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## ***Improving Instructor/Student Interaction With Electronic Mail***

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**E**ffective communication between students and instructors is the cornerstone of engineering education. Any innovation that can improve the quality of such interaction merits serious consideration. Traditionally, instructor/student interaction involved face-to-face classroom queries and discussions, office visits, telephone calls, and written notes, as well as encounters in hallways, lunch rooms, and at social occasions. We wish to report the results of a University of Arizona experiment that used a non-traditional technology, electronic mail, to supplement traditional modes of instructor/student interaction.

## The Problem

Students both on- and off-campus report insufficient communication with instructors. Forsythe and Wright discovered serious problems with instructor/student interaction when they evaluated the remote-video system used by National Technological University.<sup>1</sup> Their research revealed that many students and remote-site coordinators were dissatisfied with delays in returning graded materials, tests, and homework assignments. Many students also reported difficulties contacting instructors, and an astounding 80 percent of the students had no contact whatsoever with the instructor.

These same problems attributed to remote videobased education are often found in the traditional university classroom as well. Our research discovered that even in the traditional classroom, many engineering students are relatively passive participants who seldom interact with the instructor. A third of the students report they never asked a question in class. Outside the classroom, one-fifth never visited the instructor's office, and only a few students (13.2%) telephoned the instructor.

## Why Electronic Mail?

The University of Arizona's MICROCAMPUS is a video technology system that delivers regular university courses to off-campus students (usually in their workplaces) via videotape, microwave, and satellite. In struggling to solve these problems they have tried office hours when remote students could call instructors, occasional instructor visits to some remote sites, live (real time) "talk back" where students could interact with the instructor via a dedicated telephone line, and slow-scan video transmission.

Building on this experience and their knowledge of electronic mail, a small group of AU educators considered using electronic mail to supplement instructor/student interaction. Proponents of electronic mail and conferencing have long argued its advantages for information exchange and instruction.<sup>2</sup> Several universities use electronic mail to supplement classroom interaction and, recently, a few completely electronic conferencing universities have been established.<sup>3</sup> The Forsythe and Wright survey<sup>1</sup> discovered that an overwhelming majority of students (95%) and instructors (84%) expressed an interest in interacting by means of electronic mail or computer conferencing. What remained to be determined was how electronic mail would actually fare within a conventional classroom within an established university.

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## The Experiment

During the 1985-86 academic year, two professors in the Electrical and Computer Engineering Department experimented with the use of electronic mail in four courses: Data Communications Networks, Random Processes, Satellite Communications, and Detection Theory. Slightly over half the students took the courses on-campus in traditional classroom settings. These lectures were transmitted by video to the rest of the students, who were located in remote, off-campus locations. A talk-back telephone located in the remote classroom enabled off-campus students to ask the instructor questions during the class period.

Almost 80 percent of students had previously taken videobased instruction. Though two-thirds of the students had at least some experience with electronic mail, off-campus students were more familiar with this technology than their on-campus counterparts.

At the beginning of the course, the students were instructed on how to use electronic mail to communicate with the instructor and teaching assistant. (It should be noted that the original documentation provided to the students on how to use the system was poor.) Students were told that assignments, study guides, and special supplemental information—not covered in class—would be available through electronic mail and hard-copy handouts, which took three to five days to reach off-campus students. As an incentive to encourage them to use the system, homework assignment answers were available only on electronic mail.

The easy-to-use, but relatively powerful, VAX-VMS mail system was used. Students had relatively easy access to the system either through terminals in the department, throughout campus, or personal computers. Remote users had access to all features of the VAX and were on par with the local users with the exception of their telephone costs. Students as far away as New York were accommodated by the system.

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## Evaluation Method

Our objective was to compare the advantages and disadvantages of electronic mail with the traditional modes of instruction/student interaction both inside and outside the classroom. Outside classroom interaction included office visits, phone calls, written correspondence and electronic mail. Inside the classroom interaction primarily referred to spontaneous questions, whether from local students or via remote talk-back from off-campus students. Evaluation instruments included a questionnaire administered at the end of the course, a transcript of the electronic messages between instructors and students (without students names), and interviews with the instructors.

## Results

In the classes we surveyed, discussions between students and instructors ranged from information exchanges about assignments, career guidance, and non-academic topics, to work on complex problems (figure 1). Half the students reported they had questions concerning course content. No significant differences were discernible between on-and off-campus students in this respect.

During class time, however, students in the more traditional on-campus classroom were more likely to raise questions than their remote counterparts. Eighty-two percent of on-campus students occasionally asked questions, in sharp contrast to only 25 percent of the off-campus students.

Between classes, off-campus students obviously found it difficult or inconvenient to meet the instructors. Only a few (7%) visited the instructor's office, in contrast to 79 percent of the on-campus students who claimed they made at least one such visit during the semester. Both groups of students generally avoided the telephone; three-fourths of them never called the instructor. Of those who did, most were off-campus students (41% vs. 13%).

