

Computer-Assisted Instruction: Is It an Option for Bibliographic Instruction in Large Undergraduate Survey Classes?

Joan Kaplowitz and Janice Contini

Developing effective library instruction for large undergraduate survey courses can be a difficult task. In 1993, librarians at UCLA's Louise M. Darling Biomedical Library decided to develop a computer-assisted library instruction program for the roughly 800 to 900 undergraduate biology students per year who are enrolled in the department's basic, required-for-the-major introductory course. A formal summative evaluation of the effectiveness of this CAI, as compared to the lecture method, also was developed. The evaluation utilized both a quantitative pre- and posttest design using objective questions and a qualitative follow-up survey featuring open-ended questions.



Developing effective library instruction programs that efficiently deal with large undergraduate courses is often extremely difficult. In 1993, librarians in the Reference Division of UCLA's Louise M. Darling Biomedical Library decided to develop a computer-assisted instruction (CAI) program to replace the library skills instruction sessions previously offered to the three hundred biology undergraduate students per quarter. This course, Biology 5L (Organismic and Environmental Biology Laboratory), is a required preparation course for the biology major. This instruction, which took place during the first week of each quarter, consisted of a fifty-minute lecture/tour following a two-hour field trip in which

undergraduate students were taught measuring and surveying techniques used by biologists. Many of these students are unfamiliar with the organization of the biology literature, yet the emphasis of their assignments in this course is on locating current journal literature. Because little formal evaluation of CAI effectiveness as a mode for library instruction appears in the literature, the biomedical library reference librarians decided to develop a formal, summative evaluation that would compare the effectiveness of the CAI process to the then in-place lecture-type presentation.

Traditional approaches such as lecturing to the whole class in a one-shot session or scheduling presentations for the typically smaller discussion or laboratory

Joan Kaplowitz is a Reference Librarian in the Louise M. Darling Biomedical Library at UCLA; e-mail: jkaplowi@library.ucla.edu. Janice Contini is Head of Reference at the Louise M. Darling Biomedical Library at UCLA; e-mail: jcontini@library.ucla.edu.

sections have both advantages and drawbacks. The large lecture hall approach ensures that everyone is exposed to the same material at the same time. It requires minimal personnel (usually only one librarian) and often is done in the student's own classroom, thereby minimizing the facility demands made on the library. However, large group presentations can seem impersonal and out of context. Moreover, it is extremely difficult to involve the students actively in the learning process. Although small-group presentations can be more interactive and personal, they are more labor-intensive for librarians, can be difficult to schedule, and can place enormous demands on both space and equipment. In addition, as the number of people scheduled to make the presentation increases, the consistency of the presentation can decrease.

The authors estimate that it took roughly five hundred hours of librarian time to design the program and an additional five hundred hours of programmer time to implement the design.

CAI has many characteristics that make it an appealing way to teach basic library skills to large numbers of students. It is interactive, self-paced, and self-directed, and gives students immediate feedback on their progress. Moreover, it presents exactly the same content to all students, thereby eliminating the unavoidable variations that can result when six or more instructors are involved in the lectures. Finally, CAI offers an alternative learning approach that may be appealing to students who have experienced only the lecture method.

However, development of a CAI program is not a trivial task. The time and expertise needed to design and develop CAI are crucial considerations. The authors estimate that it took roughly five hundred hours of librarian time to design

the program and an additional five hundred hours of programmer time to implement the design. An examination of the applications of CAI to library instruction revealed that most CAI addressed the notion of teaching some specific skill, most often use of an OPAC. The intent of the biomedical library's CAI project was to address larger, more global instruction issues such as the nature of scientific communication and methods of information access in the life sciences.

Online searches of the PsycINFO®, ERIC, and Library Literature databases revealed that very little has been done in the area of objectively evaluating CAI in general. Even less has been done in evaluating CAI applications to library instruction. Most evaluations are either formative and used as a feedback mechanism in the development process itself, or summative and deal primarily with the affective outcome of having students use CAI. Summative evaluations generally focus on whether the students liked the process, not whether they learned the material presented in this format. This probably is due to the fact that it is very difficult to assess the cognitive effectiveness of any library instruction. Although objective tests are easy to administer and score, the questions used to assess learning are out of context and do not necessarily test how well a student may function in a real-life situation. More qualitative measures, such as reviewing students' papers or projects, certainly assess a more real-life situation but are difficult to design and quantify. (For further background on this topic, please see the annotated, selected bibliography on the biomedical library's Web page: www.library.ucla.edu/libraries/biomed/adm/persons/caibib.htm).

