Developing a microcomputer laboratory at a small liberal arts college

JOHN D. BATSON and GILLES O. EINSTEIN
Furman University, Greenville, South Carolina

This paper summarizes the development and initial implementation of a network of microcomputers for use by undergraduate psychology students at a small liberal arts college. We describe the hardware and the software, the general development plan, and some problems that should be considered by others who may plan to develop a similar laboratory.

This report describes the development of a microcomputer laboratory for use by undergraduate students in psychology. Although the laboratory serves a variety of purposes, its principal focus is on statistical analyses of data collected by students in courses and in independent research.

Background Information

A general description of our department will provide a context for a better understanding of our plans for the laboratory. Six faculty members teach approximately 8 sections of "General Psychology" and 20 sections of advanced courses over 3 terms in any single 9-month academic session. There are 16 unique courses in the curriculum, representing traditional content areas in psychology. Approximately 40 majors graduate yearly. In the past decade, 36% of the majors have entered graduate or professional programs.

Configuration of the Network

The network configuration is shown in Figure 1. Eight personal computer workstations are controlled by a ninth machine, the file server. Output devices are a Hewlett-Packard LaserJet printer and an 8-pen color plotter.

Each workstation is a Hewlett-Packard Vectra with an EGA color monitor, 640K RAM, a 1.2MB disk drive, and a 20MB hard disk. Each is equipped with a mouse and a math coprocessor.

Focus of the Grant: Statistical Analysis Early in the Major

Major funding of the project came from the National Science Foundation's (NSF) College Science Instrumentation Program (CSIP). The focus of the proposal was on student experiences in our PSY 22 course "Experimental and Statistical Methods," which normally is the second class taken by majors. PSY 22 is a cornerstone experience for our majors; it covers research methods, design, and statistics. The students collect and analyze data

Figure 1. Configuration of the network hardware.

and perform a variety of statistical procedures throughout the term. One goal of our proposal was to build a laboratory where they could learn basic procedures in statistical analysis packages. The package used thus far is the Statistical Package for the Social Sciences (SPSS).

For three years (1984-1987) before we established our network, students representing a subsample of those in PSY 22 were taught to use SPSS on the mainframe computer. This group generally had little or no experience with computers and none of the students had prior experience with SPSS. Thus, in addition to learning SPSS commands and procedures, they had to learn to log on and off; how to operate an editing system to build, modify, and save an SPSS batch file; and how to submit the job and direct the output to a line printer. During the course, four statistics homework assignments were made, which the students were required to complete with hand-held calculators as well as with SPSS on the computer. Before the first assignment, the students were asked to monitor the time required to complete each assignment by hand and by computer and to record these times on a data sheet that we gave them. They were also asked to rate their "frustration" in completing the assignment by hand and by computer (frustration was measured on a 5-point scale). Difference scores were formed for the time and the frustration variables by subtracting the computer score from the score for the calculations done by hand. Thus, negative scores indicated that the assignment took more time or created more frustration when done by computer than when done by hand.

Work supported, in part, by a special education grant from The Duke Endowment. Correspondence may be addressed to John D. Batson, Psychology Department, Furman University, Greenville, SC 29613.

Figure 2. Mean difference scores for time to complete the four statistics assignments. A positive score indicates that the assignment was done more quickly by computer than by hand.

Figure 2 shows the mean difference scores for time to complete the four assignments. The students clearly found the computer to require more time at first, but as the term progressed, the assignments were completed more quickly with the computer than by hand. The differences over successive assignments were significant [$F(3,159) = 29.02$, $p < .01$].

Figure 3 shows the mean difference scores for frustration during the completion of the four assignments. As was the case with the time factor, more frustration was caused by the computer initially, but the students gradually experienced less frustration when working assignments by computer. These changes in frustration were also statistically significant [$F(3,114) = 16.99$, $p < .01$].

The four assignments, in order, required that the students compute (1) general descriptive statistics, (2) t tests, (3) a one-way factorial analysis of variance, and (4) a two-way factorial analysis of variance. The data in Figures 2 and 3 are thus confounded with differences in the

Figure 3. Mean difference scores for self-scored frustration during completion of the four statistics assignments. A positive score indicates that the assignment caused more frustration when done by hand than when done by computer.

difficulty of the assignments. However, despite the fact that the assignments generally increased in difficulty over the term, the students quickly found that the computer saved more time and generated less frustration. These data clearly indicate that undergraduates can acquire relatively sophisticated computer skills as part of their methods or statistics courses.

