Effects of teaching an introductory psychology laboratory using a computerized research tool

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In the introductory psychology laboratory at Drexel University, we employ courseware modules that transform the computer into various pieces of psychological research equipment. Students enrolled in this course use the courseware modules in a series of experiments that investigate motor learning, perception, memory, and other psychological phenomena. In choosing this form of computerization, we have encountered challenges to our methods of instruction, both in the laboratory and in the lecture hall. Opportunities, in the form of financial and programming assistance, have also resulted from our computerization efforts.

Castellan (1983), Collyer (1984), and Hewett (1986) offered guidelines for the construction of courseware to be used in the teaching of psychology. These guidelines address the types of programs that should be created to enhance student thinking, learning, and understanding. Adherence to these guidelines results in courseware applications that can transform the computer into a tool for working with information.

Within these guidelines there is one rule that developers of courseware hold to be very important: Design courseware so that through its use, the student becomes an active learner, involved with and manipulating the information, as opposed to a passive learner who simply receives information. "Activity" means more than pushing keys on the computer's keyboard in response to stimuli or questions; it means being fully involved with a task in an intellectual sense, as in elaboration of incoming information or conscious reflection of experience (Piaget, 1965/1970). Piaget suggested that it is in this highest level of cognitive activity that learning and understanding are most likely to occur.

In this paper we present a case study of the use of psychology courseware in the laboratory at Drexel University, with special attention given to the teacher's role in encouraging students to reflect on their experiences as subjects.

DEVELOPMENT OF THE PSYCHOLOGY LABORATORY

We began to use computers in the laboratory component of introductory psychology classes in 1984. Groups of 15 students with individual Macintosh Plus Computers perform different psychological experiments, using 12 courseware modules created by Douglas L. Chute, who served as the courseware architect, and the Drexel Univer-

sity Software Development Group, which completed all of the programming (Chute, 1986; Perkey, 1986).

The decision concerning what to computerize was facilitated by the existence of a class-tested, pedagogically sound package of instructional materials brought to Drexel by Chute. (These materials had been developed and continually refined for nearly five decades by Robert S. Daniel, Professor Emeritus of Psychology, University of Missouri, Columbia.) The purpose of the materials was to give students hands-on instruction in experimental design and research methodology. The text used in the original course supplied the structure of experiments to be performed. Traditional pieces of research equipment, such as reaction timers, tachistoscopes, mirror tracers, and pursuit rotors, were used in the experiments to demonstrate perceptual and cognitive processes and motor learning. In the 1972, 1974, and 1985 editions of the laboratory manual, Chute made changes and revisions that permitted the computer to be integrated into the course (Chute & Daniel, 1988b). Now the revised instructional package, called "MacLaboratory for Psychology," includes a student laboratory manual (Chute & Daniel, 1988a); instructor's notes for beginning teaching assistants; 12 courseware applications, which replace the pieces of research equipment mentioned above; and comprehensive courseware documentation.

Each year, approximately 1,300 students enroll in the introductory course. Students progress from serving as subjects in experiments and completing homework assignments to designing and performing their own individual research projects. Homework assignments require students to define the psychological concepts examined in each experiment, define and identify experimental design components (e.g., independent, dependent, and control variables; standardized procedures), and perform statistical tests on the data collected.

The introduction of the computer and courseware into our curriculum brought both direct and indirect effects that caused us to evaluate our teaching methods in both the laboratory and the lecture hall.

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DIRECT EFFECTS OF THE COMPUTERIZATION OF THE LABORATORY

Teacher Training

Graduate students serve as instructors in the laboratory. Few have had previous teaching experience, and their computer experience is generally limited to the use of statistical applications in undergraduate experimental psychology courses. Some have word processing experience.

Prior to the fall term all instructors participate in a 2-day training seminar conducted by the courseware architect and the members of the Software Development Group. In this orientation, the graduate-student teaching assistants are introduced to the Macintosh and the MacLaboratory package. Training continues throughout the term in weekly meetings conducted by a senior instructor, also a graduate student, who has had experience in teaching the laboratory. These sessions familiarize the instructors with the specific content of each experiment and the operation of the courseware; however, most of the training on how to teach and how to use the computer as an aid for instruction occurs in the laboratory itself.

Learning how to exploit the instructional capacities of the courseware applications was a very slow process because of two problems consistently encountered by students: (1) insufficient time to complete the experiment during the laboratory period and (2) difficulty in coming up with ideas for the individual research project. What follows is a description of the events that led to an understanding of how our version of interactive courseware could be used to meet the instructional goals of the MacLaboratory package and to address these two problems.

Meeting Instructional Goals in the Laboratory

The goal of the laboratory—to teach students to become better consumers of research and designers of their own scientific investigations—dictates that instruction be provided in the techniques of the experimental method, in statistics, and in scientific communication (Chute & Daniel, 1986). Within the limited time allotted to the laboratory session, the students must be given instruction in the methods of experimentation, enough information and direction to understand the task, and sufficient time to complete the task.

The problem laboratory instructors have in adjusting to the length of the class may be due to their natural inclination to want to teach psychology in the laboratory. However, the weekly 2-h lecture session of a course reviews the fundamental principles and concepts of psychology, and the associated laboratory session need not reiterate this material. Rather, it should permit the students to experience, observe, and measure the concepts and phenomena discussed in the lecture. In the laboratory, a brief introduction to the psychological content is all that is necessary to prepare the laboratory student to

investigate concepts. Much of the responsibility for learning, therefore, is placed on the student. Presentation of the course content activates knowledge structures in the student. Tools for exploration, in this case the computer, enable the student to become actively involved in the association and recombination of these structures to generate new understanding (Piaget, 1970).