The librarians involved felt strongly that the two modes of presentation had to be evaluated and their effectiveness compared before any recommendations could be made regarding elimination of the lecture mode in favor of CAI. The ex-

pectation was that CAI would be as good as or better than the lecture method in providing this type of instruction. The librarians also expected that the students would find the CAI experience more enjoyable and less stressful than the lecture method because CAI is self-paced and interactive, and makes extensive use of graphics.

Conceptual Framework for Instruction

In formulating the outlines for the CAI, the design team reexamined the conceptual framework that had been in use for the lecture. The standard lecture that had been in place for many years used a tool-based framework. After an initial overview segment that discussed scientific communication, types of material, and the elements of a citation, each major life science index was examined one at a time.

In discussing how to organize the CAI, the team began to question the tool-based framework. Ultimately, it was decided that the CAI would be more useful as a concept-based design, so the team developed a decision tree approach organized around the types of questions the students usually have. The CAI would illustrate how to use library materials based on what the individual student's information need was at the time. This seemed a more practical and real-life type of situation.

In addition, the supporting material that appears in the students' lab manual was reorganized along the same lines. The team then was faced with an ethical dilemma. Now that a new conceptual framework for both the CAI and the lab manual had been determined, what should be done about the lecture? For research purposes, the lecture should remain untouched so that the new technique could really be compared to the old technique. However, that would mean using what now was felt to be a less-than-effective conceptual framework with half the students. Ethically, the team felt that

the best possible instruction should be delivered to all students. Therefore, the lecture material was reorganized to match the conceptual framework being used in the CAI and the lab manual. Thus, all three modes of instruction (CAI, lecture, lab manual) used the decision tree model. However, this decision, which undoubtedly was beneficial to the students, ended up interfering with the ability to really evaluate the relative effectiveness of the different modes of instruction.

Methodology

The Biology 5L evaluation featured a pre- and posttest design directed toward examining both the affective and the cognitive outcomes of the two forms of instruction. (Samples of these tests may be obtained by e-mailing the Louise M. Darling Biomedical Library Reference Division at biomed-ref@library.ucla.edu.) A follow-up study then was used to gather additional qualitative, affective data from students to supplement the information obtained through the quantitative pre- and posttest design.

Pre- and posttests were based on material previously designed by Joan Kaplowitz^{1, 2} and were developed to evaluate the educational outcomes of both presentation modes (lecture versus CAI). The variables measured included usage factors, affective attributes, and cognitive skills. The evaluation also attempted to examine questions regarding learning preferences as they relate to presentation technique. In addition, the researchers hired a consultant from the UCLA Statistical Consulting Center to assist in the final design of these instruments.

The study was undertaken in the 1994–95 academic year. The pretest was administered during the first lab section meeting of the quarter. Library instruction using one of the two modes followed the pretest administration. A hands-on homework assignment that utilized the material being taught was required of all students. The posttest was administered dur-

ing a lecture period following completion of the instruction and this assignment.

The CAI package was evaluated for one full year to account for possible seasonal variations. The teaching assistants involved in the class were randomly assigned either the CAI or the lecture as the

The CAI package was evaluated for one full year to account for possible seasonal variations.

mode of instruction to be used with their students. As a result, roughly half the students used the CAI and half attended the lecture. Scores on the pre- and posttests were compared for each group of students (i.e., those receiving the lecture presentation and those receiving the CAI presentation). The difference between the pre- and posttests for each group was analyzed to determine the effectiveness of each presentation mode. The scores for the two groups were compared to see if any difference in effectiveness could be detected.

Additional data regarding the students' feelings about using the CAI were gathered the following year via a more open-ended, qualitative-type follow-up survey. This survey also asked questions about the written instruction that appears in the students' biology lab manual. Librarians wanted to find out if the students were making use of this written material, and if so, what comments they might have about it. This survey was administered in the individual lab sections about halfway through the spring quarter of 1996.