The experiment revealed that 70 percent of all students used electronic mail, and on-campus students used electronic mail almost as frequently as office visits to communicate with the instructors. Most students (82%), used electronic mail to gather information on assignments, homework answers, and other information. Only half (49%) actually exchanged messages with the instructor and/or teaching assistant. Off-campus students used electronic mail more frequently than on-campus students to send messages to the instructor (63% vs. 36%).

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Usage frequencies recorded on the VAX accounting system indicate considerable activity, recording the number of times a student runs the VAX MAIL program, but not what the student did while in the MAIL utility. By mid-semester, students were averaging 12.9 interactions on electronic mail per month (SD=9.24).

Qualitatively, instructors noted that more challenging questions, reflecting more thought, were raised by students using electronic mail. Instructors felt their own electronic responses were often of higher quality than those they provided off-the-cuff in the classroom. Instructors obtained another unexpected benefit from electronic mail, a complete transcript of student inquiries, which could be helpful in preparing future lectures. Figure 2 summarizes these qualitative results.

Students evaluating the experiment strongly supported electronic mail as a supplement to other forms of communication with the instructor, with eighty-eight percent rating it a "useful addition" to the classroom. Off-campus students unanimously endorse electronic mail, although twenty percent of the on-campus students do not share their enthusiasm.

Students were asked to rank their preferences for methods of communicating with their instructor (figure 3). On-campus students preferred face-to-face to other forms of communication, with electronic mail ranking second, followed by telephone calls and traditional written communication. Off-campus students were less discriminatory, showing comparable preference for either telephone conversations or electronic mail. The classroom remote talk-back option was less attractive, with written communications the least desirable.

Several students appreciated the relative certainty of contacting the instructor through electronic mail rather than playing telephone tag. Others enjoyed receiving study guides in a timely manner, being able to ask a question day or night without having to travel to the instructors' office, and avoiding the need to make appointments to ask two or three questions.

Students who disliked electronic mail found it too impersonal, required them to find a terminal, or forced them to type. Others (16%) complained of technical problems, poor on-line editors, and other system features.

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Students recommended improvements to the system, including a list of all students in the class to help them contact each other. They also suggested access to a printer at some terminal areas (to obtain a hard copy of their communication) and acknowledgment to the sender that the message had been received. One student campaigned for a "modem in every pot."

### Cost Considerations

While the costs of using a mail program on an instructional computer are difficult to specify in absolute terms, when electronic mail is used on an existing computer for instructional use, the cost appears nominal. Disk storage proved no problem, since the VAX has excess storage space. Heavy users of the mail program had about 10 percent of their allocated space devoted to mail files. Typical users had half that.

The computing capacity required to send a mail message, or check and read new messages, amounts to about half that needed to compile a typical student FORTRAN program. Since the students do not use mail nearly as much as they compile programs (the relation was not studied but is probably an order of magnitude or more), electronic mail does not seem a considerable burden for the computer.

Hidden savings also occurred within the department. Instructors or teaching assistants can type assignments directly into the mail system, bypassing the wait for secretarial time and photocopiers. Once entered, assignments can be saved and reused with little or no alteration. Instructors used their office time more efficiently, since handling multiple student inquiries via electronic mail bypassed office visits and telephone interruptions. Teaching assistants also became more efficient, responding directly to student questions or referring selected queries to the instructor. Likewise, instructors could review the teaching assistant's interaction with the students.

## Conclusions

The experiment suggests that students overwhelmingly prefer electronic mail to supplement their interaction with the faculty, that electronic mail improves the quality of instruction, and that electronic mail is easy and relatively inexpensive to use in many classroom situations. Moreover, electronic mail saves faculty time and department resources.

Based on this limited experiment, we are not ready to recommend that instructors abandon the classroom, drop their office hours, ignore their telephones, and videotape their lectures, while settling back to answer their electronic mail. This experiment does suggest, however, that use of electronic mail can supplement and significantly improve the quality and frequency of instructor/student interaction. Electronic mail merits the serious consideration of engineering educators.

## References

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Figure 3: Student Preferences of Media for Communicating with their Professor.

Media	Location of Student			
	ON-CAMPUS (N=32)		OFF-CAMPUS (N=25)	
	Rank	Rating	Rank	Rating
Face-to-Face	1	1.06	-	N/A
ELECTRONIC MAIL	2	2.47	2	2.08
Personal Phone call	3	2.97	1	2.04
Remote Talk-Back	-	N/A	3	2.48
Written Note	4	3.53	4	3.36

Sample Size = 32 on-campus and 25 off-campus students.

Note: Ratings are on a 1-4 scale, 1 = most preferable

N/A

\* The questionnaire responses permitted off-campus students to rank face-to-face interaction, which some might argue should not be considered a viable option for these students. With the face-to-face category included, the results are: (1) face-to-face, 2.54; (2) personal phone call, 2.69; (3) electronic mail, 2.73; (4) remote talk-back, 3.15; and (5) written notes, 4.00.