Computerized laboratories for psychology instruction: How successful are they?

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This paper discusses the impact of two computerized laboratories on the undergraduate psychology program at the University of North Carolina at Charlotte. An assessment of student and instructor reactions together with other measures of success is presented, and strengths and weaknesses of upgrading traditional psychology laboratories to computerized facilities are addressed.

Our department supports two instructional laboratories: a Research Methodology Laboratory, upgraded in 1981 with funds from the National Science Foundation's (NSF) Instructional Scientific Equipment Program; and a General Psychology Laboratory, upgraded in 1986 with money from the NSF's College Science Instrumentation Program. The grant funds were used to upgrade existing instructional laboratories to computerized facilities for the purpose of providing "hands-on" experience with a broad variety of research examples in psychology. We wanted to go beyond the use of such traditional lab projects as operant conditioning with a rat, mirror drawing exercises, and pursuit-rotor, memory-drum, and reaction-time tasks, and expose students to contemporary research in psychology. Also, in the Research Methodology Laboratory there was the added objective of removing the frustration involved in teaching students about data analysis. In the traditional lab, data analysis was handled through the use of calculators and campus mainframe computers, and the experience was tedious and frustrating for both the students and instructors. Our department's overall objective was to make our labs more efficient. Providing enough equipment and supplies to run traditional undergraduate labs was costly in money and in instructor time.

The computerized laboratories have been operational for several years, and we have given some thought to their departmental role. The first question, of course, involves how well the objectives of the lab have been met. To provide hands-on experience in psychological research in the required sophomore-level course in Research Methodology, we developed an eight-room suite with individual microcomputers—an Apple IIe microcomputer plus a printer in each room. The layout was intended to provide a suitable environment for the conducting of research in laboratory sections with 25 students. We average 75 stu-

dents per semester in three sections of this course. The Research Methodology Laboratory is scheduled for use by each section for a 2-h class period each week.

A major factor in the successful implementation of this lab was a ready supply of software. We purchased "ready-to-run" software that could be used for: (1) lab exercises that demonstrate contemporary psychological research, (2) statistical analysis, and (3) computer-assisted instructional (CAI) lessons that offer repeated practice with conceptually difficult material. The success with which we accomplished our goal can be seen particularly in the size of the software library that supports the lab. In 1981, when we upgraded the lab, we installed 16 programs that included lab exercises, data analysis programs, and CAI lessons (Goolkasian, 1985). The present library consists of over 29 software programs. We readily take advantage of new programs as they become available either in the public domain or from commercial vendors. In particular, we have been interested in adding open-ended software exercises—that is, programs that allow the students to construct experiments of their own design, using the microcomputer as the scientific instrument. Such programs as the Apple Pascal Tester (Poltrock & Foltz, 1982) and the Test and Questionnaire Construction Kit (Meier & Geiger, 1986) are examples that add an element of vitality and flexibility to the laboratory experience. Also, we have developed our own software whenever necessary. For example, we have developed a lab exercise that administers and scores a state-anxiety and a test-anxiety inventory. This program demonstrates computerized test administration and scoring, and it is used in a correlational exercise in which the student's scores on the two anxiety tests are correlated with each other and with other measures such as course grade and GPA.

Student and instructor reactions were collected by means of a short evaluation form distributed in the first semester during which microcomputers were used. Seventy percent of the students agreed that the lab exercises made it easier to learn the material in the class, and 67% agreed that the lab exercises represented an important learning experience. Although there was a difference in opinion regarding whether the lab time was well spent, an overwhelming majority (82%) of the students disagreed

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with the idea that the lab was a waste of time. Written comments by the students indicated that they enjoyed the opportunity to use the microcomputers. When the evaluation instrument was again used in a 2-year follow-up study, opinions were found to be relatively unchanged. The students showed an overwhelmingly positive reaction to the computerized laboratory.

Instructor reactions were also quite positive, even though the ways in which the lab was being utilized varied. Some instructors used the microcomputers as a means of providing students with hands-on experience with psychological research, while others emphasized their value for data analysis. The instructors were unanimous in their opinion that teaching with the lab was a stimulating and exciting experience, and that the lab provided the students with necessary practical experience in research methodology.

Another measure of success for this facility has been the degree to which it has benefited instruction in other courses. This lab is used for demonstrations in our more advanced courses (e.g., Sensation and Perception, Learning, Human Cognitive Processes, Psychological Assessment, Research Design), and it is also used by students who enroll in independent research. Such spinoffs were not as apparent with the previous noncomputerized laboratory.

However, despite the positive reactions on the part of our faculty and students, other independent measures such as course evaluations, course grades, and enrollment were not affected by the upgrading of the laboratory experience. It was obvious that the computerization of the laboratory experience did not influence the students' perceptions of the Research Methodology course, and that it did not significantly affect performance on course examinations. As with other course improvements, the students responded positively to the specific evaluation of the lab experience, but their general impression of the overall course was unchanged and specific to the instructor.

On the basis of our experiences with the Research Methodology Laboratory, we again sought funds from the NSF to upgrade our much larger General Psychology Laboratory. The General Psychology Laboratory is a three-room suite that consists of two classrooms and a central room containing 36 microcomputers housed in study

carrels. A local area network connects the microcomputers to a hard drive, a tape storage device, and nine printers. More than 500 students enroll in 22 sections of this laboratory each semester.