Results

Although roughly eight hundred students were enrolled in Biology 5L during the 1994-95 academic year, the study included only data from those students who completed both a pre- and posttest. The net result was data from a total of 423 students. Two hundred of these students at-

tended the lecture and the remaining 223 used the CAI program. The average number of correct responses on the pretests was 13.02 (68.9%) for the lecture group and 13.33 (69.71%) for the CAI group. The average number of correct responses on the posttests was 15.30 (79.85%) for the lecture group and 15.12 (79.58%) for the CAI group. Statistical analysis of these responses using t-tests failed to reveal any significant differences between the groups. Students' posttest responses seemed equivalent regardless of whether they had used the CAI or had attended the librarian's lecture. On the basis of these data, a decision was made to eliminate the lecture method and use CAI as the mode of presentation for all students in the future.

Although the survey did not reveal any clear difference between the two modes of instruction, CAI was still deemed a better choice for the library because it was less labor-intensive. In addition, informal discussions with the faculty, teaching assistants, and students seemed to indicate that students liked using CAI better than just listening to a lecture. Moreover, because the conceptual framework of the lecture had been changed to match that of the CAI and the lab manual, an additional artifact may have been introduced inadvertently. In effect, the new CAI was not being compared to the original instruction. Because the lecture had been changed, the study ended up comparing two new forms of instruction rather than comparing a new form to an old one.

Although the decision had been made to move to CAI as the preferred mode of instruction, the authors still felt that some additional data were needed. The objective pre- and posttest analysis indicated that CAI was indeed a reasonable option for delivering instruction to this group of students. Now it seemed appropriate to examine why the students felt this mode of instruction worked so well. What exactly did they like or dislike about using a computer to learn the material? How

did the CAI and the revised pages in the lab manual work together to provide instruction? Did students prefer this mode of instruction over the standard (though revised) lecture method? Was anything needed to improve the CAI or the lab manual?

The follow-up survey, done in the spring of 1996, addressed some of these concerns. Because CAI effectiveness was no longer the primary issue, the authors felt that a more qualitative survey featuring open-ended questions would more likely elicit the types of responses they were seeking. The results from this survey are summarized in table 1. Surveys were distributed to all 175 students enrolled in the course, and 139 surveys were returned for a response rate of 79.43 percent. The breakdown of students by class was: 8.6 percent freshman, 23.1 percent sophomores, 38.1 percent juniors, 15.8 percent seniors, and 4.3 percent other (primarily university extension students).

In general, the survey responses were favorable and reinforced the librarians' informal impressions of how the students were interacting with the program. Most students finished the program within the allotted time frame of forty-five to sixty minutes and felt that it contained exactly the right amount of material for them to complete their assignments.

Questions three through seven were designed as a Likert scale, with 1 representing "strongly disagree" and 5, "strongly agree." The intent of this section was to assess the students' overall impression of CAI. Most students liked the program, thought it was clear and well organized, and felt it was an easy way to learn the material. When asked whether they would prefer a lecture or CAI as a mode of instruction, responses broke down roughly into thirds with 37 percent preferring CAI, 32 percent preferring the lecture method, and the rest undecided. Roughly a third of the students also indicated they felt they had a better understanding of the material fol-

lowing use of the CAI program, compared to 23 percent who felt they did not have a better understanding and 30 percent who were undecided.

The questions in the next section were open-ended and aimed at eliciting descriptive comments from the students about CAI. The fact that it was fun, easy to use, and graphical won high marks from many of the students. The students also liked the organization of the material and the interactive nature of the program. The fact that they could work at their own pace also was a plus.

The students' biggest criticism of the program was that it was much too long and needed more realistic examples. Some students did not like the organization of the material, and felt that it was boring and tedious and did not accurately represent what they were going to find in

The students' biggest criticism of the program was that it was much too long and needed more realistic examples.

the library. Suggestions for change all centered on the issues of length, repetitiveness, and a desire for more real-life simulations. Despite these criticisms, however, almost half the students indicated they would recommend use of this program to others.

The remainder of the survey concentrated on the library instruction pages in the lab manual. Of the 139 survey respondents, eighty-three (59.7%) said they had used the manual. Almost 90 percent of these students indicated that the material in the manual was helpful. They liked the way the material was organized and the fact that they could refer back to pages as needed, especially when working on their assignments in the library itself. Many students commented that although they liked CAI as a means of original learning, they also liked having something portable, such as the lab manual, to refer

