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A Comparison of Computer Aided Instruction versus Traditional Instruction in an Elementary Algebra Course

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Abstract

The purpose of this study was to compare and evaluate the effectiveness of computer assisted instruction versus traditional laboratory instruction for educating freshman college students (n=174) about elementary algebra. The study treated computer testing and tutorial simulated instruction and traditional instruction as independent variables and learning outcome and attitude, based on posttest scores, as the dependent variables. The findings indicated that sequence of the both methods of instructions was a significant factor. Students learned more mathematical concepts when they utilized the traditional method of instruction and then used computer laboratory instruction (MyMthLab).

Keywords: instruction; Mathematics; attitudes; MyMathLab.

1. Introduction

In any mathematics curriculum, students are expected to take certain courses in a particular sequence. The mathematics instructor expects the students to have met certain course prerequisites and to possess certain fundamental skills that will provide the student with the opportunity to be successful in his or her mathematical endeavor.Students often find themselves in a situation where progress is hindered because they lack fundamental algebraic skills. Several studies indicate that an instructor of mathematics for over 20 years, the researcher has observed that the difficulties that students have with higher level courses such as trigonometry, analytic geometry, calculus, and differential equations appears to be a result of their lack of basic algebraic skills [16,1]. Many writers [5,7,12] have expressed concern about student's lack of basic algebraic skills. In addition, the importance of algebra has been addressed by the College Board Equality Project in (1981) and by other educators.

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The mathematics teacher, therefore, should experiment with different methodologies in order to assure that he or she is providing the students with appropriate alternatives for learning [8, 15]. A review of the literature has failed to reveal research, which involves teaching an entire basic mathematics course using computer software as the instructional tool. According to Ganguli [10] investigated the effect of using computers as a teaching aid in mathematics instruction on student attitudes toward mathematics. He used computers as supplement to normal class instruction. The sample in the study consisted of 110 college students enrolled in four sections of an intermediate algebra class offered by the open-admission sunder graduate unit of a large Midwestern state university. The instruction focused on how to develop the concept of relationship between the shape of a graph and its function. The results indicated that the attitudes of the experimental group which was taught with computer aid were significantly changed in a positive direction whereas the control group that was taught without computer aid failed to show a similar result. Likewise, the results have shown that students in the microcomputer treatment group experienced a higher positive self-concept in mathematics, more enjoyment of mathematics and more motivation to do mathematics than control group. Furthermore, the two instructors who participated in the study both indicated that the computer-generated graphics led to more active classroom discussions in experimental sections and consequently created more rapport between the teacher and the students than in the control sections. Tilidetzke reported no significant difference in mean scores on a posttest between computers aided instruction and traditional instruction in an Algebra course when studying three topics of course material with two hours of computer lab time [14]. He recommended research be undertaken using a broader range of topics presented on the computer with several levels of difficulty. The present study investigated the effects of computer aided instruction (CAI) as a supplement to the traditional lecture-discussion approach in the learning of Elementary Algebra. Few studies were found in the literature in which this comparison was made [2, 4]. The research results are mixed, with some investigations [13, 11] reporting positive results about CAI instruction and other studies [6] reporting results favoring the traditional approach. In another study Tilidetzke [14] reported that the computer aided instruction approach is as effective as the traditional approach. The present study was designed to provide further knowledge about the effects of CAI in the learning of Elementary Algebra. That is, are students that study College Algebra by means of a lecture-discussion approach supplemented by CAI more successful than those students not exposed to CAI? In addition, the study addressed the question of whether CAI has any effect in attitude toward mathematics for those students who are exposed to it.

2. Objectives of the study

The objectives of this study were to:

1. Compare the achievement levels of college students who received computer assisted instruction with students who received traditional instruction.
2. Evaluate the effectiveness of computer assisted instruction in educating undergraduate students in elementary algebra.
3. Compare which instructional method helped students to better understand the underlying applied concepts of elementary algebra.

4. Evaluate the comparative results of effectiveness between computer assisted instruction and traditional instructions by means of pretest and posttest differential, and;

5. Assess the students' attitude toward computer assisted as a mode of instruction as opposed to the traditional approach.

These objectives were formulated into 8 null hypotheses, which are stated along with their tests in the result section.

3. Purpose of the study

The purpose of this study was to compare and evaluate the effectiveness of computer assisted (MyMathLab) instruction versus traditional instruction for educating undergraduate college students (n =174) about elementary algebra.

The study also examined the students' attitudes toward computer assisted instruction versus traditional instruction.