The software library includes over 30 programs stored on a hard drive. In addition to the three categories of software mentioned above, we also use simulations of psychological phenomena in this lab. Our goal was to supplement the general psychology lectures with demonstrations of contemporary phenomena. We asked the students to evaluate each of their weekly exercises during the first semester that the lab was implemented (fall, 1986). These data are reported in Goolkasian and Lee (1988), and the students' comments were incorporated into changes that were made in the following semester.

In addition to utilizing student ratings, we have also tried to assess the effect of the CAI lessons that we developed. For example: A measure of the effectiveness of the lesson "How to write a research report" can be taken from the students' success rate in writing four required laboratory reports on projects conducted throughout the semester. The students interact with the computer lesson to learn what information to include in the abstract, introduction, method, results, and discussion sections. They do not receive additional instruction on this topic, other than through occasional questions that they direct to the lab assistants. Also, the majority of students enrolled in this class are freshmen, who very likely do not learn much about writing research reports in their other classes. Each report is graded and returned to the student by the lab assistant. The percentage of the 462 students enrolled in this lab during the spring 1987 semester who received a passing grade on each of the four lab reports are as follows: 92%, 92%, 90%, and 92%.

General Psychology Laboratory provides laboratory experiences prerequisite to the more advanced courses in psychology. The impact of this laboratory is felt particularly in our sophomore course in Research Methodology. We conducted a survey of the students enrolled in Research Methodology during the spring 1988 semester, in order to evaluate the effectiveness of General Psychology as a preparatory experience. Table 1 presents the results of that survey, analyzed in relation to the time when the students took General Psychology. The students who

Table 1
Student Attitudes Regarding the General Psychology Laboratory

Questions	Group		
	1	2	3
To what degree do you think General Psychology Lab ...			
(1) stimulated your interest in psychology?	3.17	2.66	2.42
(2) increased your anxiety about Research Methods?	2.07	1.60	1.97
(3) prepared you for Research Methods?	1.99	2.90	2.61

Note—Students were divided into groups on the basis of when they were enrolled in General Psychology Lab. Group 1 represents the 20 students surveyed who enrolled prior to the computerization; Group 2 consists of the 14 who were enrolled during the 1st year of the computerized lab; and Group 3 represents the 10 students enrolled during the 2nd year. The numerical data represent the averaged weighted response to a 5-point scale, with 1 indicating "not at all," and 5, "very much."

took the lab after the computerized upgrade reported less anxiety about enrolling in Research Methodology, and they felt better prepared than did the students who enrolled in the lab prior to its computerization. When they were asked to comment on the strengths and weaknesses of the General Psychology Laboratory, the percentages of positive and negative comments were comparable before and after the computerization, with two notable exceptions. There were more negative comments about the student lab assistants after the computerization than before, and a number of students who were given the computerized simulation of operant conditioning indicated that they would have preferred working with a live rat in an operant conditioning project. The student response to the computer simulation was not as favorable as the student reaction to the operant conditioning exercise with the live rat. We are continuing with the simulated exercise, however, because of ethical concerns about using laboratory animals in routine lab exercises.

The supervision and training of the lab assistants have been strengthened to try to remove the student complaints. We have found that the student lab assistants in General Psychology tend to rush through the computerized exercises and are sometimes reluctant to answer questions regarding the material that is covered in the lab. To address these problems, weekly training sessions are held with the lab assistants in order to prepare them for the material covered in each laboratory and to provide feedback from a faculty instructor.

To summarize: the answer to the question posed in the title of this talk is that the computerization of our undergraduate laboratories has been a resounding success, not so much as a result of how much the students are learning in the classroom but because these labs have an effect that reaches beyond the one-credit laboratory experience that they were designed to improve. They have become a departmental resource for the improvement of instruction across our curriculum. We are experimenting with using the computer simulations and CAI programs for remedial training for our students during nonscheduled lab hours. We have developed a CAI lesson, "Introduction to Physiological Psychology," that mixes text with animated graphics to introduce students to the neuron, sensory-motor arc, central and peripheral nervous systems, and brain areas. Of all the topics in general psychology, the textual material on physiological psychol-

ogy is rated by the students to be the most difficult. Allowing the students to interact with this program provides another learning tool for those who have difficulty with the textbook presentation. The ready availability of microcomputers in the department has changed the way we teach data analysis. We no longer spend class time with routine and tedious explanations of working formulas for statistical analysis. We assume that students will take advantage of the available computer programs for practice with statistical calculations. Using a computer projector that mounts on an overhead projector, we can bring a micro into our classes and supplement the lectures with dynamic demonstrations of psychological phenomena. Computerized labs are successful, because with them faculty can incorporate the computer as a teaching tool and use it in many ways to improve instruction in psychology.

In conclusion, it should be added with respect to instructional labs that there are some advantages to using "trailing edge" technology. The experiences of others who have used that technology can be useful, and "ready-to-run" software for that system is available. Even when you write your own programs, there is still some advantage to looking at examples of what others have done, for when you are on the cutting edge, it is risky. Students tend to be pragmatic, and they do not always see the glamour of new equipment. From their perspective, they are unwilling participants involved with untested techniques that have a high chance of failure.

A successful instructor is one who allows students to move beyond their understanding of the material. When one uses CAI, particularly with tool-based software, this happens more readily than it does with the textbook, or through any other form of experiential learning.

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