TABLE 1
Follow-up Survey Results: Summary Statistics

Question	% Response	Question	% Response
1. How long did it take you to complete the library's Computer-Assisted Instruction program?		6. After completing the Computer-Assisted Instruction program, I had a better understanding of how to use the various indexes to search for journal articles on my subject.	
0-15 minutes	8.6	Strongly agree	9.4
16-30 minutes	32.4	Agree	25.9
31-60 minutes	46.8	Undecided	41.7
More than 60 minutes	2.9	Disagree	17.3
2. The Computer-Assisted Instruction program contained:		Strongly disagree	5.8
More information than I needed to complete my assignments/papers	33.1	7. The Computer-Assisted Instruction program was a difficult way to learn how to use indexes and other library material.	
Less information than I needed to complete my assignments/papers	10.8	Strongly agree	2.8
Just the right amount of information to complete my assignments/papers	51.8	Agree	12.2
None of the information I needed to complete my assignments/papers	0.7	Undecided	30.2
Not applicable	3.4	Disagree	38.8
3. The Computer-Assisted Instruction program was clear and well organized.		Strongly disagree	15.8
Strongly agree	12.2	8. Did you feel that the Computer-Assisted Instruction program helped you complete your assignments in Biology 5L? Please describe why or why not.	
Agree	38.8	Yes	64.0
Undecided	36.7	No	35.0
Disagree	10.1	9. What did you like best about the Computer-Assisted Instruction program?	
Strongly disagree	2.2	Easy to use/fun	17.9
4. The directions for using the program were clear and easy to follow.		Graphics	16.5
Strongly agree	20.1	Organization	9.4
Agree	41.0	Interactive nature	9.4
Undecided	30.0	Work at own pace	9.4
Disagree	7.5	Examples/overview	5.8
Strongly disagree	0.0	Link to manual	1.2
5. I would rather listen to a lecture than use a computer program to learn new material.		Nothing	5.7
Strongly agree	12.9	Not applicable	24.5
Agree	19.4	10. What, if anything, did you dislike about the Computer-Assisted Instruction program?	
Undecided	30.2	Too long	21.6
Disagree	15.8	Unclear/disorganized	5.7
Strongly disagree	21.6	Boring/tedious	5.0
		Not enough detail	5.0
		Didn't teach/too simple	5.0
		Individual misc. comments	10.0
		Not applicable	21.6

TABLE 1 cont.
Follow-up Survey Results: Summary Statistics

Question	% Response	Question	% Response
11. Would you recommend this Computer-Assisted Instruction program to other students who need to learn how to find journal articles on topics in the life sciences? Why or why not?		15. What did you like best about the <i>Library Resources for the Life Sciences</i> pages in the lab manual?	
Yes	49.6	Clear organization	44.5
No	28.1	Portable/could refer to it	12.0
Not applicable	22.3	Easy to use	10.8
12. If you could change the Computer-Assisted Instruction program, what changes would you make?		Examples used	6.0
Shorten it	14.4	Short	2.4
Add examples/make it more realistic	10.1	Informative/helpful	2.4
Improve organization	7.2	Not applicable	20.5
Get rid of it	5.0	16. What, if anything, did you dislike about the <i>Library Resources for the Life Sciences</i> pages in the lab manual?	
Less repetitious	2.1	Various individual answers	10.0
Make it faster	2.1	Not applicable	90.0
Make it less childish	1.4	17. What would you change about the <i>Library Resources for the Life Sciences</i> pages in the lab manual?	
Individual misc. comments	6.3	Various individual answers	10.0
Not applicable	49.6	Not applicable	90.0
13. Did you make use of the <i>Library Resources for the Life Sciences</i> section of your Biology 5L laboratory manual to help you complete your class assignment?		18. What are your overall comments about the Computer-Assisted Instruction program, the <i>Library Resources for the Life Sciences</i> pages in the lab manual, or both?	
Yes	57.5	Both useful/keep both	54.7
No	23.7	Keep manual only	31.3
Not applicable	16.5	Still needed personal instruction from librarian	9.3
14. Did you find the <i>Library Resources for the Life Sciences</i> pages in the lab manual helpful when doing your 5L assignments? Please describe why or why not.		Individual misc. comments	4.8
Yes	89.2		
Somewhat	2.7		
No	2.7		
Not applicable	6.0		

Note: The responses to questions 14–18 were tabulated on the 83 out of the total 139 who answered yes to question 13.

to when needed.

There were very few negative comments or suggestions for change regarding the lab manual section. When asked for a final summation, more than 50 percent of the students indicated they would recommend keeping both the CAI and the manual section because they were a good

combination for learning the material.

