ($F_{1,89} = 3.9$, $p = .05$). During this time, they actually wrote fewer comments than the Americans, though the difference was not significant. Evidently, the foreign students are compensating for their difficulties in communication by spending a great deal more time reading the same material. These differences are also confounded with the apparent gender differences; most of the foreign students are NJIT students, and most NJIT students are male.

There is an impressionistic piece of evidence to support this interpretation. Whenever a "read branch" is created, the author is notified whenever anybody reads it. The project director, in the course which she taught, noticed that several of the foreign students read the same item several times.

These observations support the hypothesis that the virtual classroom can facilitate "self pacing." Evidently, the foreign students simply go much more slowly in covering the same material as do the American students. Unlike a traditional classroom, their need to go more slowly and review the same material several times does not slow down their faster classmates.

The differences were even stronger when comparing those for whom English is or is not a native language. For instance, those for whom English is a native language spent an average of 14.8 hours online, whereas those for whom English is a second (or third) language spent an average of 41.2 hours online ($F_{1,116} = 12.3$, $p = .001$). However, there were no significant differences related to native language in number of conference comments composed or number of private messages sent.

## Variations in Outcomes

Analyses of variance for each of the more than 50 outcome measures were computed for each of the student and equipment characteristics. For the most part, there were no significant differences. Those relationships which were significant are discussed below.

### Nationality, Native Language, and Race

A little over half of the participating students were foreign. This is due to the high number of foreign students at NJIT, particularly in computer science courses. We had some concerns about whether the medium would cause a problem for students from another culture.

There was only one significant difference between American and foreign students. Foreign students were slightly more positive about being stimulated to do outside reading. Thus, in sum, there are apparently no cultural barriers that make the virtual classroom approach a problem for foreign students.

When looked at by native language, there are several items for which ratings by the 19 students for whom English is not a native language are significantly lower. Most of them relate to ratings of the instructor. None relate to overall course outcomes or comparisons between face-to-face and online courses (Table 7). Though it is undoubtedly more difficult for students who use English only as a second language to take courses in this medium than for those who use English (the language in which the courses were conducted) as a first language, the relative handicap is probably less than in traditional classes. Generally, it is easier to read and write in a foreign language than it is to speak and to comprehend spoken language. In any case, our data do not suggest that the medium has to be avoided by students for whom English is not the first language.

There were only six Black and two Hispanic students who completed both questionnaires; not enough to base any conclusions on. There were, however, nineteen "Asian" and 79 "white" students for whom we have data. No differences among ethnic groups were statistically significant.

While we need more data on Blacks and Hispanics, it is likely that if there were any particularly crucial problems or advantages related to the medium for minority groups, they would have been suggested with even the small sample we have.

Table 7

Native Language vs.Outcomes

| | English | Not English | F | P |
|---|---|---|---|---|
| Waste | <u>4.3</u> | 3.6 | 6.3 | .01 |
| Organized | <u>2.1</u> | 2.5 | 4.2 | .04 |
| Interesting Presentation | <u>2.0</u> | 2.6 | 5.8 | .02 |
| Inst. Overall | <u>2.1</u> | 2.7 | 5.3 | 2.0 |

Note: Underlined means are more favorable

Typing

Those with excellent typing skills are significantly more likely than those with only "hunt and peck" skills to "learn to value other points of view" (means of 1.8 vs. 2.9; $F=3.9$, $p=.01$). There were no other differences associated with typing skill. Good typing is thus not a precondition of beneficial outcomes of the virtual classroom. The finding that typing skills are not a factor in acceptance of computer-mediated communication for educational applications is consistent with the findings of previous studies of acceptance of CMC for other applications (Hiltz, 1984; Hiltz, Kerr, and Johnson, 1985).

Gender

Females were consistently more positive in their reactions than males. Many of these differences were statistically significant (Table 8). In particular, females were more likely to feel that the course was important and to be more diligent in completing reading and writing assignments on time. They were more likely than males to report that written assignments aided their learning; that they became more confident in expressing their ideas; made new friendships in the class; and found the comments of the other students useful.

Age

There were only four differences in responses among age cohorts that were both substantively and statistically significant. Older students (beyond traditional college age) were more critical about the instructor organizing the course well. They were also somewhat less likely to report that they had developed the ability to communicate clearly about the subject; increased their critical thinking skills; or developed new friends. These are probably maturational differences; in other words, older students in traditional face-to-face courses are probably likely to differ from younger students in the same ways. On the whole, then, age of students is not related to outcomes of using the virtual classroom; it can be effective for older adults as well as for traditional college-age students.

Table 8

Gender Differences in Outcomes

(Analysis of Variance)

| Variable | Males (N=64) | Females (N=27) | F | P |
|---|---|---|---|---|
| Important | 2.1 | 1.7 | 4.6 | .04 |
| Waste | 3.9 | 4.5 | 6.1 | .02 |
| Course Overall | 2.8 | 2.3 | 4.4 | .04 |
| Completed Reading | 2.4 | 1.8 | 8.2 | .01 |
| Add Reading | 2.8 | 2.3 | 5.9 | .02 |
| Written Aided | 2.1 | 1.8 | 3.9 | .05 |
| Completed Written | 2.1 | 1.6 | 5.9 | .02 |
| Confident Expressing | 2.7 | 2.3 | 5.7 | .02 |
| New Friendships | 2.8 | 2.3 | 3.8 | .05 |
| Stop Participating | 3.2 | 4.2 | 5.5 | .02 |

## Academic Standing

The graduate students in this study were taking two very different kinds of courses online. Some were voluntarily taking totally online media studies courses through Connected Education and the New School. The others had only "class two" (slower than class one) accounts and were using the system in a completely supplementary mode (rather than as a replacement for any face-to-face classes) in a Computer Science course on Design of Interactive Systems. Both of these types of use of the system were different than the mode of use in the five undergraduate courses. Thus, it is likely that any differences or lack of differences associated with academic standing may be masked by confounded variables.

The only significant difference observed is that the graduate students were less likely to feel that course requirements were clear. There are no differences among underclassmen vs. junior and seniors vs. graduate students, on any other items. Thus, the medium seems equally suited to all levels of college or university education.

## Reason for Participating

There were few significant differences in assessment of outcome related to the primary reason for taking the online course. Those who said they had "no choice" were most likely to agree that they were "forced to think for themselves" but least likely to feel that they "gained a better understanding of themselves;" there were no other items for which responses were significantly different.

Thus, though instructors were afraid that "forced participation" would lead to adverse consequences, this is not borne out by the data on subjectively reported outcomes.

Access to and Type of Equipment

The effects of differential access to equipment and of different types of equipment on the reported outcomes of online courses are not as strong or pervasive as might be expected, among the population of mostly undergraduates who are attending other classes on campus. Each measured aspect of terminal access was examined individually in terms of its relationship to each of the 53 outcome questions, with an analysis of variance. We did not examine combinations of attributes because of the relatively small number of subjects. All significant relationships are shown in Table 9. The mean values that are "better" are underlined to emphasize them.

There were no significant relationships at all for the question on access from one's office or place of work. For access to a terminal at home, only one relationship was significant. Those with a terminal at home rated the courses as a little "too easy," while those without access from home rated them as a little "too difficult."

One would think that the very best of all possible worlds would be to have a microcomputer of one's own at home, with a 1200 baud modem. However, this assumption is not borne out by the data. There are few significant differences associated with the sophistication of the equipment (printer or CRT as sole display mode, or microcomputer vs. "dumb terminal." One would think that the faster, more expensive 1200

Table 9
Significant Effects of Access To and Type of Equipment
Analysis of Variance Results

| Variable | | | | |
|---|---|---|---|---|
| | HOME MICRO | | | |
| | Yes | No | F | p |
| LEVEL | 2.9 | 3.2 | 4.1 | .05 |
| | USUALLY USE HARD COPY ONLY | | | |
| INHIBITED | 3.1 | 4.4 | 5.1 | .03 |
| | USUALLY USE CRT ONLY | | | |
| COMMENTS USEFUL | 4.0 | 3.2 | 4.3 | .04 |
| | USUALLY USE MICROCOMPUTER | | | |
| INTERESTING | 1.6 | 2.0 | 4.2 | .04 |
| IMPORTANT | 1.8 | 2.1 | 4.4 | .04 |
| ADDITIONAL READING | 2.9 | 2.5 | 4.3 | .04 |
| | BAUD RATE | | | |
| | 300<br>N=24 | 1200<br>N=28 | f | p |
| INTERESTING CONTENT | 1.5 | 1.9 | 3.2 | .05 |
| GOALS CLEAR | 2.1 | 2.9 | 4.3 | .02 |
| REQUIREMENTS | 2.3 | 3.4 | 5.9 | .001 |
| HARD WORK | 1.6 | 2.3 | 4.7 | .02 |
| ORGANIZED | 1.8 | 2.5 | 4.2 | .02 |
| GRADING | 2.0 | 2.6 | 3.7 | .03 |
| KNOWLEDGABLE | 1.2 | 1.9 | 6.4 | .01 |
| CLEAR | 1.7 | 2.5 | 4.2 | .02 |
| INTERESTING | 2.0 | 2.8 | 7.4 | .001 |
| PRESENTATION | 1.7 | 2.6 | 5.7 | .01 |
| CONSTRUCTIVE | 2.0 | 3.0 | 9.9 | .001 |

baud modems would be better than the slower, cheap 300 baud modems. However, there are a large number of outcome measures for which the 1200 baud modems as the usual access mode produce significantly worse outcomes. Those who usually use 1200 baud, as compared to 300 baud, found the courses less interesting, goals and requirements less clear; were less likely to report that they became more confident in expressing their ideas; less likely to feel that the instructor organized the course well; less likely to feel that the instructor was knowledgeable or discussed points of view other than his own; less likely to feel that they could get personal help; among other differences. This seems counter-intuitive until one thinks about the fact that students are likely to let the 1200 baud input just roll off the screen as fast as it comes in and try (probably unsuccessfully) to keep up with it, rather than using screen pauses, or sending things to a printer or downloading, to read them more carefully. One practical conclusion is that if we are to purchase modems to lend students in the future, they will be the cheap $50 300 baud modems instead of expensive $600 fast " smart" modems. For the inexperienced students, slower is better.

