Teaching Methodology with Computers: A Comparison

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ABSTRACT

This study tests the effectiveness of enriching traditional experimental psychology lab sessions with a variety of computer-assisted exercises in order to improve students' performance in the course, as well as to improve their performance on two special quizzes on methodology. The experiment was carried out over the course of one semester in three separate experimental psychology classes. These three classes involved two male teachers: one with ten years of previous experience in teaching this course, and the other teacher with no previous experience in teaching methodology. Two-way analysis of variance were done on both measures of performance and clearly indicate that the computer enriched lab sessions did **not** improve students' final grades ($p>.05$). In fact, the opposite effect was observed for the students' performance on the quizzes: the standard lab sessions produced a significantly better performance than the computer enriched lab sessions ($p<.01$). This result seems to indicate that a well organized traditional lab session can be just as effective, and even more effective than a computer enriched lab session. However, these results may be partly attributed to measurement problems associated with the quizzes and an unintentional de-emphasis of traditional skills in the computer enriched group.

INTRODUCTION

An important consideration for many college teachers is whether or not to utilize a computer laboratory as an integral part of their methodology course. The advantages and disadvantages of using computers in teaching research-related skills to college students have been examined in a number of previous studies. For example, Hirtle & Kallman (1985) describe the development of a laboratory module for their experimental psychology courses. Their computer module simulated an actual experiment and recorded the individual data, as well as quizzing the student for an understanding of the experimental concepts. They suggest that this kind of "computer lab" ensures that each student encounters many of the components of the research experience. Other researchers have also reported on the development of such methodology labs (Pittinger & Britton, 1985; Belmore, 1983; Jackson-Smith, 1983; Perera, 1981). Computer enriched lab sessions have also been recently explored in the area of essay and creative writing (MacArthur, 1988).

However, Chute (1986) points out that current research has not clearly established a cause-effect relationship between the use of computers and improved performance by the students. The difficulty in proving such a cause-effect relationship begins with isolating the specific variables which actually cause the improved performance. A computer enriched laboratory experience includes a variety of new and confounding variables, such as a highly motivating or rewarding "atmosphere" which may not be replicated in the "traditional" or control lab environment. There also may be a great deal of enthusiasm generated by the teacher and by certain computer literate students thus generating a greater amount of concentration and time spent on each exercise.

Other motivating factors in the computer lab may come from the students' added ability to produce output with a polished look; the nature of the screen display may prompt students to review each others' work and promote more peer review and revision. (MacArthur, 1988). These **motivating** factors, and others may in fact account for the observed increases in students' performances, rather than the process of any specific computerized exercise.

For the prospective teacher of methodology, it is important to identify whether or not the acquisition of specific research skills is facilitated with the use of computerized lab sessions. Researchers such as Peden and Steinhauser (1986) hold the view that traditional teaching methods are effective in this area and should be supplemented or reinforced with computer technology, and not replaced by the new technology. The teaching of a number of specific research skills may in fact **not** require any computerized reinforcement which may lead students to have a false sense of competence after having easily mastered the computerized exercises.

The aim of this project is to clearly identify whether or not several of the learning objectives proposed by the new 360-001 and 300-001 methodology courses are best taught in a "computer enriched" laboratory environment rather than in a more traditional lab setting. As suggested by Peden and Steinhauser (1986), the computer laboratory should not replace the traditional setting, in which students gather and analyze data by with pencil, paper and a calculator. In fact, the students in the computer enriched laboratory would be required to do **both** the traditional and computerized versions of the same exercise. In this way, the computer will serve as a reinforcement or supplement for the skills acquired with the traditional technique, rather than as a replacement. The students in the control or "standard" group will do the same exercises as the "computer" group using only a pencil, paper and calculator.

One other variable examined in this study is the effect of **"teacher experience"** in teaching methodology. Since this study involves two teachers, of which one has ten years experience in teaching experimental psychology and the other has no experience at all, a comparison can be made.