Discussion

The responses to the follow-up survey went a long way toward supporting the librarians' feelings that the CAI in combination with the lab manual was an effective and user-friendly way of offering

instruction. Students appear to be functioning quite independently when they come to the library and usually need only be pointed in the right direction to locate the indexes in question, or be referred back to the correct pages in the lab manual to refresh their memory about what they learned using CAI.

Many of the comments made on the survey reinforced the authors' hypothesis about why there appeared to be so little difference between the CAI and the lecture method in the original study. Although many students love to use com-

By combining the CAI with written backup, it is possible to offer variety and reach most of the students.

puters, many still are intimidated by them. Further, many students still prefer the human touch offered by a lecture or a one-on-one session with a reference librarian. Still others prefer to read the material and refer to it as needed. If the authors had in fact been successful in randomly assigning students to the CAI and lecture groups, these differences also would be equally distributed. Both groups would have a certain number of students who love computers and an equal number who hate them. Differences between these groups would then disappear because the responses of those who love computers and responded favorably to CAI would be negated by those who hate computers and were unable to learn well using that mode of instruction. The reverse of this situation would appear in the lecture groups with "good" lecture learners' responses being negated by those who do not learn by listening to a lecture.

The authors were especially delighted to read the comments on use of the lab manual in conjunction with the CAI—and even in lieu of it. Offering instruction in many different modes is really the ideal and addresses the differing learning

styles issue. However, practically speaking, most libraries cannot offer more than one, or at best two, different modes of instruction for the same topic. By combining the CAI with written backup, it is possible to offer variety and reach most of the students. Those who do not like to use computers can rely more heavily on the lab manual and, of course, can still ask questions at the reference desk. Those who learn well from computers do not need to use the lab manual, although it is there for future reference if needed. The CAI program also is available in the library itself should students want to refresh their memories electronically.

Conclusion

The students in this study definitely viewed CAI as a very viable option for bibliographic instruction. However, from the library's perspective, this mode of instruction clearly is not a cost-effective approach. So what does the future look like? Although librarians in the biomedical library have been quite happy with the move from lecture to electronic delivery of instruction, they have found the CAI program to be very expensive and labor-intensive to develop. They now have used the program for more than two years and the time has come to think about updating and revising it. To do so, however, will require hiring a programmer and spending many hours working on the project. Currently, it is unclear whether that endeavor would be worthwhile.

At the same time, the library is exploring new possibilities. As always, technology continues to march on and now there exists a very viable alternative to CAI—the World Wide Web. Because the conceptual framework that was developed for the CAI and the lab manual seems to be working well, the hours that went into designing the intellectual content of the CAI were well spent. The aspects of CAI (graphical interface, move at own pace, interactive) are all things that now can be done fairly easily on a Web page.

Use of the Web instead of CAI also would address some of the students' complaints, especially those concerning length and repetitiveness. The CAI program was structured in a very linear manner. Students began at the beginning and had to move through the program, step-by-step, to the end. They were forced to go over material they already might have been familiar with, and could not skip around as needed. Forcing the students through the program was a conscious design decision. It was felt that all students should be taught how to search by scientific name as well as by general topic, regardless of their immediate information need. In other words, the program was designed to follow the "just-in-case" philosophy rather than simply teach students what they currently needed to know. The fact that students would not have easy access to CAI at a later date contributed to this decision. However, using this design philosophy lengthened the program, and in the students' eyes, made it tedious and repetitive.

Using the Web as the mode of delivery certainly would address these problems. Due to the hyperlink characteristic of the Web, students could interact with the material in any order they liked and could concentrate on just the material they felt they needed to review. Those who wished to look at all parts of the instruction could do so, and those who felt they needed only certain aspects would be free to pick and choose.

Furthermore, mounting this material on a Web page would increase the students' ability to access it. Right now, they can only use CAI in their own biology lab and in the library. Putting the information in Web format means they could use it anywhere they had Web access. Students could use the program in any computer lab on campus and even from their own homes. The authors definitely learned a lot about electronic delivery of instruction by developing the CAI program and look forward to applying this knowledge to the next phase of this instruction.

Notes

1. Joan Kaplowitz, "A Pre-and Post-test Evaluation of the UCLA English 3 Library Instruction Program at UCLA," *Research Strategies* 4 (winter 1986): 11-17.
2. Thomas K. Fry, "The English 3 Library Instruction Program at UCLA: A Follow-up Study," *Research Strategies* 6 (summer 1988): 101-8.