The only significant disadvantage of having a printer only (no CRT, which by definition means a dumb, 300 baud line printer) is that this type of equipment is likely to make the student feel more "inhibited" in taking part in the discussion, than those who have access to equipment with a CRT. On the other hand, for those who have the most expensive type of equipment, a microcomputer, the course is likely to seem more interesting and important, and they are "more likely to become confident" in expressing their ideas. However, those who use a microcomputer are less likely to be "stimulated to do additional reading;" perhaps they spend their extra time with the machine, rather than on reading printed matter. These few differences lead to the conclusion that the cheapest, simplest equipment is more than adequate to benefit from this mode of course delivery. Currently, an old, used line printer with a built-in 300 baud modem can be obtained for a few hundred dollars; that is all the student needs.

There are generally moderate levels of correlation between measures of level of activity by students in the virtual classroom, and their assessment of outcomes. On the other hand, there are very strong correlations between the extent to which students agreed that various types of "group learning" took place, and their agreement that the virtual classroom is a better learning mode than traditional classrooms, or that they learned more.

## Activity Levels and Outcomes

Pearson's correlation coefficients were computed for the relationship between each of our activity level measures and the items rating course outcomes and comparing the face-to-face with the virtual classroom. The relationships of primary interest are at the bottom of the following table, starting with "inhibited." As would be expected, those students who wrote more comments, spent more hours online, and logged in for more sessions were also those who were least likely to feel inhibited in the virtual classroom, most likely to feel that they communicated more with other students than they would have in the traditional classroom, most likely to feel more involved in the virtual vs. traditional classroom, and most likely to find the comments and reviews of other students useful. The direction of cause and effect cannot be determined from these data. As would be expected, it is also true that the more the students participated in the virtual classroom, the more likely they were to feel that it is a better learning mode than the face-to-face classroom, and the more likely they were to feel that they learned more as a result of using the system.

Table 10
Online Activities and Outcomes;
Pearson's Correlations

| Outcomes | Activity Levels | | | | |
|---|---|---|---|---|---|
| | Number Comments | Total Time | Total Logins | Total Private | Diff Addresses |
| INTERESTING | *-.22 | | *-.21 | *-.19 | *-.22 |
| IMPORTANT | -.16 | -.14 | **-.24 | *-.20 | *-.21 |
| GOALS CLEAR | | | -.13 | *-.20 | **-.24 |
| REQUIREMENTS | | | | | |
| READING | *-.17 | *-.23 | *-.21 | | |
| WRITTEN GOOD | **-.24 | *-.17 | -.14 | | |
| LECTURES | -.15 | -.14 | -.16 | *-.20 | *-.21 |
| HARD WORK | | | | | |
| WASTE | *.21 | *-.18 | | | .14 |
| LEVEL | | | | | |
| COUSE OVERALL | **-.30 | -.13 | **-.25 | *-.22 | **-.24 |
| ORGANIZED | | | | | |
| GRADING | | | | | |
| INST. ENJOYS | *-.20 | | | | |
| KNOWLEDGEABLE | -.17 | | | | |
| ENCOURAGED | *-.21 | | *-.20 | *-.19 | *-.19 |
| CLEAR | | | | .14 | |
| OTHER VIEWS | -.14 | | | | |
| HELP | | | | | |
| INTERESTING | | | | | |
| CONSTRUCTIVE | | -.15 | | .14 | |
| INST. OVERALL | **-.26 | | *-.19 | | -.14 |
| MORE INTEREST | **-.24 | -.13 | **-.26 | *-.16 | -.21 |
| FACTS | | | -.15 | | -.16 |
| CONCEPTS | *-.19 | *-.20 | **-.32 | **-.26 | **-.28 |
| ISSUES | *-.19 | *-.18 | -.19 | | |
| COMMUNICATE CLEARLY | **-.25 | | | | |
| CRITICAL | *-.17 | *-.17 | -.14 | | |
| ETHICAL | **-.24 | **-.24 | **-.23 | -.14 | *-.15 |
| INTEGRATE | | -.15 | -.15 | | |
| READ | | | | | |
| ADD READING | | *-.21 | *-.22 | | -.14 |
| PARTICIPATED | **-.30 | **-.26 | **-.37 | **-.32 | **-.35 |
| OUTSIDE | | | | *-.20 | *-.19 |
| WRITTEN AIDED | *-.14 | -.16 | | | |
| WRITTEN DONE | | -.14 | -.15 | | |
| THINK | | | | | |
| CONFIDENT | *-.22 | **-.25 | **-.33 | **-.35 | **-.37 |
| FRIENDS | | -.14 | | | |
| OTHERS VALUED | **-.24 | -.14 | | | |
| DID BEST | | **-.24 | **-.26 | **-.25 | **-.26 |
| SELF | **-.26 | **-.24 | *-.17 | *-.18 | -.16 |
| INHIBITED | **.29 | *.18 | **.34 | **.31 | **.31 |
| COMMUNICATED MORE | *-.21 | **-.30 | **-.30 | **-.33 | **-.35 |
| PROF ACCESS | | -.15 | | *-.19 | -.16 |

| | | | | | |
|---|---|---|---|---|---|
| MOTIVATION | *-.22 | *-.21 | *-.21 | | |
| STOP | *.20 | | .18 | **.30 | **.28 |
| BORING | **.29 | | | **.27 | **.27 |
| INVOLVED | **-.25 | **-.25 | **-.27 | **-.32 | **-.34 |
| OTHERS USEFUL | **-.37 | **-.23 | **-.34 | **-.30 | **-.29 |
| REVIEWS USEFUL | *-.19 | *-.21 | **-.25 | **-.24 | *-.22 |
| BETTER LEARNING | **-.27 | **-.28 | **-.24 | | |
| LEARNED MORE | **-.26 | **-.29 | **.31 | *-.34 | **-.33 |

(Footnote):
Number of cases varies from 87 to 93
Coefficients shown only if significant at least at the .10 level
* $P < .05$
** $P < .01$

Expectations Predict Outcome

There are moderately strong correlations between many of the pre-use expectations of students and the ratings which they gave of outcomes of the course at the end, and of comparisons between the traditional and virtual classroom. Those students who had positive expectations generally tend to be more likely to report positive outcomes (Table 11).

In particular, expectations that the system would be "friendly" rather than unfriendly is significantly correlated with many of the outcome variables, and has the highest correlation with the overall evaluations that EIES provided better learning and that they learned more than in traditional classes. Expectations that use of the system would increase the efficiency and/or the quality of education are also consistently related to post-use judgements that the virtual classroom is "better" in many respects.

Table 11
Correlations Between Pre-Use Expectations and Post-Use Ratings

| | EASY | FRIEND | NOT FRUS | PROD | INCEFF | INCQUAL | OVERALL | EXPTIME |
|---|---|---|---|---|---|---|---|---|
| MORE INTEREST | | | | | *.18 | *.15 | .17 | |
| FACTS | -.16 | -.17 | | *-.17 | *.22 | | | |
| CONCEPTS | | *-.18 | | | *.17 | | .17 | *-.21 |
| ISSUES | | -.16 | | | *.17 | *.19 | **.24 | |
| COMM CLEARLY | | *-.22 | -.17 | | | | | |
| CRITICAL | -.17 | **-.29 | -.15 | | .16 | *.19 | | |
| ETHICAL | -.15 | **-.29 | | | .15 | *.19 | .14 | |
| INTEGRATE | -.15 | | | | .15 | .15 | | -.21 |
| READ | | | -.14 | | | | | |
| ADD READING | | -.15 | | | *.23 | *.19 | *.19 | **-.25 |
| PARTICIPATED | *-.19 | *-.20 | | | .16 | | .16 | |
| OUTSIDE | -.14 | | | | *.23 | | | |
| WRITTEN AID | | | | -.16 | | .16 | | -.17 |
| WRITTEN DONE | -.15 | *.22 | | | | | | |
| THINK | | | | | | | | -.16 |
| CONFIDENT | | *-.23 | | | *.23 | .16 | *.17 | |
| FRIENDS | | **-.30 | | | | | | |
| OTHERS VALUE | *-.18 | **-.29 | *-.18 | | .14 | *.19 | | |
| DID BEST | *-.19 | **-.31 | | -.14 | .17 | | *.21 | |
| SELF | | -.17 | | | | | | |
| INHIBITED | | | | | | | | |
| COMM MORE | | **-.35 | | *-.18 | .17 | **.27 | *.22 | |
| PROF ACCESS | | -.16 | | *-.17 | .14 | *.18 | **.27 | |
| MOTIVATION | | -.14 | | | | .13 | | |
| STOP | | | | | | | | |
| BORING | .15 | **.34 | | **.32 | *-.18 | *-.18 | **-.26 | |
| INVOLVED | | **-.30 | | | *.20 | *.16 | **.24 | |
| OTHER USEFUL | | *-.17 | | | **.27 | *.19 | | |
| REVIEWS USE | | *-.18 | | -.16 | **.24 | | | |
| BETTER LEARN | -.16 | **-.37 | *-.20 | **-.35 | **-.28 | **-.35 | **.34 | |
| LEARNED MORE | *-.19 | **-.39 | | **-.24 | **.31 | **.36 | **.29 | *-.19 |

NOTE: Coefficients displayed only if p<.10
* p< .05
** p< .01
N of cases varies from 85 to 90

## Outcomes by Course

We have seen that outcomes vary with amount and type of online activity; and that amount and type of online activity varied among courses. As would be expected, outcomes also varied significantly among the online courses. The differences on over half of the outcome measure were significant at the .05 level or less. Examples of the extent of the differences are shown in Table 12. Different courses were "best" and "worst" on various items, though there was a consistent tendency for the graduate CIS course which had the slow class 2 accounts and those courses in which there was the least online activity to rank near the bottom on most items. The items for which the responses differed significantly among courses are the following (see Appendix for complete wording):

.Course goals clear

.Work and grading clear from start

.Reading assignments good

.Written assignments good

.Lecture material

.Overall course rating

.Instructor well organized

.Grading fair

.Instructor enjoys teaching

.Material presented clearly

.Discussed others' ideas

.Got personal help

.Interesting presentation

.Work critiqued in a helpful way

.Overall rating of teacher

.Ability to communicate about the subject

.Understanding ethical issues

.Developed new friendships

.Value others' viewpoint

.Felt more involved in course

.Other students' comments useful

.Other students' work useful

When all of the courses from NJIT were combined, and all of the courses from Upsala combined, there were few significant differences among the three schools. The only consistent differences were that the Connected Education New School students tended to perceive "group learning" benefits more than NJIT or Upsala students. They were more likely to find the comments and assignments of other students to be useful and least likely to feel "inhibited" in discussing issues online.