Student performance will be measured in two ways: (a) with two quizzes specially designed (by the experimenter) to measure acquisition of several of the learning objectives proposed by the new 360-001 and 300-001 methodology courses; (b) with the students' final mark in the course (determined by the teacher's evaluation and not the experimenter's).

METHOD

Subjects:

A total of 74 male and female CEGEP students enrolled in three experimental psychology classes were scheduled to complete the study. Of this total, 50 students were registered in two classes with an "experienced" teacher (ten years of teaching experimental psychology), and the remaining 24 subjects were registered for the course with the "inexperienced" methodology instructor. A large majority of these students were computer illiterate and had never completed a course in research methodology. Three of these subjects dropped out during the semester and another 8 subjects were eliminated because they did not write **both** of the two special quizzes. These 8 students all had a final mark of less than 40%. In all, the results from 63 students were used in the final statistical analysis.

In each of the three classes, students were randomly assigned to either the traditional lab session or the computer enriched labs for the rest of the semester. In all other aspects, including the lecture/theory part of the course, as well as all evaluation experimental conditions remained the same for both groups.

Apparatus:

The computer laboratory included 11 Macintosh SE's linked via an AppleShare network to a file server and two dot matrix (Imagewriter II) printers. Since a maximum of 11 students were assigned to each lab session, each subject had the exclusive use of a computer for as long as necessary. The software included the "Cricket Graph" program for the generation of graphs and the "StatWorks" program for the descriptive and inferential analysis of data.

The traditional laboratory was similar in size to the computer room, and contained the usual tables and chairs. A maximum of 14 subjects were assigned to this room for lab sessions. Students were asked to supply their own calculators.

Procedure:

The typical **computer-enriched** lab assignment differed from a **traditional** lab assignment in one major aspect - the exercises had to be completed with the help of the computer and also replicated using just pencil, paper and calculator (as in the traditional lab condition). For example, subjects in the "traditional" lab had to draw a scatter plot and calculate the correlation coefficient using the calculator. On the other hand, students in the computer-enriched condition were required to complete these tasks using the computer as well as utilizing traditional methods. These subjects usually chose to complete their lab assignment first with the computer and then with the pencil, paper and calculator.

In preparation for the formal phase of this study, it was necessary to complete some preliminary or "pilot" work during the previous semester. The following is a summary of this preparation, as well as the subsequent utilization of this material during the course of the actual study.

(a) The actual **lab assignments** were prepared during the previous semester and were pretested on a class of experimental psychology students. In all, seven such assignments were prepared and were then scheduled over a 13 week period during the semester. Some of the longer assignments involved several learning skills and were spread out over two or three weekly lab sessions. (Each session was 90 minutes per week and was preceded by a 90 minute preparatory lecture with the teacher).

Much of the work completed by the subjects during each lab session was directly related to one of the three psychology projects assigned to each subject by the teacher. In one of the research projects, for example, all students had to complete two questionnaires, and then generate a scatter plot illustrating and calculating the correlation between several pairs of variables. This project took several lab sessions to complete and included three consecutive lab assignments.

(b) It was necessary to develop two **quizzes** to specifically measure acquisition of the skills practiced during each lab session. The first quiz was administered after the completion of four assignments (during week seven). This quiz tested the students' mastery of skills such as "presentation of data in the appropriate tabular or graphic format" and "the calculation of primary descriptive measures". The second quiz, administered after the completion of the next three assignments (week thirteen) tested the students' mastery of such skills such as "the analysis of data using the appropriate type of inferential statistic".

In order to ensure that all students were **motivated** to to well in the quizzes and successfully complete all lab asssignments, each quiz was worth 5% toward the final grade in the course. The successful completion of all lab assignments was also worth 5% of the final mark.

It is important to point out that the same quiz was administered to every subject in all three classes, regardless of their experimental assignment. The two quizzes therefore tested only the acquisition of traditional skills (the use of computers was not allowed during the quiz). These quizzes were evaluated by the experimenter and not by the teachers.