Beginning this year, we are teaching the PC version of SPSS, which differs in a number of ways from the mainframe version. Unlike mainframe SPSS, the PC version is menu driven and may be operated interactively as well as in batch mode. The students will therefore have new opportunities to learn about data analysis.

Independent Research

A substantial percentage of our majors pursue independent research projects. Since 1980, students have made 80 research presentations at regional and national conferences. For each independent research project, substantial quantities of data are collected and the students utilize SPSS routines to analyze the outcomes. Thus, independent research reinforces earlier learning and provides the students with important professional experiences that will serve them well as they apply to, and later perform in, graduate programs.

Other Advanced Courses

We will continue to expand the ways our network can enhance learning in other, advanced courses. A number of instructional software packages are available for teaching concepts related to topics in courses on animal behavior, perception, cognition, learning, and social psychology, as well as on other subjects. Many of the CONDUIT packages, for example, make very good supplements to these courses.

General Benefits of a Centralized Computer Laboratory

In addition to the specific benefits in various courses, our computer laboratory has provided a number of other general advantages for the students. A readily available laboratory, along with a commitment among the faculty to use the laboratory, allows us to give the students a variety of exposures to computer hardware and software. After taking several courses that include computer assignments, the students become quite sophisticated computer users, and they develop a more thorough understanding not only of important psychological concepts, but also of how computers can be applied to a variety of problem-solving situations.

An additional benefit that derives from having several students work within the same laboratory is less tangible. For lack of a better term, however, one might call this the "camaraderie" factor. A number of students have reported informally how much they have enjoyed studying, working on statistics homework, or just getting to know other psychology majors when working with other

students at night or on the weekends. At a small college, a sense of "belonging" to the department is quite important; it often leads to sustained interest in some topic. Many students begin to get more serious about psychology in this way, and then spend more and more time in the laboratory.

Problems in Planning a Computer Grant Proposal

Although the NSF's equipment program, now the Instrumentation and Laboratory Improvement (ILI) program, is a great way to build a computer laboratory, many other issues and potential problems should be considered carefully before committing department resources to the project.

First, the NSF-ILI program is not cheap. Currently, the requirements are that for every dollar the NSF grants, the institution must commit at least one additional dollar.

Another potential concern is space. Even if a computer equipment proposal is funded, there must be room to establish the laboratory. On the other hand, an award for new equipment can sometimes be used to advantage in order to acquire new space. In our case, new space was provided by the administration, and extra funds were provided through The Duke Endowment Fund for simple renovations and for purchasing furniture.

A critically important issue concerns security. It should be impossible, or at least very difficult, for users to copy software from the system. More important is the necessity of keeping the software from being disturbed or destroyed. All of the software that our students use is available from the file server on a "read-only" basis, and output files are directed to the students' personal flexible disks instead of to the server.

Security also entails protection against uninvited customers. Students are increasingly sophisticated users of computers. Clear policies should be established concerning user priorities, and these policies should be strictly enforced.

The National Science Foundation does not fund equipment requests for word-processing. But any room full of computers will potentially attract multitudes of students who want to type term papers in the lab. Although word-processing can be a significant aspect of a computer laboratory, without continued vigilance a computer lab can quickly change from a science-education facility into a sophisticated typing center. We think that students should have access to word-processing software, but we believe that word-processing should be given the very lowest priority.

The use of computer equipment entails many recurring expenses, including service contracts and supplies. Replacement cartridges for the LaserJet printer, for example, cost more than \$100, and we use 6-8 of these per year. Thorough plans for a computer laboratory must include ways to cover these additional costs.

Summary and Conclusion

We believe that undergraduate students in psychology should be well acquainted with research design and statistical analysis. Although our lab is centered on the research methods and statistics course, many other students utilize the facility for purposes that range from experimental simulations to advanced statistical analysis for independent research. We heartily encourage other teachers to consider ways to enhance their academic program with computers and recommend the NSF's ILI program as a potential source of funding.