Table 12
Differences in Outcomes Among Courses:
Analysis of Variance for Sample Items

| Course | N | Interesting Mean | Central Issues Mean | Better Learning Mean |
|---|---|---|---|---|
| Math 305 | 5 | 1.0 | 1.6 | 3.8 |
| CIS 213 | 14 | 2.0 | 2.1 | 4.9 |
| CIS 350 | 6 | 1.7 | 1.3 | 2.7 |
| CIS 732 | 36 | 2.6 | 2.1 | 4.1 |
| Sociology | 12 | 1.9 | 2.1 | 3.7 |
| Data Analysis | 5 | 2.2 | 2.8 | 5.0 |
| Connect-Ed | 12 | 1.8 | 1.9 | 3.2 |
| F | | 4.1 | 3.1 | 2.5 |
| p | | .001 | .001 | .03 |

Note: "Interesting" is agreement with statement that the material was presented in an interesting way (1= strongly agree; 5= strongly disagree).

Process and Outcome

There are very high correlations among individual items which compare aspects of the traditional and virtual classroom, and the items which measure the overall outcome of having learned more or finding the virtual classroom to be a better learning mode (Table 13). To some extent, these high correlations can be attributed to "cognitive consistency" or a lack of close attention to individual items among respondents, with a tendency to answer the same on a group of related items. However, this was not the case for other types of items from the questionnaire, where inter-correlations are nowhere near as high. It seems likely that what the data are showing is that better outcomes for the virtual classroom are conditional upon the processes shown in Table 13 which are potentials, actually occurring. Only if the students communicate more with other students, have better access to the professor, feel more "involved" as a result, and find the contributions of the other students to be useful, does the virtual classroom approach produce superior results. These findings are consistent which those in the pilot study (Hiltz, 1986).

Table 13
PROCESS AND OUTCOME:
CORRELATIONS BETWEEN ITEMS COMPARING
FACE-TO-FACE CLASSES AND THE VIRTUAL CLASSROOM

| | BETTER LEARNING | LEARNED MORE |
|---|---|---|
| INHIBITED | -.15 | **-.31 |
| COMMUNICATED MORE | **.54 | **.57 |
| PROF ACCESS | **.50 | **.53 |
| MOTIVATION | **.54 | **.42 |
| STOP | *-.20 | **-.23 |
| BORING | **-.48 | **-.43 |
| INVOLVED | **.64 | **.60 |
| OTHERS USEFUL | **.42 | **.51 |
| REVIEWS USEFUL | **.51 | **.51 |
| BETTER LEARNING | 1.0 | |
| LEARNED MORE | **.73 | |

NOTE: * SIGNIFICANT AT .05

** SIGNIFICANT AT .01

## Multiple Regression

Explained variance in the extent to which the virtual classroom mode is perceived as a better learning environment or to which students perceived that they learned more due to using EIES can be increased by using several variables in combination. However, the results must be interpreted with caution, since the variance in the "independent variable" (in terms of the amount and type of use made of the system in various courses) is so great and the sample is so small that this strategy is likely to lead to false confidence that variations in success of the virtual classroom have indeed been explained.

"Course" is a nominal variable with many categories, and cannot be properly used in a multiple regression. In table 14, selections of the best predictors of various types (other than "course") were included as candidate variables for a stepwise multiple regression. Two items were included from pre-use expectations: whether the system was anticipated to be "friendly" to use rather than impersonal, and overall expectations about the usefulness of the system. Sex of the student and baud rate of the equipment usually used were also included, along with the major measures of activity level: the number of comments entered, total time online, and number of private messages sent. The perceived extent to which more interactive or "group learning" took place is represented by the questions on whether access to the professor was improved, whether the student felt more "involved," whether the comments of the other students were useful, and whether they communicated more with other students as a result of using the system.

The results are shown in Table 14. The measures of "active" learning (in the form of the question on feeling more involved in taking an active part in the course) and on group learning (in the form of finding the comments of other students useful) are the best predictors of an overall outcome of "learning more" via this medium. Increased access to the professor and a pre-use expectation that the system would be "friendly" to use also contribute significantly to the prediction. About half of the total variance in whether using the system led to learning more is explained by the combination of these four variables.

Thus, the results of the multivariate analysis support the initial hypotheses that the ability of the medium to support "active learning" and "group learning" are key to its success. However, as we have seen, the courses included during this year of exploratory trials varied a great deal in the extent to which these potentials of the medium were actually realized. Rather than pushing further with multivariate quantitative analysis which is inappropriate for these data, some final qualitative observations are in order.

Table 14
STEPWISE REGRESSION EQUATION FOR "LEARNED MORE DUE TO EIES'
(Pairwise Deletion of Missing Data)

| STEP | VARIABLE | MULT R | R SQUARE | b | Beta |
|---|---|---|---|---|---|
| 1 | INVOLVED | .60 | .36 | .36 | .31 |
| 2 | OTHERS USEFUL | .67 | .45 | .28 | .26 |
| 3 | PROF ACCESS | .70 | .49 | .23 | .24 |
| 4 | FRIENDLY | .73 | .53 | -.24 | -.21 |
| | (CONSTANT) | | | 1.94 | |

Adjusted R sq: .50
At Step 4, F= 18.7, p= <.001

Candidate variables not selected into the equation: OVERALL, BAUD, SEX, NUMBER COMMENTS, TOTAL TIME, TOTAL PRIVATE, COMMUNICATED MORE

## Comments by Students

The open-ended questions at the end of the post-course questionnaire elicited a wide range of responses, similar to that for the structured questions on the face-to-face vs. virtual classroom: from wildly enthusiastic to strongly negative, with most feeling neutral and not bothering to comment. These comments did occur much more frequently for the graduate-level 732 course, and almost all of them were about EIES response time on class two accounts. For instance:

> "Adequate response time and a competent editor would help."

> "I think your virtual classroom is a good concept but the fact that it would take 3 hours to get one paragraph written made it an impossibility!"

> "The response time on EIES (for student priority) is beyond tolerance."

> "I feel it could be a useful tool if the EIES editor was easier to use and the response time better."

> "The general idea is good, but the response time is INTOLERABLE."

> "Supplying EIES with such terrible performance (one page of printout per hour) was a big mistake. EIES is now a four letter word... Take my advice, don't ever make anyone a class two (or class 20 or whatever it is called.)"

All but one of the above quotes came from class two CIS 732 graduate students, and all were accompanied by very negative ratings on the questions about learning more due to EIES. Though class two response accounts were supplied in a purely "adjunct" mode, it seems fair to conclude that this is not doing the students any favor. If regular (paying) accounts with reasonable response time cannot be supplied for a course, EIES should not be used at all.

Some students also found the medium impersonal instead of stimulating or fun. For instance, one states, "You cannot replace an instructor with written text. EIES was like reading a book."

On the other hand, some students feel like they have seen the future, and it works. Comments reflecting these points include:

> "It is especially beneficial to students who work full-time and may not be able to attend every class. More courses using electronic lecturing would be welcome."

> "If I had a choice I would never take another course face-to-face!"

> "I am very enthusiastic about learning via this medium. I have found it exciting and enjoyable. It eliminates all the stresses of schedules, dressing, and traveling, leaving the focus on interactive education."

> "Fun, independent. You can take your own time to think, learn what everyone in the class is doing, get suggestions from the entire class. If you work hard, you have got the knowledge of the entire class."

> "I have truly enjoyed this class even though the quantity of work at times was exceedingly high... The lectures and group discussions on EIES were fun and enjoyable because the approach was open ended for questions and responses. The format we used this semester will probably become a standard by the time my children attend second grade."

> "I have enjoyed working with the system and found it very interesting to participate in this sort of class. I would recommend that more classes utilize the system. It made learning more enjoyable."

<u>Most Needed Changes</u>

The last question on the post-use questionnaire was an open-ended one which requested the one change that would most improve the course which the student had taken. The most frequent answer was better response time (24%), followed by "more feedback" from the instructor (16%). 13% asked for better documentation (and/or training on how to use the system); and 13% complained that the online segments of courses were harder. No other improvements were mentioned by more than 10%.

Speedup in response time will be helped most by not including any students who do not have "class one" access; however, the complaints also will apply to anything written in INTERACT and running on EIES1. The second request will be easier to fulfill; faculty must realize that they need to be especially attentive and responsive online, since students cannot tell what the instructor thinks of their contributions unless they explicitly respond.

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APPENDIX

## BASELINE QUESTIONNAIRE FOR STUDENTS
## VIRTUAL CLASSROOM PROJECT
(N of Respondents= 123)

YOUR EIES USER #: ____________________

COURSE NAME: ____________________

DATE: ____________________

### A. YOUR PREVIOUS EXPERIENCE WITH COMPUTERS

EXPERIENCE

Which of the following best describes your previous experience with computer systems?

(1) 16% I am a novice; this will be my FIRST USE of a computer system
(2) 31 I have OCCASIONALLY used computer terminals and systems before
(3) 22 I have FREQUENTLY used computer systems
(4) 31 Use of computers is central to my PROFESSIONAL work

USED CMC

Have you ever utilized a computerized messaging system, tele-conferencing or computerized conferencing system before?

(1) 66% No
(2) 34 Yes (Which systems have you used?)

THIS SYSTEM

Have you ever used THIS system before?

(1) 90% No
(2) 10 Yes

### B. EXPECTATIONS ABOUT THE SYSTEM

Indicate your expectations about how it will be to use this system by circling the number which best indicates where your feelings lie on the scales below.