All other evaluation and testing for the purpose of calculating each students' **final mark** was done by the two teachers. This final mark included results from the administration of two class tests, the students' participation in and analysis of three experimental projects written in the appropriate APA format, as well as credit for the quizzes and lab assignments.

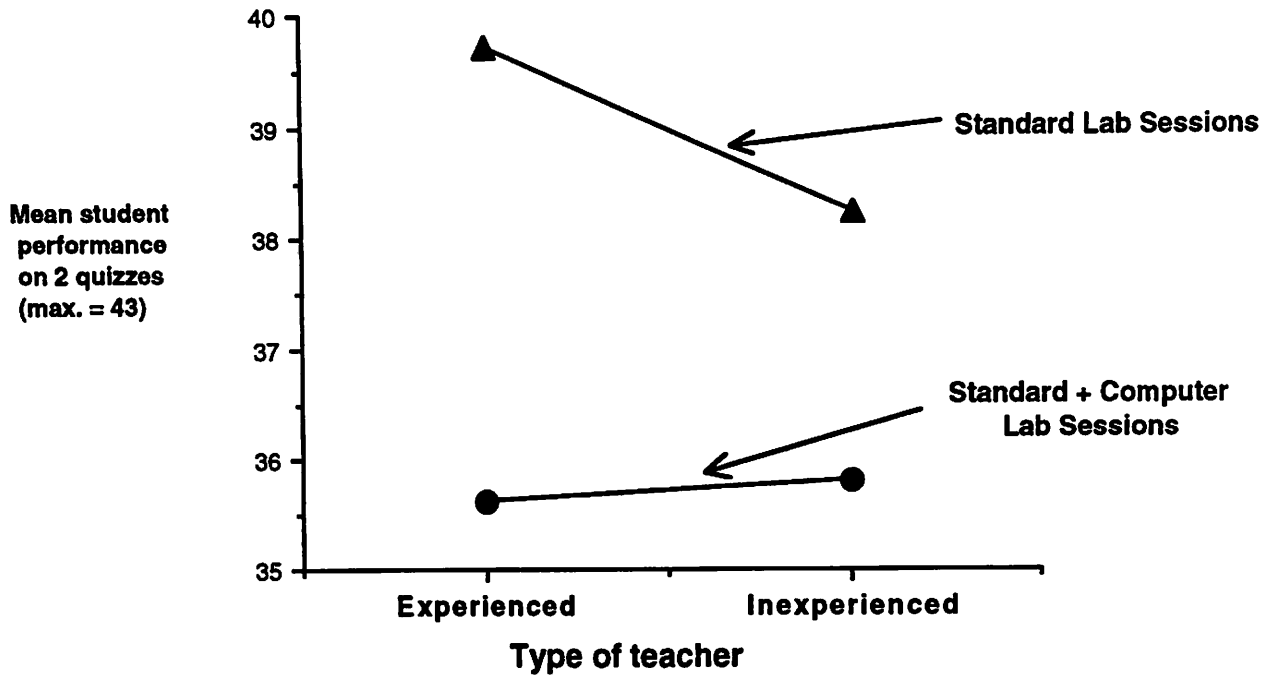
(c) **Reference material and equipment** was prepared for the study in order to assist students in the completion of three experimental projects during the semester. As mentioned above, the data generated by these three projects had to be analyzed by the students during the course of several lab assignments. Subsequently, as part of the course requirement, each student prepared the project in the appropriate APA format for the teacher to evaluate.

(d) At least three **lab monitors** had to be trained in order to assist the students during lab sessions. These three lab monitors were necessary to supervise subjects with assignments in both types of laboratories. Furthermore, these monitors made it unnecessary for either the teacher or experimenter to interact with the subjects during the course of each lab session, thus eliminating the possibility of unintentionally influencing the student with our expectations of the results.