4. Assumption of the study

1. No interaction (Social, academic, or otherwise) occurred among experimental and control groups;
2. The presence of experimental and control groups in the same class had no effect on either group; and
3. Students were randomly and independently assigned in both the experimental and control groups with respect to traditional work and control work.

5. Limitation of the study

The participating classes in this study were limited to those students who enrolled in MATH1310 elementary algebra class during spring semester of 2007. A total of 174 subjects participated in this study.

The experimental units for this study were limited to the following subjects. The subjects were:

1. Operations With Real Numbers
2. Simplifying Variable Expressions
3. Solving Linear Quadratic Equations and Inequalities
4. Simplifying Polynomials

6. Methods of procedure

Instruments. A total of six measuring instruments were used to collect data in this study (a) pretest, (b) posttest I, (c) posttest II, (d) posttest III, (e) pretest student attitude questionnaire, and (f) posttest student attitude questionnaire.Pretest, The pretest instrument was developed by the researchers. The pretest was administered during the first meeting before the instruction began. The pretest consisted of 40 multiple choice question items; this test was designed to be used as a covariate. The pretest items were selected from the tests and quizzes given to Math1310 students in previous semesters. The KR-20 reliability estimated this test was 0.72.

Posttest I. The test items were identical in content to the pretest.

Posttest I consisted of 40 items, ten items for each proposed subject. Scores on posttest I ranged from 19 to 36 out of a total of 40 possible, with the mean score of 29.52. The KR-20 reliability estimated this test was 0.76.

Posttest II. The test items were identical in content to the pretest. Posttest II consisted of 40 items, ten items for each proposed subject. This test was identical to the pretest. Scores on posttest II ranged from 21 to 35 out of total of 40 possible, with the mean score of 34. The KR-20 reliability estimated this test was 0.76.

Posttest III. The posttest III instrument was also developed by the researchers. Posttest III was conducted at the end of the study. Posttest III consisted of 40 multiple choice items, ten items for each proposed subject. This test was identical to the pretest. Scores on posttest III ranged from 24 to 39 out of total of 40 possible, with the mean score of 13.56. The KR-20 reliability estimate of this test was 0.75

Pretest Student Attitude Questionnaire. The pretest student attitude questionnaire was administered to both the experimental and control groups during the first meeting before the instruction began. This test was designed to be used as a covariate to control for initial differences in the students' attitude toward the computer assisted instruction. Of the 40 items in the instrument 20 were positively worded and 20 were negatively worded. The items used a Likert scale with 5 responses from "Strongly Agree" to "Strongly Disagree". The reliability coefficient of this was 0.79.

Posttest Student Attitude Questionnaire. The student attitude posttest was administered to both the experimental and control groups at the end of the study. This test was similar in content to the pretest student attitude questionnaire with some appropriate changes in wording, such as the tense. The reliability coefficient of this test was 0.78.

Statistical Analysis of Data. All scores were coded by the researchers and provided as a data file for running statistical analysis by applying Statistical Package for Social Sciences (SPSS). The statistical methods used for analyzing the data in this study were Analysis of Covariance, the T-test for independent and T-test for dependent values.

Computer Assisted Program. The computer assisted program that was used in this study was the MyMathLab program which is a customizable text specific online courseware (available for all Addison-Wesley major mathematics titles from basic math through precalculus and service) which integrates Addison-Wesley testing and tutorial software with instructional content in a complete course management environment, that is entirely supported and maintained on an Addison-Wesley Web server.

Research Procedures. This study used an experimental design in order to examine the effects of the independent variables on the dependent variables. This type of design compares among groups to which subjects have been randomly assigned (Borg & Gall, 1989). Random assignments were used to make equivalency between the two groups in this study.

A pretest-posttest control group design was used in the experiment. The design is schematically presented as the following.

Group one	R	O1	T	O2	C	O3	O4
Group Two	R	O1	C	O2	T	O3	O4

R: Stands for random assignment of subjects.

O: Stands for observation O1 is the pretest, O2, O3, and O4 are the posttests.

T: Stands for traditional treatment.

C: Stands for experimental treatment.

In this study, the researchers randomly assigned subjects to particular groups. The experimental group received the pretest, experimental treatment, and posttest I, traditional treatment, posttest II, and the posttests, while the control group received the pretest, traditional treatment, posttest I, experimental treatment, posttest II, and the posttests.

Classroom Procedure. Both the experimental and control groups received theoretical instruction together from their instructors at different times and locations. However, both the experimental and control groups received the same in class tests and homework problems.