EASY

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|---|
| | 2% | 7 | 10 | 24 | 19 | 25 | 15 | 4.8 | 1.5 |
| | Hard to learn | | | | | | Easy to learn | | |

FRIENDLY

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 4% | 3 | 12 | 13 | 25 | 26 | 17 | 4.9 | 1.6 |
| Impersonal | | | | | | Friendly | | |

NOT FRUSTRATING

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 4% | 8 | 13 | 26 | 19 | 20 | 10 | 4.9 | 1.6 |
| Frustrating | | | | | | Not frustrating | | |

PRODUCTIVE

| : 1 : | 2 : | 3 : | 4 : | 5 : | 6 : | 7 : | | |
|---|---|---|---|---|---|---|---|---|
| 1% | 2 | 7 | 18 | 23 | 33 | 16 | 5.3 | 1.3 |
| Unproductive | | | | | | Productive | | |

INCREASE EFFICIENCY

Do you expect that use of the System will increase the efficiency of your education (the quantity of work that you can complete in a given time)?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|
| 12% | 11 | 15 | 28 | 23 | 7 | 4 | 3.8 | 1.6 |
| Definitely yes | | | Unsure | | | Definitely not | | |

INCREASED QUALITY

Do you expect that use of the System will increase the quality of your education?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|
| 14% | 21 | 22 | 29 | 12 | 3 | 1 | 3.1 | 1.4 |
| Definitely yes | | | Unsure | | | Definitely not | | |

OVERALL EXPECT

Overall, how useful do you expect the System to be for online classes?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | S.D. |
|---|---|---|---|---|---|---|---|---|
| 18% | 18 | 27 | 23 | 7 | 6 | - | 3.0 | 1.4 |
| Very Useful | | | | | | Not useful at all | | |

TIME EXPECTED

While you are part of an online course, how much time in the average week do you foresee yourself using EIES in relation to your coursework?

(1) 2% Less than 30 minutes
(2) 13 30 minutes to 1 hour
(3) 44 1 - 3 hours
(4) 33 4 - 6 hours
(5) 6 7 - 9 hours
(6) 3 10 hours or more

## C. ACCESS TO TERMINALS

TERMINAL WORK

Please describe your access to a computer terminal or microcomputer at your office or place of work.

(1) 23% No terminal
(2) 40 Have my own terminal
(3) 7 Share a terminal, located where I can see it from my desk
(4) 10 Share a terminal, which takes ____ minutes to reach
(5) 20 Not applicable; I do not have an office

HOME TERMINAL

Do you have a micro or terminal at home (or in your dorm, wherever you live during classes)?

(1) 57% No
(2) 44 Yes

TERMINAL TYPE

What kind of terminal do you usually use? (Check all that apply)

| YES | NO | |
|---|---|---|
| | | CRT |
| 47% | 53 | CRT (video display) |
| | | HARD |
| 11 | 89 | Hard copy (printer terminal) |
| | | BOTH |
| 30 | 70 | Both |
| | | MICRO |
| 38 | 62 | Microprocessor |
| | | HCOPY |
| 30 | 70 | With hard copy |
| | | DISK |
| 44 | 57 | With disk storage |

BAUD RATE

At what baud rate or speed do you normally operate?

37% 30 characters per second
38 120 characters per second
26 Other (please specify) ___________

## SOME BACKGROUND INFORMATION

REASON

What is the most important reason or motivation explaining your participation in this online course or class activity?

(1) 42% I had no choice; the instructor requires it.
(2) 10 I was curious about how this technology works
(3) 26 I have a professional or job-related interest in the topic.
(4) 13 I have a general interest in the topic.
(5) 2 The reputation of the instructor(s)
(6) 2 More convenient than traditional classes
(7) 5 Other (please describe)

SEX

| Your sex: | Male | Female |
|---|---|---|
| | 67% | 33 |

AGE

Your age at last birthday:

MAJOR

Your major:

NATIONALITY

| Nationality: | U.S. | OTHER |
|---|---|---|
| | 46% | 54 |

ETHNIC

Ethnic/Racial Background

5% Black/Afro-American
2 Hispanic (Mexican, Puerto-Rican, etc.)
70 White
18 Asian or Asian-American
5 Other

ENGLISH LANGUAGE

Is English your native or first language? 79% Yes 21 No

TYPING

How would you describe your typing skills?

(1) 5% None
(2) 19 Hunt and peck
(3) 39 Casual (rough draft with errors)
(4) 30 Good (can do 25 w.p.m. error free)
(5) 7 Excellent (can do 40 w.p.m. error free)

STANDING

Academic standing

- 9% Freshman
- 10 Sophomore
- 15 Junior
- 18 Senior
- 44 Master's candidate
- 3 Doctoral candidate
- 1 Post-doctoral

QUESTIONNAIRE FOR PARTICIPANTS IN ONLINE COURSES

COURSE — We would like you to respond to this survey in terms of ONE course. For which course will you be supplying ratings?

Course name ______________________________

SCHOOL — I am:

(1) 92 An NJIT student
(2) 32 Upsala student
(3) 17 New School (Connect-Ed) student
(4) - Other ______________________

(Total N= 141. Post-Use responses= 96.)

TERMINAL ACCESS — Is access to a terminal or micro for the online class a problem for you?

| | 1% | 6 | 13 | 15 | 65 | 4.4 | 1.0 |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | MEAN | SD |
| | Serious Problem | | | | Not a Problem | | |

BUSY LINES — How much problem have you had with "busy" lines or no available ports to EIES?

| | 1% | 7 | 16 | 32 | 44 | 4.1 | 1.0 |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | MEAN | SD |
| | Serious Problem | | | | Not a Problem | | |

SLOW RESPONSE — To what extent has the slow response of the EIES system been a problem or barrier for you?

| | 23% | 23 | 25 | 20 | 9 | 2.7 | 1.3 |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | MEAN | SD |
| | Serious Problem | | | | Not a Problem | | |

TIME SPENT — About how much time per week have you spent participating in this course? (including "in class" and out, reading and writing, on and offline)

(1) 6% Less than one hour
(2) 21 1-2 hours
(3) 26 3-4 hours
(4) 37 5-9 hours
(5) 10 Ten hours or more

# VIRTUAL CLASSROOM SOFTWARE FEATURES

ANONYMITY — Did you use the anonymity feature on EIES?

79% (1) Never used
10 (2) Once or Twice
12 (3) Three or more times

ANON USEFUL — If you used anonymity or pen name: Did you think this was useful?

| Very Useful | | | | | | Not Useful | | |
|---|---|---|---|---|---|---|---|---|
| 14% | 29 | 7 | 29 | 4 | - | 18 | 3.5 | 2.0 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | MEAN | SD |

BRANCH RESPONSE — Did you use the "branch" response feature?

19% (1) Never
27 (2) Once or twice
54 (3) Three or more times

[If used "branch response" feature:] Did you think this was useful or not? Can you suggest any improvements to this feature?

BRANCH READ — Did you use the "branch" read feature?

44% (1) Never
22 (2) Once or twice
35 (3) Three or more times

[If used "branch read" feature:] Did you think this was useful or not? Can you suggest any improvements to this feature?

GRAPHICS — Did you use the GRAPHICS feature in your class?

98% (1) Never
2 (2)Once or twice
- (3) Three or more times

[If used "graphics" feature:] Did you think this was useful or not? Can you suggest any improvements to this

## COURSE EFFECTIVENESS

There are three sets of items in this section. Try to to separate them out in your thinking. The first relates to the content of the course; the second, to the teaching or presentation style and effectiveness of your instructor; the third, to the outcomes of the course for you. Following this section, we will ask you to make some direct comparisons of the relative advantages and disadvantages of the online or "virtual" classroom and the traditional classroom.

### COURSE CONTENT

For each of the following, please circle a response that corresponds to the following scale:

SA= Strongly Agree
A= Agree
N= Neither agree nor disagree (neutral)
D= Disagree
SD= Strongly Disagree

| | | SA | A | N | D | SD | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| INTERESTING | The course content was interesting to me | 34% | 52 | 9 | 4 | 0 | 1.8 | .76 |
| IMPORTANT | Course content is important or valuable | 27% | 53 | 19 | 1 | 0 | 1.9 | .71 |
| GOALS CLEAR | Course goals were clear to me | 12% | 46 | 22 | 18 | 3 | 2.6 | 1.0 |
| REQUIREMENTS | Work requirements and grading system were clear from the beginning | 13% | 37 | 20 | 20 | 12 | 2.8 | 1.2 |
| READING | The reading assignments are good | 17% | 53 | 19 | 10 | 2 | 2.3 | .93 |
| WRITTEN GOOD | The written assignments are good | 14% | 61 | 19 | 4 | 2 | 2.2 | .81 |
| LECTURES | The lecture material is good | 25% | 47 | 19 | 7 | 3 | 2.2 | .98 |
| HARD WORK | The students had to work hard | 32% | 40 | 23 | 4 | 1 | 2.0 | .91 |
| WASTE | This course was a waste of time | 3% | 7 | 8 | 34 | 47 | 4.1 | 1.1 |

LEVEL Is this course taught at an appropriate level?

| : 1 : | 2 : | 3 : | 4 : | 5 : | | |
|---|---|---|---|---|---|---|
| 2% | 14 | 62 | 18 | 3 | 3.1 | .73 |
| Too easy | | Just right | | Too difficult | MEAN | SD |

COURSE OVERALL How would you rate this course over-all?

| (1)Excellent | (2)Very Good | (3)Good | (4)Fair | (5)Poor | MEAN | SD |
|---|---|---|---|---|---|---|
| 11% | 38 | 34 | 15 | 3 | 2.6 | .97 |

COMMENTS ABOUT THE COURSE CONTENT?