RESULTS

Figure 1 illustrates the two main experimental effects (influence of type of lab condition and type of teacher) as measured by the students' performance on the two special quizzes. A weak interaction between these two main factors is also indicated in the figure. The figure indicates that, for both types of teachers, subjects obtained superior quiz scores in the traditional laboratory condition.

Figure I - Interaction between type of treatment and teacher as measured by performance on 2 extra quizzes.



A two-way analysis of variance reveals students from the "traditional" lab group had significantly higher quiz scores than students who used computers in the "enriched" lab environment ($F=10.70$; $p<.01$). Table 1 (below) summarizes this analysis of variance and indicates that the factor of experience versus inexperience for teachers did not result in a significant effect ($p>.05$). Furthermore, the interaction between teacher and lab condition was also not significant ($p>.05$).

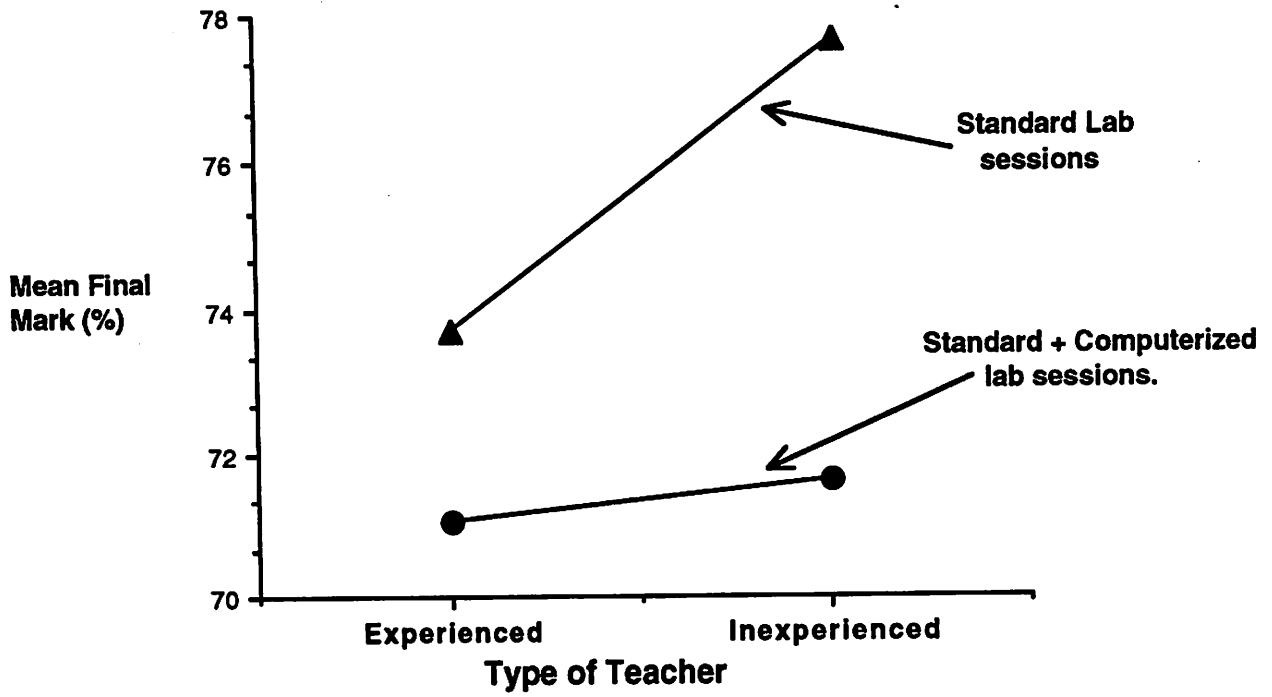
Table 1.

Two-Way Analysis of Variance illustrating the two main experimental effects: (a) type of Teacher and (b) type of lab Treatment; as measured by the students' **performance on 2 special quizzes**. The table also analyzes the interaction between the type of teacher and type of treatment as measured by the quizzes.