Software In The Classroom. In order to become familiar with the use of software (MyMathLab), all subjects were provided with private email accounts and an bulletin board posting s or other notices and announcements to the class using this email roster system. Students received three weeks of computer practice activity before the study began. Both experimental and control groups were supervised by their instructors at the different times.

The treatment (experimental) group used the computer software (MyMathLab) as the means of conducting laboratory session. Students were provided instruction on the use of the computer, both through demonstration and in a written format. Students were monitored by the researchers during the computer laboratory session. The online learning consisted of three times meeting in a week computer lab session and availability of online learning resources in the intranet and internet available to the students. MyMathLab was used as a delivery mood of the online part of this course.

The control group learning consisted of normal classroom lecture that was conducted three times in a week in more or less traditional manner.

Data Collection Procedures. At the beginning of this study, a general information sheets was administered in order to gather demographic information on each subject. At this time students were given the opportunities participate in the study and they were requested to respond the pretest student attitude questionnaire. Prior to instruction, the forty items pretest was administered to all subjects to assess students' background and knowledge of elementary algebra.

After completion of the pretest and the student attitude pretest questionnaire, the subjects were randomly assigned to the experimental treatment group (computer lab group) and the control treatment group (traditional treatment group).

After three weeks of experiments, the forty items posttest I was administered to all subjects to measure treatment effects. Then the experimental group switched with the control group.

After three more weeks of experiments, the twenty items posttest II was administered to all subjects to measure the treatment effects.

At the end of the study, two instruments were administered to all subjects. The first was posttest III which was used to measure treatment effects. The second was the posttest student attitude questionnaire which was used to determine student attitude toward the computer simulated laboratory instruction and traditional method of laboratory instruction.

7. Results

The major hypotheses of the study and the results of testing these hypotheses are summarized as follows:

Null Hypothesis I. There is no significant difference between the pretest mean scores of the experimental and control groups.

Because the calculated t-value was 1.39 which is not significant at 0.05 levels, null hypothesis I was retained (Table 1). This finding implies that the random assignment of the subject produced equivalent groups.

Table 1: The T-Test Summary Table of Pretest Mean Scores of the Experimental and Control Groups

Pretest	N	MEAN	STD DEV	T	DF	R>|T|
GROUP 1	87	34.20	4.62	1.39	118	0.1673
GROUP 2	87	34.97	3.88			

Group 1: Control Group Group 2: Experimental Group

Hypothesis 2. There is no significant difference between the adjusted groups means scores of the experimental and control groups as measured by a posttest I with a pretest covariate.

There was no significant difference between the experimental and control groups as indicated by F-value of 0.32 which is not significant at 0.05 level (Table 2). Therefore, null hypothesis 2 was retained. Both methods of instruction tended to produce similar effect.

Table 2: Analysis of Covariance Summary Table for Posttest I Scores with Pretest Scores as a Covariate

SOURCE	DF	SS	MS	F-VALUE	F	SIG
Covariate	1	31393.90	31393.90	279.26	0.000	Yes

Groups	2	72.34	36.17	0.32	0.725	No
Error	171	19111.04	112.418			

Regression Coefficient for adjusting = 0.281

GROUP	MEAN	STD DEV	ADJUSTED MEAN
1	29.68	5.64	29.64
2	28.12	4.85	28.16

Significant at 0.05 level.

Hypothesis 3.There is no significant difference between the mean scores of the experimental and control groups as measured by posttest II with a posttest I covariate.

There was a significant difference between the control and experimental group as indicated by an F-value of 4.73, which is significant at 0.05 level.

The simulation group scored significantly higher than the control group on posttest II (Table 3). Therefore, the hypothesis 3 was not retained.

Table 3: The Analysis of Covariance for the Posttest II with a Posttest I Covariate

SOURCE	DF	SS	MS	F-VALUE	F	SIG
Covariate	1	30236.79	30236.79	276.98	0.000	Yes
Groups	2	516.22	258.11	4.73	0.031	Yes
Error	171	2755.534	16.21			

Regression Coefficient for adjusting = 0.528 Significant at 0.05 level.

GROUP	MEAN	STD DEV	ADJUSTED MEAN
1	31.47	5.32	31.43
2	33.87	5.65	33.91

Hypothesis 4.There is no significant difference between the mean scores of experimental and control groups as measured by a posttest III with posttest II covariate.

There was no significant difference between the two groups as indicated F-value of 1.43, which is not significant at 0.05 level (Table 4).

Therefore, hypothesis 4 was retained.

Table 4: The Analysis of Covariance for the Posttest III with a Posttest II Covariate

SOURCE	DF	SS	MS	F-VALUE	F	SIG
Covariate	1	2436.49	2436.49	216.95	0.001	Yes
Groups	2	32.29	16.14	1.43	0.240	No
Error	171					

Regression Coefficient for adjusting = 0.280 Significant at 0.05 level.