## CHARACTERISTICS OF THE TEACHING

| | | SA | A | N | D | SD | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| ORGANIZED | Instructor organized the course well | 22% | 45 | 27 | 5 | 1 | 2.2 | .88 |
| GRADING | Grading was fair and impartial | 20% | 40 | 34 | 6 | 1 | 2.3 | .89 |
| INS ENJOYS | Instructor seems to enjoy teaching | 50% | 39 | 10 | 2 | 0 | 1.6 | .75 |
| KNOWLEDGABLE | Instructor seems knowledgable about this subject | 60% | 30 | 9 | 2 | 0 | 1.5 | .74 |
| ENCOURAGED | Students were encouraged to express ideas | 45% | 42 | 11 | 1 | 1 | 1.7 | .78 |
| CLEAR | The instructor presented material clearly and summarized main points | 34% | 33 | 19 | 14 | 0 | 2.1 | 1.0 |
| OTHER VIEWS | Instructor discussed points of view other than her/his own | 33% | 45 | 17 | 3 | 1 | 2.0 | .86 |
| HELP | The student was able to get personal help in this course | 25% | 38 | 30 | 5 | 1 | 2.2 | .92 |
| INTERESTING PRESENTATION | Instructor presented material in an interesting manner | 29% | 39 | 24 | 9 | 0 | 2.1 | .93 |
| CONSTRUCTIVE | Instructor critiqued my work in a constructive and helpful way | 18% | 29 | 42 | 11 | 0 | 2.5 | .92 |

INSTR OVERALL — Overall, I would rate this teacher as

| (1)Excellent | (2)Very good | (3)Good | (4)Fair | (5)Poor | MEAN | SD |
|---|---|---|---|---|---|---|
| 30% | 32 | 26 | 12 | 0 | 2.2 | 1.0 |

COMMENTS ABOUT THE INSTRUCTOR OR THE TEACHING?

## OUTCOMES OF THE COURSE

| | | SA | A | N | D | SD | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| MORE INTEREST | I became more interested in the subject | 26% | 48 | 21 | 3 | 2 | 2.1 | .89 |
| FACTS | I learned a great deal of factual material | 16% | 55 | 25 | 3 | 1 | 2.2 | .80 |
| CONCEPTS | I gained a good understanding of basic concepts | 28% | 55 | 16 | 1 | 0 | 1.9 | .69 |
| ISSUES | I learned to identify central issues in this field | 20% | 59 | 20 | 1 | 0 | 2.0 | .67 |
| COMMUNICATE CLEARLY | I developed the ability to communicate clearly about this subject | 14% | 51 | 33 | 2 | 1 | 2.3 | .76 |
| CRITICAL | My skill in critical thinking was increased | 14% | 41 | 37 | 7 | 0 | 2.4 | .82 |
| ETHICAL | I developed an understanding of ethical issues | 10% | 23 | 50 | 12 | 5 | 2.8 | .96 |
| INTEGRATE | My ability to integrate facts and develop generalizations improved | 6% | 50 | 33 | 10 | 1 | 2.5 | .80 |
| READ | I regularly completed the required readings | 20% | 53 | 16 | 12 | 0 | 2.2 | .89 |
| ADD READING | I was stimulated to do additional reading | 13% | 36 | 31 | 16 | 5 | 2.7 | 1.1 |
| PARTICIPATED | I participated actively in class discussion | 14% | 42 | 37 | 5 | 2 | 2.4 | .87 |
| OUTSIDE | I was stimulated to discuss related topics outside of class | 15% | 45 | 26 | 14 | 1 | 2.4 | .94 |
| WRITTEN AIDED | The written assignments aided my learning | 23% | 56 | 17 | 3 | 1 | 2.0 | .80 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WRITTEN DONE | I regularly completed the written assignments | 33% | 47 | 15 | 3 | 2 | 1.9 | .90 |
| THINK | I was forced to think for myself | 30% | 51 | 20 | 0 | 0 | 1.9 | .70 |
| CONFIDENT | I became more confident in expressing my ideas | 6% | 41 | 45 | 7 | 1 | 2.6 | .77 |
| FRIENDS | I developed new friendships in this class | 9% | 40 | 30 | 14 | 7 | 2.7 | 1.1 |
| OTHERS VALUED | I learned to value other points of view | 13% | 43 | 41 | 3 | 1 | 2.4 | .79 |
| DID BEST | I was motivated to do my best work | 25% | 34 | 33 | 6 | 1 | 2.2 | .94 |
| SELF | I gained a better understanding of myself | 10% | 22 | 52 | 15 | 1 | 2.8 | .86 |

## COMPARISON TO TRADITIONAL CLASSROOMS

We would like you to compare this online course to your previous experiences with "face to face" courses. To what extent do you agree with the following statements about the comparative process and value of the EIES online course or portion of a course in which you participated?

**INHIBITED**

I felt more "inhibited" in taking part in the discussion.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 10 | 14 | 32 | 10 | 19 | 12 | 4.4 | 1.6 |

**COMMUNICATED MORE**

I communicated more with other students in the class as a result of the computerized conference.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 15 | 14 | 23 | 17 | 16 | 11 | 4.2 | 1.7 |

**PROF ACCESS**

Having the computerized conferencing system available provided better access to the professor(s).

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 16% | 27 | 14 | 18 | 6 | 12 | 7 | 3.4 | 1.9 |

**MOTIVATION**

The fact that my assignments would be read by the other students increased my motivation to do a thorough job.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 4% | 27 | 20 | 19 | 10 | 12 | 8 | 3.7 | 1.7 |

**STOP**

When I became very busy at work, I was more likely to stop participating in the online class than I would have been to "cut" a weekly face-to-face lecture.

| 1 (Strongly Agree) | 2 | 3 | 4 | 5 | 6 | 7 (Strongly Disagree) | MEAN | SD |
|---|---|---|---|---|---|---|---|---|
| 18% | 16 | 16 | 21 | 9 | 12 | 9 | 3.6 | 1.9 |

BORING

The online or virtual classroom mode is more boring than traditional classes.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 8% | 10 | 10 | 23 | 13 | 23 | 14 | 4.5 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

INVOLVED

I felt more "involved" in taking an active part in the course.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 6% | 17 | 20 | 35 | 7 | 6 | 7 | 3.7 | 1.5 |
| Strongly Agree | | | | | | Strongly Disagree | | |

OTHERS USEFUL

I found the comments made by other students to be useful to me.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 6% | 24 | 27 | 19 | 6 | 7 | 10 | 3.5 | 1.7 |
| Strongly Agree | | | | | | Strongly Disagree | | |

REVIEWS USEFUL

I found reading the reviews or assignments of other students to be useful to me.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 7% | 30 | 22 | 24 | 5 | 5 | 6 | 3.3 | 1.6 |
| Strongly Agree | | | | | | Strongly Disagree | | |

BETTER LEARNING

I found the course to be a better learning experience than normal face-to-face courses.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 12% | 11 | 19 | 26 | 8 | 16 | 8 | 3.9 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

LEARNED MORE

I learned a great deal more because of the use of EIES.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
|---|---|---|---|---|---|---|---|---|
| 10% | 19 | 15 | 17 | 18 | 13 | 9 | 3.9 | 1.8 |
| Strongly Agree | | | | | | Strongly Disagree | | |

What one change in course content, instructor's technique, or EIES would most improve the course, in your opinion?

COMMENTS on the use of computerized conferences for courses?

THANK YOU VERY MUCH!!
PLEASE DO NOT FORGET TO FILL OUT AND SIGN YOUR CONSENT FORM.

## APPENDIX- NARRATIVE DESCRIPTIONS OF COURSES

### NJIT Math 305- Statistics for Technology
Rose Dios
Report on "Week 1," February 1986

The topic of study during the first "EIES week" for this course was the historical and philosophical aspects of probability theory and its application to nuclear risk assessment. The homework comments assigned to the students were not very successful since only half the class responded, even though the whole class read all of the lecture material. Why didn't they do their homework even though they logged on to EIES, read all of the material, and obtained a printout of the lecture for future reference? Most students responded to that question by saying that they did not feel confident enough in the area of philosophy to enter in a comment that they knew would be read by THE WHOLE CLASS. So they were embarassed and felt shy and this resulted in their silence with respect to the conference. Just a few days ago I received a private message with that week's homework assignment as its content. The student said that he wanted to answer the questions (Better late than never) but that he didn't want to enter his response into the conference because he didn't feel that it was worthy of taking the other students time. Since then we have spoken and he is allowing me to copy in his message as a conference comment. In fact his response to the questions is very well done and valuable !! But he didn't see it that way. Hopefully other students will follow his example and enter in their responses as well.

The following week I gave an in class quiz: 50% of it was ONLINE material and 50% was OFFLINE material. The statistics on their grades are shown below:

| ONLINE | OFFLINE |
|---|---|
| MEAN= 38.17<br>OF A POSSIBLE 50 PTS. | MEAN= 41.33<br>OF A POSSIBLE 50 PTS. |
| STANDARD DEVIATION<br>= 10.73 | STANDARD DEVIATION<br>= 2.749 |
| MEDIAN= 39.5<br>OF A POSSIBLE 50 PTS. | MEDIAN= 42<br>OF A POSSIBLE 50 PTS. |
| MODE(S)= 50, 25<br>WITH FREQ.=2 | MODE(S)= 44<br>WITH FREQ.=3 |

What do these statistics say about the 2 different groups? Well, there was a lot of variation between grades for the ONLINE material. Students either did very well or very poorly ... there was no middle ground performance. Regarding the OFFLINE material, there was a very small variation in grades. Everybody did just about the same as everbody else, namely about "B" quality work. The average grade on the OFFLINE material was 3.16 points higher than that for the ONLINE material (out of 50 pts.) but that point differential was a change in letter grade from C for ONLINE to B for OFFLINE.

WEEK 2

The week of March 10th was our second online week and the topic of study was "Random Variables, Probability Distributions, And Their Statistics." This topic was mathematical as opposed to historical/philosophical. The assignment given to the class was to respond to 8 mandatory response branches, each of which constituted a mathematical homework problem. Despite bugs in branch and with the help of individual tutoring of students at the terminal just about everyone in the class did their homework!! Most of the homework was correct and in some instances it was 100% perfect! The main problem that the students voiced repeatedly was that BRANCH is too slow!! So this was an improvement over week 1. But still I received some homework as private messages instead of as a branch response because some students were too shy and they didn't want the class to see their responses because they suspected that they were wrong. It's amazing how shy some students are. I find that such students just need the professor to give them a vote of confidence and to encourage them to feel more confidence in their work.