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between teacher	18.77210	1	18.77210	1.05972	0.060
Between treatment	189.60715	1	189.60715	10.70364	0.002
Interaction	9.05845	1	9.05845	0.51136	0.477
Error	1045.14167	59	17.71427		
Total	1262.57937	62			

Figure 2 illustrates the two main experimental effects (influence of type of lab condition and type of teacher) as measured by the students' final mark in the course. This measure of performance was totally determined by the class teacher and not by the experimenter. A weak interaction between these two main factors is also indicated in the figure. The figure indicates that, for both types of teachers, subjects obtained slightly higher final grades with the traditional laboratory condition, especially in the inexperienced teacher's class.

Figure 2 - Interaction between type of Treatment and Teacher as measured by the course's Final Mark .



However, a two-way analysis of variance reveals that the observed difference in final grades was not significant ($F=1.92$; $p>.05$). Table 2 (below) summarizes this analysis of variance and indicates that the factor of experienced versus inexperienced for teachers also did not result in a significant effect ($p>.05$). Furthermore, the interaction between teacher and lab condition was not significant ($p>.05$).

Table 2. A Two-Way Analysis of Variance illustrating the two main experimental effects: (a) type of Teacher and (b) type of Treatment; as measured by the students' **final grade**. The table also analyzes the interaction between the type of teacher and type of treatment as measured by this final grade.

Source	Sum of Squares	Deg. of Freedom	Mean Squares	F-Ratio	Prob>F
Between teacher	83.80785	1	83.80785	0.76981	0.384
Between treatment	208.79703	1	208.79703	1.91788	0.117
Interaction	36.95151	1	36.95151	0.33941	0.562
Error	6640.99745	61	108.86881		
Total	6970.55385	64			

DISCUSSION

The results of this experiment do not support the hypothesis that a computer enriched laboratory environment is superior to a traditional psychology lab in facilitating the learning of research skills. Our results clearly contradict earlier studies which suggest that the opposite effect can be achieved through the the use of computer technology in the experimental psychology laboratory (Pittinger & Britton, 1985; Belmore, 1983; Jackson-Smith, 1983; Perera, 1981).

Nevertheless, this study has produced a very significant result in the opposite direction ($p<.01$), as indicated by "traditional" students' superior performance on the two special quizzes. The highly significant nature of these results would indicate that this was not just a "fluke" event. On closer examination of the two lab conditions, such a result may be attributed, at least partially, to our unintentional **de-emphasis** of "traditional" skills in the computer-enriched condition.

For example, subjects in the computer-enriched lab usually preferred to first work with the computer in order to complete each assignment. This allowed such students to more easily and quickly complete the "standard" part of their assignment and therefore spend less time mastering the skills which require the "traditional" solution. In fact, these subjects may have developed a false sense of confidence in their level of skill, since the solution was so simple to obtain via computer technology. Subsequently, when tested on the quizzes and asked to use a "calculator" solution only, these "computer literate" subjects probably had more problems because they had less practice in drawing graphs and calculating data without <u>first</u> figuring out the solution with a computer. This unforeseen development that crept into our study cannot be easily

resolved even in future studies, since it is difficult to design "equivalent" lab assignments in such different experimental conditions and then develop an **identical** quiz to test for the acquired skills.

In order to create such "equivalent" lab conditions and at the same time develop a valid quiz to test mastery of skills, all experimental subjects should be trained in the use of computers in order to create several levels of "computer enriched" laboratory conditions. The quiz of mastery could then take place in the computer lab for all experimental subjects, and allow the use of computers in answering quiz items.

In conclusion, our study indicates that a computer enriched laboratory is not necessarily superior to the traditional lab session in facilitating the acquisition of research skills. In fact, our results indicate that in our laboratory environment, the traditional lab is significantly superior, if the acquired skills are tested with traditional techniques only.

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