8. SYPOSIUM ON EVALUATION OF EDUCATIONAL SOFTWARE

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The effectiveness of computerized instruction at the college level: Five suggestions for successful implementation

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Although the literature suggests that computers cannot completely replace traditional learning environments, a closer examination of factors that confound method with medium offers new research avenues for successful implementation of computer-based learning at the college level. Five suggestions for successful implementation of computers in the university setting are discussed.

Attempts to integrate computers into higher level education are evidenced by the growing number of computer learning centers on college campuses and the allocation of federal funds to individuals working to train instructors in the implementation and use of computers in the college classroom. The purpose of this paper is to provide reasons and suggestions for implementing the computer at the college level. The difficulty in presenting these suggestions is that I may be in the position of preaching to the choir. The very name of this society (and journal) suggests a bias in favor of teaching psychology with computers. Perhaps this paper will be more useful if viewed as an outline for apologetics to be used when one must defend computer implementation to colleagues and administrators. This talk might better be titled "How to Win Colleagues and Influence Administrators." Allow me to review five suggestions for the successful implementation of computer-assisted instruction (CAI) and computer-based instruction (CBI) at the college level.

First, one should emphasize the resources that are conserved with CAI and CBI rather than those that are lost. Although the haphazard implementation of computers into courses can result in wasted time and money (Castellan, 1986; Eamon, 1986), numerous studies have shown that once computers are integrated into a course, teachers are freed from technical duties involved in the preparation of demonstrations and experiments. Students also have the opportunity to utilize time effectively. While more advanced

students can work through a computer program quickly, students who need more time to study the demonstrations and examples can work at a pace suited to their needs. It has been shown that CBI is particularly time efficient and cost effective at the University of Georgia, where professors must travel to off-campus sites to teach some courses, and where many students must travel long distances to take courses on campus. Foell (1989) found that teaching an off-campus curriculum development course by computer cost 34% less than did teaching it more traditionally. The data showed no significant differences in exam scores between the two groups. In addition, 48% of the experimental group said that they favored taking the course by computer and 37% were undecided.

Second, one should choose software wisely and involve teachers in the evaluation of it. In conducting a study in which I compared CBI with traditional delivery, I noted that students quickly lost interest in software that essentially consisted of text transferred from a workbook to a computer screen. The students glossed over programs that demanded they read multiple screens of text, but they paid careful attention to screens that contained interactive examples or provided review questions with immediate feedback. In our research at the College of William and Mary, Cynthia Null and I found that even when students using a computer were told they would be tested on material presented by computer, they hurried through the screens of text and spent time on the demonstrations and test items, both of which bore more resemblance to video games than to textbooks. As Tepas told us in his 1991 discussion of empowering people with computer technology (Tepas, 1991), people want to work, but they want the work to be interest-

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ing. In this day of video technology, software must be evaluated for components of feedback and student interaction. One possible way to increase teachers' interest in the use of computers to deliver information is to introduce them to authoring language software so that they can construct programs suited to their own needs. Such an approach has been implemented successfully in the Department of Education at Boston College (Junkala, 1991) and at a center for technological education in Israel, where teachers are required to take a year-long course in which they are taught to develop and evaluate software (Ronen, 1990). The program has produced favorable attitudes among instructors toward the use of computers in the university.

Third, one should be wary of the argument that students fear computers. I have found no studies that support this notion. In addition, pre-post studies of students' attitudes toward computers before and after the use of CAI indicate that students have favorable attitudes and usually endorse CAI or CBI after the computer has been introduced. Boh, Pitterle, and DeMuth (1990) found that pharmacists developed positive attitudes toward CBI after utilizing the computer for a continuing education course at the University of Wisconsin. Similar results were obtained at the University of Delaware, where students using CAI in a basic statistics course not only earned exam scores comparable to those of students taught traditionally, but also developed strong positive feelings about using computers, which they said helped them understand the course material better (Hollowell & Duch, 1991). It may be that the problem of attitude, like the often cited problem of novelty, is not as great at the college level as it might be at the secondary school level, where CBI has been less effective (Kulik & Kulik, 1987). At the college level, students are more likely to have had experience with computers. In a study of pharmacy students, for example, Anderson-Harper and Popovich (1990) found no relationship between students' attitudes and exam scores. Eighty-six percent of the students had used a computer prior to enrolling in the course. One possible reason why students may report fear of computers is that they may fear, not the computer per se, but the course in which the computer is implemented. Black (1988) has reported that computers are used disproportionately in mathematically oriented courses such as statistics and research methods. In the assessment of students' attitudes, the type of course in which the computer is utilized must be considered.

Fourth, one should be careful not to limit the use of computers to CAI such as tutorials, drills, simulations, demonstrations, experiment generators, and statistical analyses. With careful consideration of software, as well as of students' and teachers' expectations (Castellan, 1986), CBI too can be used effectively. Brazier (1989) found that the use of computers and handouts to teach an operant lab course allowed laboratory activities to be expanded, allowed the lab to include more information, and freed the instructor from technical duties. As noted previously, CBI was implemented successfully in a continuing education program for pharmacists at the University of Wisconsin (Boh et al., 1990). CBI is often considered unthinkable, because individuals assume that a teacher adds a unique component to

the course. The preceding examples, however, point to students' satisfaction with CBI. In fact, Foell's (1989) study of off-campus teaching showed that people in the experimental group rated the teacher as highly as did students taught traditionally. It is also possible that studies showing more success among conventionally taught students reflect the method more than the medium. For example, the study that we conducted at the College of William and Mary (Welsh & Null, 1991) tested the effectiveness of CBI in an experimental psychology laboratory course. Although the traditionally taught group performed better on test questions, we could not tell whether this was a factor of better medium, or whether the traditionally taught group simply spent more time doing the laboratory project. Social norms dictate that a student sit through a class period in its entirety. Whereas the traditionally taught students were expected to listen to a 10-min introduction (which was read verbatim from the software package), to complete a 30-min experiment, and to sit through a review of each question, the students in the computer group knew that they could go home as soon as they had finished the lab assignment. If they pressed the Enter key, they could skip through the instructions, examples, and discussion of the project and simply work on the test questions. The teacher in the traditional group may have represented nothing more than a police officer requiring the students to pay attention to the presented material. The students in the computer condition may not have felt compelled to listen and learn. This problem was alleviated somewhat by requiring a graded APA-style report of the lab; the computer group, however, still paged through the lab screens quickly. A graded exam with interactive practice questions done on the computer could highlight the advantages of CBI more precisely. For example, CAI is not constrained by limited class time. Reed-Sanders and Liebowitz (1991) have pointed out that one advantage of using CBI is that computers can test one's understanding of course material before exam time, a practice often absent from the talking-teacher, text, and chalkboard method of delivery.

Finally, one must continue to investigate CAI and CBI! On the one hand, it may seem that there is no point in doing comparative research because the confoundings involved in separating the method from the medium appear overwhelming. Concerns that CAI or CBI evaluations serve only to evaluate particular software packages and not CAI or CBI per se also steer people away from conducting comparative studies. Outlining these factors will help us implement CAI and CBI better and convince others to do the same. In 1986, Eamon told us not to assume that everyone was implementing CAI and CBI successfully. Today, I warn you against assuming that the computer simply cannot assist or, in some cases, replace teacher instruction at the college level.

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