I gave an in class quiz the following week in which 50% of the test was on ONLINE material and 50% of it was OFFLINE material. The following statistics are indicative of the test scores:

| ONLINE | OFFLINE |
|---|---|
| MEAN= 42.857<br>OF A POSSIBLE 50 PTS. | MEAN= 36.714<br>OF A POSSIBLE 50 PTS. |
| STANDARD DEVIATION<br>= 4.880 | STANDARD DEVIATION<br>= 9.979 |
| MEDIAN= 45 | MEDIAN= 38 |
| MODE= 45<br>WITH FREQ.=3 | MODE(S)= 31, 47<br>WITH FREQ.=2 |

So the average grade for ONLINE material was 6.143 points higher than the average for OFFLINE material. There was also less variation for the ONLINE material than for OFFLINE so that students did consistently well in the ONLINE part of the test. Why do I think this happened? Well, I have to be honest: The material that I covered on EIES was taylor-made for this kind of instructional technique. BUT DESPITE THAT, IT COULD HAVE EASILY FAILED TO DO THE JOB. EIES AS A TOOL DID WORK AND IT WORKED WELL!! And I also have to add that the students worked harder at learning this material because of the way it was presented. Some students admitted to having spent 2 or 3 times as much time studying Math 305 during EIES week because they don't have the traditional classroom situation in which the instructor teaches them the intricacies of the subject's theory. So the students felt as if they were on their own and that they were being held accountable for learning this material AND SO THEY WORKED MUCH HARDER THAN USUAL TO LEARN IT!!

## DISCUSSION OF EIES WEEK 3 IN MATH 305 (STATISTICS)

The week of April 10th was the third week of online coursework in Math 305. The subjects that were discussed were

1. The Normal Distribution as an approximation to the Binomial Distribution.

2. Sampling Distribution Theory and the sampling distribution of the Mean of a random variable. The Central Limit Theorem.
3. Confidence Intervals for the true mean of a random variable.

This time I lectured on this material for the 2 weeks that preceded the EIES week and what I did on EIES was to REVIEW THE HOMEWORK ON THESE 3 TOPICS WHICH HAD ALREADY BEEN TREATED IN THE TRADITIONAL CLASSROOM LECTURE SITUATION.

I assigned 3 homework problems on EIES to be graded for credit, one on each of the above topics and each one as a separate MANDATORY RESPONSE BRANCH. I originally had 8 students registered for this course and 3 have just disappeared over the course of the semester. Of the remaining 5, all of them did the homework completely and almost all correctly. I would describe their performance as excellent on the homework and very good on the test.

I gave an in class quiz the following week dividing the subject matter into 2 groups: material covered completely in class (part 1), and

material lectured on in class but homework done on EIES exclusive (part 2).

The following statistics describe their performance on these 2 parts.

| PART I (OFFLINE) | PART II (ONLINE) |
|---|---|
| MEAN SCORE (OF 50) = 43 | MEAN SCORE (OF 50) = 40.333 |
| MEDIAN SCORE (OF 50) = 44 | MEDIAN SCORE (OF 50) = 40.00 |
| MODES = 50 and 40 (FREQ=2) | MODE = 40 (FREQ=2) |
| STANDARD DEVIATION = 7.874 | STANDARD DEVIATION = 7.394 |

Looking at these results, the students did well on both parts!! The offline score was 2.667 points higher than the online score on the average. Both average scores are in the "B" range (Offline is a higher B than Online) and the variation in the students' performance was almost the same (half a point difference) for offline versus online scores. My opinion (somewhat biased since I have tremendous faith in EIES as an instructional medium!!) is that EVEN WHEN TREATING VERY DIFFICULT AND DELICATE STATISTICAL CONCEPTS THE EIES MEDIUM HAS SUCCEEDED AS A TOOL FOR LEARNING ENHANCEMENT IN THE SUBJECT MATTER OF "STATISTICS FOR TECHNOLOGY". Looking directly at the test scores I see that of the 6 students tested, 2 of them did better on the ONLINE part than on OFFLINE while 4 did better on the OFFLINE than on the ONLINE part... so some students do appear to learn better using EIES.

- Final Exam Performance

The following descriptive statistics summarize student performance on the final exam.

| ONLINE | OFFLINE |
|---|---|
| Mean (of possible 45) = 35.4 | Mean (of possible 45) = 39 |
| Median (of possible 45) = 38 | Median (of possible 45) = 41 |
| Mode (of possible 45) = 27<br>FREQ = 2 | Mode (of possible 45) = NONE |
| Standard deviation = 7.893 | Standsard deviation = 5.148 |

In both cases the average grade was in the "C" range (ONLINE is a low "C" and OFFLINE is a high "C") with much greater variation in ONLINE as compared to OFFLINE. IT WAS A TOUGH EXAM ...

***

The students seemed to have become cohesive over the course of the semester, perhaps partially because of the use of the system. They planned a dinner reunion meeting during July, which is very unusual for students in a course to do.

# INTRODUCTION TO COMPUTER SCIENCE (NJIT CIS213)

B.J. Gleason

## Fear and Loathing in the Virtual Classroom

I was honored when I was asked by Murray Turoff to teach a section of CIS 213, Introduction to computer science, using EIES instead of the traditional classroom. However, while I was honored, I didn't realize just how much fun it would be. Not that it wasn't fun, it was just different.

### "I need a volunteer - you, you and you... "

I walked into the classroom, carrying a massive amount of EIES material with me, and welcomed all my students, about 24 of them. After describing the project, the class dropped off to about 14...

It appears as if the class hadn't been informed about the project. And many of them didn't want anything to do with it. I could undertsand that perfectly. When an NJIT student signs up for a night course, that is what they want. They don't want to learn how to use a new computer system, etc... A few of them seemed thrilled about it, the rest weren't.

### DIVE - DIVE - DIVE

Under the original idea of the virtual classroom, this semester we were supposed to test it a little, a few assignments online, discuss it over the summer, and then full classes in the fall. I didn't feel that this was an adequate test of the system, so I tossed my students in head first. We would meet every 3rd week. Two weeks online, one week in the classroom. There were several reasons for meeting in the classroom. The major of which was to collect programming assignments. I didn't have much of a choice in this, since the "Switcher", the package to allow students to do programming on eies, was still in the design phase.

During the first week, I noticed that many people didn't keep up with the reading. So, I dicided to add a quiz to each lecture, using the "Branch" feature to have the students answer the questions. I told my students that the quiz wouldn't count for much, it was just to make sure that they kept up with the material. This was a mistake. If you tell someone something isn't important, that is the way they treat it. Combine that with the fact that the "Branch" command was the slowest command ever devised by the myopic programming team. Now, not only weren't the students reading the material, but they weren't taking the quizzes either.

## The Bull in the China Shop Affair

One of the "perks" the students received was access to an online conference called "The Cafe", which was run by the New School and Paul Levinson. Since he had students online, he thought it would be a nice idea to let all the online students get together. It was a nice idea, but...

One of the problems I noticed came to me in the form of a student, who I will call TAC [ not his real name ].

TAC "walks" into the cafe and "spilled 30 gallons of scalding hot coffee all over him. He was rushed off to a hospital, leaving a pool of blood."

Needless to say, this is not typical behavior for most people involved in teleaconferencing. But it got better.

He returned, after "extensive plastic surgury. But the hospital ran out of skin grafts, so they used potato peels."

I received a message from Paul, with the above message attached, "chewing me out" for not properly disciplining my students. Tac was removed from the cafe.

I got in touch with tac, and after much hemming and hawing, and almost throwing him out of the class, we got the problem straightened out.

It seems as if Tac had a "closed view" of teleconferencing, in which he was the only on around. What I impressed on him was that being on eies was like being in a room full of people, many of whom you don't know. You have to behave as such.

I have decided that in the next on line class, a section on ettiquette will be mandatory.

## Changes in latitute, changes in attitute.

One of the first changes I made was to increase the value of the quizzes. This caused much unrest in my class. But it forced them to keep up. Another change was the structure of the quiz. Intially, the student read the question in the conference comment, and then answered the quiz in the branch. The problem was that while I know when the student answered the quiz, i don't know when they read it. So I installed the question in a "read" structure, so I would recieve notification of when they read the question. So I told the students that they must now answer the quiz in 30 minutes.

But I still ran into problems. Some people were reading the quiz, and then tried to answer it the next day, long after the 30 minute deadline. So they received a zero for the quiz.

I realized I wasn't winning any friends, but this is what happens when you put theory into practice.

## The Demise of the virtural classroom

The week before the midterm, I had a review online. There were no questions. When, two weeks before the final, I asked if they wanted to have the review online or off. OFF!!!!!

The last three weeks of class were in the classroom. And quite frankly, it was a bit of a relief. The review went over very well, and I was very impressed with many of the finals. I feel that the results were compatable with that of the normal classroom, but we have yet to compile all the data.

## VC: A Retrospective

In some ways I was happy with the results of the virtual classroom, in others, not too happy.

I felt the results were encourging. I have developed the proper tools needed to develop and teach an online course. We found a large number of faults in the exsisting software, and suggested a number of improvements.

What would have been nicer was if the students had been fully aware of the VC aspect of the class they signed up for. This problem has been taken care of for the Fall semester. I felt that since a number of students were opposed to the idea, they didn't particapate as much as they would have, if they were informed before signing up for the class.

The VC is a lot more work for the student. For a course such as CIS 213, where the teacher is lecturing FACTS, rather than discussing concepts, it ends up being more reading for the student, rather than interactive communications, like in a normal conference. I tried to start up soem discussions, but the students tended to look at them more as assignments rather than discussions. They would place in a comment, and then nothing else. One or two continued the discussion, but it finally fell off.

I felt the mode of teaching to be a bit stifling as well. As a former college actor, I am a bit of a "ham". I find the loss of the face-to-face meetings to be disheartening. I missed it.

I think the students missed it as well. Many of them complained about the speed of eies, and most of them waited until they saw me before asking questions about the online lectures.

# USE OF EIES IN TEACHING INTRODUCTORY SOCIOLOGY
(Upsala College, Spring Semester, 1986; Prof. R.J. Meinke)

In this course EIES was used to supplement the regular in-class instruction. Nine specific assignments were given and completed on EIES. These consisted of:

a) Two specifically training assignments in systems use.

b) Seven content oriented assignments which required application or interpretation of specific sociological concepts in light of the students' personal experiences.

c) Three of these seven were given entirely in lieu of one week of in-class instruction after two-thirds of the course was completed.