A MacLaboratory Session

In a typical MacLaboratory session, students are introduced to a new psychological or behavioral phenomenon to be investigated, a new statistical test, a new apparatus, and an important component of experimental design or scientific communication. For example, a laboratory on the specialization of hemispheric function includes a brief description of the processing preferences of each of the cerebral hemispheres and how an individual's handedness, genetic heritage, and gender can influence the way his/her own hemispheres are organized. A discussion of the visual system follows so that students understand how perceptual information reaches each side of the brain. The computer is introduced during a discussion of the importance of the control of the location and duration of stimulus presentation in order to demonstrate each hemisphere's processing preferences.

The program begins with a target displayed in the middle of each screen. The student positions his/her head directly in front of the screen, covers one eye, and fixes his/her gaze on the target. With appropriate repositioning and moving about, the blind spot (exit point of the optic nerve) of each eye can be located. During the experiment, the student maintains the position of his/her head, determined by the location of the blind spot, and fixes his/her gaze on the same central target. Stimuli are then flashed on the right or left side of the target for a duration of 250 msec. Maintenance of the head position and fixing the gaze on the target ensures that the stimuli are detected by the appropriate hemiretina and perceived by only one side of the brain. A string of letters serves as the verbal stimulus to be perceived by the left hemisphere, and small icons serve as the spatial stimuli for detection by the right hemisphere.

After each stimulus disappears from the screen, the student is required to choose the characters in the stimulus string from an array displayed on the screen. The responses are recorded and stored in data files on the disk. The students transfer this data over to tables provided in the laboratory manual in preparation for statistical analysis.

Teaching With the Computer

For some students, using a computer to become an "active learner" means only responding to stimuli appearing on the screen. To encourage the students to achieve insight into this activity and to place this activity into a theoretical framework, the instructor must act as a guide. The instructor must also provide leading questions

designed to make the students aware of the nature of the processes evoked through their interactions with the computer. The role of the instructor is akin to Posner and Osgood's (1980) "going further" exercises in the University of Oregon's Inquiry Training Program, in which students are encouraged to ask a wide variety of "what if" questions after using a courseware module. When our students ask these types of questions, they are encouraged to follow them up in their own research.

For example, one instructor asked the students to describe their perceptual experience in the hemispheric laterality laboratory discussed above. One student reported that he was attaching verbal labels to the spatial stimuli (small icons) used in the task, and felt that he was therefore processing the spatial stimuli also with his left hemisphere. After further discussion with the laboratory instructor about what type of stimuli could be substituted to remedy the problem, the student redesigned both the verbal and the spatial stimuli to resemble those used by Posner and Mitchell (1967) and Gross (1972). The modified task required "same" or "different" responses to pairs of letters and pairs of random dot patterns. This change made by the student resulted in a better demonstration of laterality, and will eventually be implemented in the courseware module.

INDIRECT EFFECTS OF THE COMPUTERIZATION OF THE LABORATORY

Initially, the changes in the structure of the introductory course received mixed evaluations. Some of the adjunct staff, which is made up mostly of practicing clinical psychologists, did not see the importance of having a laboratory, and did not exert much effort to provide the necessary continuity between the content of their classes and the laboratory sessions. Therefore, some students questioned the relationship between the two parts of the course. Other faculty members accepted the lab. Our experience, therefore, indicates that a concerted effort must be made to involve as many faculty members as possible when integrating the computer into the classroom or laboratory.

The decision to develop courseware as a portable, multifunctional tool (Hewett, 1986) has also produced other indirect effects. For example, the undergraduate experimental psychology course uses some of the courseware modules, so the demand for the single pieces of traditional research apparatus is reduced. In the graduate-level cognitive psychology course, students are asked to create a stimulus file for the hemispheric function application (discussed above) to test which hemisphere processes information logically, if there is lateralization of this type of processing at all. In the same class, graduate students are presented with a demonstration followed by a discussion of the operation of neural modeling templates (Hewett, 1985). This module is also a part of the MacLaboratory package.

Other indirect effects of computer integration have evolved from the willingness of the Drexel University administration to support the use of the computer in teaching. As a result of choosing to develop courseware for use in the classroom, the Psychology/Sociology/Anthropology Department was supplied with 15 Macintosh computers for use in the lab, continuing programming support from the university's Software Development Group (Perkey, 1986), and tuition remission for the graduate students who serve as laboratory instructors.

Full descriptions of the applications can be found in Chute (1986), Westall, Perkey, and Chute (1986), and Hewett (1985). Future directions to be taken in our laboratory include the networking of the computers with the MacLaboratory Controller so that the Macintosh may be interfaced with various peripheral apparatuses (Chute, Gaeman, & Ziegler, 1987). With this network in place we will be able to perform experiments beyond those described above.

SUMMARY

Getting the most out of using the computer in the psychology laboratory requires permitting the student to explore the information discovered while serving as a subject in the experiment. The instructor should merely serve as a guide. We have little evidence to suggest that using computers in the laboratory helps students to learn better. Although computers and the proper courseware modules can provide an active learning environment, students can be just as active with the traditional pieces of research equipment. The computer-based applications do, however, offer the following advantages: availability to a larger number of students, ease of modification so that varied hypotheses may be tested, and ease of data collection.

The courseware that we employ does not make the instructor's job significantly easier. There is still a need for individualized instruction and sensitivity to the individual student's learning style. New instructors must still spend time learning how to teach and learning how to use the courseware so that the computer may be used most effectively and efficiently as an instructional aid.

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