These assignments were preceeded by a short training session which was tacked onto the end of the second in-class session. This session consisted of bringing the students into the computer lab together with several lab assistants plus two experts from EIES in Newark. The students informally grouped around the various terminals with one student actually operating the system. Different degrees of organized instruction were occurring at each terminal. As the time was limited, many students rushed off without actually getting hands-on experience with the machines. In addition, the large simultaneous useage of the system slowed the system down and, consequently, discouraged training participation. As a result some students fell behind.

In the future I would make the following changes in the training process:

a) Allow at least one entire class period for training at the terminal.

b) Lead a step-by-step pre-planned instruction that is done simulataneously by a person at each terminal with the other students watching.

c) Have each student then repeat the instructed operations on the terminal and have the assistants check their successful completion.

d) The instruction whould be very basic - how to enter the directory and how to send a private message, and should be accompanied by a simple instruction sheet that the students can take home. (The EIES Users' Manual is excellent, but my experience is that many students are unlikely to work out instructions for themselves from the manual. It is better to present the info in small batches, perhaps give assignments and quizes on specific User Manual sections.)

After the initial training session, the students were given two training assignments a week apart.

1) To complete their directory and send a simple private message to the instructor.

2) To send a conference message consisting of a short personal cocktail party-like biography.

Subsequently, the content oriented assignments were begun and continued approxiamately every ten days.

Finally as indicated above, at about the tenth week of the course classroom attendance was suspended for one complete week, and three assignments were to be completed online in three seperate terminal sessions (not all at once).

ASSESSMENT OF THE EXPERIMENT;

I found several distinct advantages in using EIES:

a) It encouraged me to utilize more written assignments. This is important as my students need extensive practice in written communication.

b) Assignments on EIES seemed to encourage many students to write more extensive answers to the assignments than usual.

c) Many shy students who would normally be reluctant to express their ideas in class contributed.

d) In general students were more open that I expected in regard to their personal experiences and feelings, even though (or maybe because of) the public nature of their comments.

I also found a number of problem areas in the use of EIES assignments:

a) Because the quality of the training experience was uneven,some students were discouraged immediately, and it took a long time to catch up (some never did).

b) It was difficult to get the assignments in on time. Some difficulties in using EIES (long waits for connections, etc.) provided easy excuses for lateness or non completion. Some students lack self-discipline and their latenesses frustrate group activities on-line.

c) The fact that most students do not have terminals at home and must use the labs also contributes to procrastination. Unfortunately, the time when most students seem to use the lab is also the time when EIES is most busy.

d) The slowness of the BRANCH sequence is also frustrating.

e) Many students do not follow explicit instructions. When asked to respond in BRANCH or to use pen names, they fail to do so. This fouls up those assignments which are geared to forcing each student to do his or her own work or to achieve objective annonymity.

f) While 18 students completed the course, only 12 mailed back their questionnaires. In the future these responses should be completed in class and collected there.

g) Finally, I find the greatest challange is to devise methods of forcing the students to interact with each other, not just me.

10) It should also be noted that conditions at Upsala College during this semester created unique problems. The controversy surrounding a labor strike at the college resulted in a pattern of absenteeism that disrupted classes and continued even after some normalacy was restored late in the semester. As a result seven students who began the course failed to complete it; and this is an unusually high number of drop-outs.

# REPORT ON A "VIRTUAL CLASSROOM" EXPERIMENT

COURSE: COMPUTER AND INFORMATION SCIENCES 300: DATA ANALYSIS GIVEN AT UPSALA COLLEGE IN THE "SATURDAY COLLEGE" PROGRAM, SPRING SEMESTER, 1986

INSTRUCTOR: C. LINCOLN BROWN, Ph.D.

The course CIS 300: Data Analysis in which the experiment was carried out is an upper level course intended primarily for majors in social sciences, particularly Human Resources Management; however, the course is frequently selected as an elective by majors in Computer Information Systems. The only stated prerequisite for the course is an"an introductory statistics course or Sociology 301: Methods of Social Research".

This course has been offered at Upsala for only two years, and one problem with the course has been the disparity of backgrounds in computing which students bring to the course. In the Spring, 1986 section of the course there were 14 students, 3 of whom were Computer Information Systems majors and 11 of whom had had no previous computer science course! While the computing necessary for the course is minimal (students write SPSSX jobs, but do no programming in BASIC or any other standard computer language), many students bring to the course a fear of the computer - and in this section it was particularly wide-spread, perhaps since most of the students were women beyond traditional college age - which requires that the instructor spend too much time teaching the use of the computer at the expense of dealing with the statistical material. (In the future this problem will be resolved by a new requirement of a two-credit course in computer literacy as a prerequisite.)

This background has been presented here partly to explain the difficulty encountered when I wanted to introduce, in addition to the use of the Prime 550 minicomputer and its editor and the use of the SPSSX language, use of a computer-based educational delivery system such as EIES. Due to the nature of the Saturday College at Upsala - classes meet on 10 Saturdays for four hours each time, with some extra sessions scheduled at mutual convenience during the semester to bring the contact hours to the usual for a 4-credit course - none of the above computer introductions could be postponed,and there was some degree of panic on the part of the students.

Since the course content, as contrasted with the method of delivery, had to take precedence, a decision was made early in the course to cut back the amount and nature of the material to be presented online. I had originally planned to cover one topic in the middle of the course online, and to leave the study of the SAS language (an alternative to SPSSX, the primary statistical software package used in the course) as an online project, optional but necessary for an "A" grade in the course. With students having such difficulty with the primary course material, I decided to omit SAS entirely from the course, and so that EIES could be used in more than just one week, I decided to present the topic of parametric statistics entirely online, but spaced throughout the course.

Specifically, each time a statistic or statistical test was used which made assumptions about the underlying distribution of the population, if a nonparametric analogue (one needing no such assumptions) existed it was covered online. Students had to check regularly for messages about such assignments, since "electures" and assignments were added to the online conference without being discussed in class.

The presentation of the material was in large part straight forward, with the students required to read online lectures and do assignments based on these lectures. However, when appropriate, questions were posed and students were asked to respond via conference comments. As one student answered a question or solved a problem, others got to see the solution and had a chance to comment on it or add to it. As with the lectures, this was similar to what might have happened in a face-to-face classroom situation, except that students had more time to solve the problem before having to answer.

One online approach which was useful in this course was, as part of their initial learning of the EIES system, having each student enter, as a conference comment, values of certain statistics which they were to determine by processing one of several system datasets. Students had to first read other students' comments to see what had already been done, then run an SPSSX job to get the information needed to make their own contributions. They simultaneously got experience on the system and obtained information necessary later in the course.

I believe that the use of the virtual classroom approach in this particular course was moderately successful. The students did as well in their understanding of material presented online as they did with the in-class material, but probably felt for the most part that the EIES system was just one extra obstacle rather than a valuable alternative method of delivery of the course materials.

I don't believe that this rather pessimistic assessment is inherent in the concept of the virtual classroom, however, but rather was due to problems specific to this particular course, section, semester, and approach. As mentioned above, my approach was largely to present brief lectures online. While even this has some advantages - the student has (hopefully) good notes without having to take them; lectures can be "heard" at any time convenient to the student - more interaction is necessary to properly use the medium.

In a course in data analysis (or statistics or mathematics), there are somewhat different needs in the classroom, whether real or virtual. "Opinions", whether those of the instructor or fellow students, are not so important as is gaining an understanding of how to solve problems. Thus, while an instructor in a humanities course might say "What do you think of this?" and have students reply online via conference comments (and perhaps read those of other students), what needs to be commented on in a statistics course are answers and methods of solution. What this probably implies is that online dialogue should be largely student with instructor rather than student with student.

A problem with using a system such as EIES in just a small part of a course, as was done here for experimental reasons, is that the time the student has to spend to learn and feel comfortable with the system is too large a percentage of the total periods and associated homework time learning the system would be reasonable if the whole course, or a major part thereof, were going to be given online, but for minor use only students see time spent learning use of the system as time lost from the main purposes of the course.

The biggest problem to be overcome for this method to be successful in any course, however, is the equipment problem - each student must have access to the EIES computer from work or home. With the students in this class, all of whom lived off campus and worked full time, and in a course which normally meets only every second Saturday, the virtual classroom concept is in theory the perfect course delivery method. However, except for 3 students who had access to a computer terminal elsewhere, the students had to make special trips to the Upsala campus to use the College's terminals, defeating completely the stated advantage of ease of access.

# COMPUTERS AND SOCIETY (NJIT CIS 350)
Starr Roxanne Hiltz

This course was added to the project for two reasons:

a. The project director wished to have firsthand experience using the prototype Branch software with an actual class.

b. Low enrollments in other courses had resulted in the availability of EIES accounts to support this course.

For most of the semester, the online conference was used only in "adjunct" mode, with online activities in addition to regular classes. Very heavy use was made of BRANCH.

The first week, the students had only to find the conference, read waiting comments, and enter a comment introducing themselves.

The second week, the use of optional or remedial and supplementary "read branches" was introduced. These were used several times a week. They consisted of electronic versions of inclass lectures and optional additional material. The students were also invited to ask questions or bring up any issue they wished to discuss-- nobody did. Unless you ask specific questions or give specific directions, new students in an electronic classroom do not tend to initiate anything.

The third week of the course, there was a required assignment online. All students had to read a "read branch" and respond to an essay question on it in a "response branch" that required their response before seeing the responses of others. They were told that they would be graded only on their own independent response, but that they were free to subsequently also respond to answers by other students. All students sucessfully completed this assignment but only one voluntarily responded to the responses of others. NJIT students, at least, seem to respond only to grade incentives; they claim in conversations that they are too busy to pursue optional activities that are not related to grades.

For several weeks, online activity continued with announcements and discussions related to written assignments and the in-class midterm. Students were given over a month to prepare for the major online activity, which would count for 25% of their grade in the course. This activity was due by the second week in April, during which time there were no regular classes and all class activity took place online. First, students had to use a response branch to post and get permission for a topic for presentation, alone or in partnership with one other students. This topic was to be taught to the class online, completely by them. Examples are "computers and music," and "computers and the military." Each student or team of students would have to enter a "read branch" with the presentation, and a response branch asking questions. An important part of the assignment was that grading would be not only on the presentation, but also on the quality of the questions and on the number and quality of their responses to the questions of other students. Here is the exact wording of the assignment, which was quite successful:

*** The Assignment ***

Here is a review of the expectations and grading on your independent work- student presentation, which I went over in class today.

1. Many of you have not yet chosen a topic. Please enter your proposed topic as a RESPONSE to branch 14, BEFORE THE END OF THIS WEEK!

2. When your topic is approved, begin gathering the journal articles or books, and entering your draft material into your assigned pages in n105. Use a separate page for each section of the report. Edit and format until it prints nicely!

3. By Monday, April 14, you are to have entered two items into the branch system. One will be a "read" branch. The read branch asks you for titles of sections of your presentation, then lets you use material previously composed (e.g., pages of n105). Your presentation should be maybe 3-5 pages, in which you summarize the technical aspects of the application you are reviewing, and any available information about how the type of system is being used, by whom; advantages, disadvantages, etc. Your job is to make a clear, concise presentation of the facts and issues; you are the "teacher." Enter your bibliography (reference list) as a separate section of the "read" branch you create. This will count as 60% of your grade.

3. Create a RESPONSE branch in which you ask one or more questions in order to inspire a discussion/debate of one or more controversial aspects of the application of your type of system.

4. Read the other students presentations and respond to their questions for discussion!

The objectives of this "branch" software are to allow you to receive the material at your own pace and preferred times; and to encourage active participation in discussion among the class.

20% of your grade will be based on how well you are able to phrase or identify interesting issues and pose them for discussion.

20% of your grade for this assignment will be based on how actively and well you respond to the questions raised by the OTHER students!

*** End of Assignment ***

The assignment is deemed "successful" in that the quality of the tutorial material, questions, and responses entered by the students was very high. Though no specific "quota" had been posted, several students engaged in extensive activity in the response branches, far beyond what would be necessary to meet the requirements of the assignment. The students seemed to become enthusiastic when they realized that they were indeed, "teaching themselves" in a group learning environment. The only aspect of the assignment which did not work well were the team presentations. These tended to be two independently composed parts, stuck together, with no transitions and frequent redundancies or omissions. Students obviously needed some coaching and more experience with true co-authoring, which was a new experience for them.

If I were to offer this course partially or wholely online again, I would include two major assignments of the same type (presentation and required questions for response.) However, the first would be by individual students, and the second, by pairs of students. The second would be preceded by some suggestions and guidelines for how to go about producing a truly joint or coauthored set of materials.

# Courses Offered by Connected Education, Inc.

Paul Levinson

This past year we offered twelve graduate and undergraduate courses entirely via computer conferencing to 70 students across the US in California, Nevada, Colorado, Illinois, Wisconsin, Delaware, Rhode Island, New Jersey and New York -- and from many parts of the world including Japan, Singapore, the Middle East, South America, Central America, and Canada. Most of our participants are professionals in the business, public sector, and educational communities, and all took full credit courses without interrupting their daily activities, in the privacy and convenience of their homes or offices. Word of our exciting program has been carried in such publications as Business Week, InfoWorld, PC Week, and BYTE, and by such writers as Isaac Asimov.

Each course carries three New School non-matriculated credits, either graduate or undergraduate (graduate level requires greater on-line participation and more in-depth assignments than undergraduate credit, and assumes possession of a bachelor's degree). These credits can be applied either towards degrees at the student's own local institutions (assuming they agree to accept transfer credits) or towards degree programs at The New School itself, including the MA in Media Studies. In fact, qualified students can matriculate and pursue the MA in Media Studies degree through Connect Ed on-line courses. Students may also take these courses on a non-credit basis. Tuition is $286 per graduate credit and $268 per undergraduate credit. (Tuition is inclusive of all necessary connect costs except the local telephone call to hook into our conferencing network. New School registration fees of $60 for graduate course work and $20 for undergraduate apply. Not-for-credit fees are the same as undergraduate.)

A great advantage of the Connect Ed program is that any model computer and modem can participate with any type of telecommunications and word processing software. Our courses are conducted entirely in an electronic "computer conferencing" classroom environment, in which faculty and students enter comments and messages electronically in a continuing exchange throughout the course. During the two months in which our courses are conducted, students can read and retrieve material entered by faculty and other students, as well as ask questions of their own, any time of their choosing, night or day. Students in addition can communicate with faculty through private message systems, and there are facilities for "live", real-time exchanges between faculty and students. The result is a very stimulating intellectual environment, described by our students as akin to "top-notch seminars" and superior to most of the in-person courses they have previously taken.

All students have access to our on-line Connect Ed library, containing hundreds of papers pertinent to our courses and to computer conferencing. There is a student lounge, a place for students to speak openly about their concerns. And one of our most successful features is the Connect Ed Cafe -- a sort of electronic hang-out where you can mingle with other students, faculty, staff, and friends of Connected Education, for fun and serious conversation alike. Topics of discussion in the Cafe have ranged from the quality of fast food in New Jersey to the nuclear accident at Chernobyl in the Soviet Union. In general, the Connect Ed student will find an electronic campus environment that simulates and goes beyond the conventional in-person classroom and campus in many ways.

Courses taken for graduate credit will generally require at least two to three comments entered per week by students, and a midterm and final paper (to be submitted on-line or mailed) of at least 200-300 lines in length. Undergraduate credit will require entry of at least one comment per week, and only one paper of 200-300 lines, or two papers roughly half the size.

## Design of Interactive Systems (NJIT CIS732)
Murray Turoff and Richard Coll

There were two sections of this Ph.D. level course. One section was conducted off campus at a local company and the other on campus. One section was taught by the instructor responsible for the course and one by an instructor teaching it for the first time. Both sections made continous use of the EIES system over the whole period of the course.

Most of the students had access to the system from home or work and all had considerably more experience with use of computers than their undergraduate counterparts.

Since this group of students were not part of the funded activity, they all had Class two accounts which made their response time considerably less than normal users. As a result they quickly got in the habit of having one member of the class go through the BRANCH facility for the delivery of long items and have those photocopied for the rest of the course - human adaption to poor computer performance.

Both sections of the course shared the same two conferences. One conference was devoted to discussion and the other reserved for doing reviews of professional papers. Each student had to do two short reviews and one longer one on a paper they found to be particularly significant.

The branch feature was used for three response type questions and for the delivery of weekly outline lecture notes that ususally ran 200-300 lines per week.

During the last half of the course a visiting expert was brought in electronically. This individual was a professional consultant on Office Automation and each student was required to come up with question for this individual to respond to. This was a very effective generator of discussion.

It is the instructor's view that the use of the conference brought about a good consistency in the material delivered in both sections and reduced considerably the time the instructors would have had to spend with one another to bring about tha same level of consistency. Most of the assignments were the same for the two sections. Certainly all major ones were.

## APPENDIX: DATA ON INDIVIDUAL COURSES

School: Upsala College
Subject area: Sociology
Course name: Introduction to Sociology
Course number: SOC100
Instructor: Robert Meinke
Start date: February 8, 1986
End date: May 25, 1986
Number students: 21
Date pre use distributed: February 10, 1986
Date post use distributed: May 28, 1986
Mode (adjunct or all online): adjunct

School: Upsala College
Subject area: Computer Science
course name: Data Analysis
Course number: CIS300
Instructor: C. Lincoln Brown
Start date: January 19, 1986
End date: May 1, 1986
Number students: 12
Date pre use distributed: January 19, 1986
Date post use distributed: May 1, 1986
Mode (adjunct or all online): adjunct

School: NJIT
Subject area: Computer Science
Course name: Introduction to Computer Science
Course number: CIS213
Instructor: Brian J. Gleason
Start date: January 20, 1986
End date: May 17, 1986
Number students: 14
Date pre use distributed: January 27, 1986
Date post use distributed: May 12, 1986
Mode (adjunct or all online): adjunct

School: NJIT
Subject area: Computer Science
Course name: Computers and Society
Course number: CIS350
Instructor: Starr Roxanne Hiltz
Start date: January 20, 1986
End date: May 17, 1986
Number students: 14
Date pre use distributed: January 21, 1986
Date post use distributed: May 9, 1986
Mode (adjunct or all online): adjunct

School: NJIT
Subject area: Mathematics
Course name: Statistics For Technology
Course number: MATH305
Instructor: Rose Dios
Start date: January 20, 1986
End date: May 17, 1986
Number students: 9
Date pre use distributed: January 21, 1986
Date post use distributed: May 1, 1986
Mode (adjunct or all online): adjunct

School: NJIT
Subject area: Computer Science
Course name: Design of Interactive Systems (graduate)
Course number: CIS732
Instructors: Murray Turoff & Richard Coll
Start date: January 20, 1986
End date: May 17, 1986
Number students: 42
Date pre use distributed: January 27, 1986
Date post use distributed: May 7, 1986
Mode (adjunct or all online): adjunct

School: New School For Social Research
Subject area: Media Studies
Course name: Ethics in the Technological World
Course number: conference #1994
Instructor: Paul Levinson
Start date: February 1, 1986
End date: March 31, 1986
Number students: 8
Date pre use distributed: February 2, 1986 (by mail)
Date post use distributed: March 22, 1986 (by mail)
Mode (adjunct or all online): all online

School: New School for Social Research
Subject area: Media Studies
Course name: Telelaw
Course number: c#1895
Instructor: Brock Meeks
Start date: February 1, 1986
End date: March 31, 1986
Number students: 7
Date pre use distributed: February 2, 1986 (mail)
Date post use distributed: March 22, 1986 (mail)
Mode (adjunct or all online): all online

School: New School for Social Research
Subject area: Media Studies
Course name: Applications in Telecommunications
Course number: c#1983
Instructor: Tom Hargadon
Start date: February 1, 1986
End date: March 31, 1986
Number students: 13
Date pre use distributed: February 2, 1986 (mail)
Date post use distributed: March 22, 1986 (mail)
Mode (adjunct or all online): all online

School: New School For Social Research
Subject area: Media Studies
Course name: Computer Conferencing in Business and Education
Course number: c#2802
Instructor: Paul Levinson
Start date: April 1, 1986
End date: May 1, 1986
Number students: 14
Date pre use distributed: April 14, 1986 (mail)
Date post use distributed: May 15, 1986 (mail)
Mode (adjunct or all online): all online

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