GROUP	MEAN	STD DEV	ADJUSTED MEAN
1	34.33	5.20	34.29
2	34.46	5.11	34.50

Hypothesis 5.There is no significant difference between the mean scores of the experimental and control groups as measured by a posttest III with pretest covariate.

There was no significant difference between the experimental and control groups. The calculated F-value was 0.725, which is not significant at 0.05 level (Table 5). Therefore the null hypothesis 5 was not rejected. Both instructional methods contributed similar results.

Table 5: The Analysis of Covariance for the Posttest III with a Pretest Covariate

SOURCE	DF	SS	MS	F-VALUE	P	SIG
Covariate	1	31489.62	31489.62	285.11	0.000	Yes
Groups	2	80.95	40.475	0.725	0.396	No
Error	171					

Regression Coefficient for adjusting = Y = 0.453

GROUP	MEAN	STD DEV	ADJUSTED MEAN
1	32.94	5.13	32.90
2	32.24	5.04	32.28

Hypothesis 6.There is no significant difference between the combined pretest and combined posttest mean scores of the experimental and control groups.

There was a significant difference between the combined pretests and the combined posttests mean scores of the experimental and control groups. The calculated t –value was 14.19, which is significant at 0.05 level (Table6). Therefore null hypothesis 6 was rejected. Both laboratory instruction methods contributed to higher posttest III scores.

Table 6: The matched T-Test Analysis for Combined Pretest and Combined Posttest Means of the Experimental and Control Groups

Test	N	MEAN	STD DEV	STD ERR	T	DF	R>|T|
Pretest	174	17.61	5.08	0.47	14.19	173	0.0001
Posttest III	174	32.97	4.48	0.42			

Significant at 0.05 level.

Hypothesis 7.There is no significant difference between the pretest student attitude questionnaire mean scores of the experimental and control groups.

There was no significant difference between the pretest student attitude mean scores of the experimental and control groups. Therefore null hypothesis 7 was retained (Table 7). This means prior to instruction, students' attitudes toward traditional and simulation instructions were relatively equal.

Table 7: The T-Test Summary Table of the Difference between the Pretest Student Attitude Questionnaire Mean Scores of the Experimental and Control Groups

Pretest	N	MEAN	STD DEV	STD ERR	T	DF	R>|T|
GROUP 1	87	112.44	10.58	2.69	0.02	172	0.495
GROUP 2	87	109.28	9.06	2.36			

Group 1: Control Group Group 2: Experimental Group

Significant at 0.05 level.

Null Hypothesis 8. There is no significant difference between the adjusted group mean scores of experimental and control groups attitude as measured by a posttest student attitude questionnaire with the pretest as a covariate.

There was no significant difference between the two groups attitude as indicated by an F-value of 2.48, which is not significant at 0.05 level (Table 8). Therefore, null hypothesis 8 was retained. This hypothesis indicates that, after treatment both groups displayed similar attitudes toward computer simulated laboratory instruction as well as the traditional method of instruction after treatment.

Table 8: Analysis of Covariance Summary Table for Posttest Scores with Pretest Scores as a Covariate

SOURCE	DF	SS	MS	F-VALUE	F	SIG
Covariate	1	30245.23	30245.23	278.22	0.000	Yes
Groups	811.321	2	270.44	2.48	0.062	No
Error	20	171	35.45			

Regression Coefficient for adjusting = 0.582

GROUP	MEAN	STD DEV	ADJUSTED MEAN
1	136.41	16.04	136.37
2	132.91	17.72	132.95

Group 1: Control Group Group 2: Experimental Group

Significant at 0.05 level.

8. Conclusion

From this study the researchers concluded that, the findings have implications regarding the design of computer aided instruction laboratories for secondary and post-secondary schools for the 21st century. According to Pyatt and Sims (2007), the role of the laboratory in 21st century science instruction is to (a) enhance mastery of subject matter, (b) develop scientific reasoning skills, (c) develop practical skills, (d) assist students in understanding the complexity and ambiguity of empirical work, and (e) understand the nature of science.

Findings revealed that no significant difference existed between the computer laboratory instruction (MyMthLab) and the traditional method of instruction as resulted by the mean scores of posttest I with pretest as a covariate, Posttest III with the posttest III as a covariate, and posttest III with pretest as a covariate. Findings also revealed no significant difference existed between students' attitude toward computer laboratory instruction and traditional method of instruction. Results indicated that students' attitudes were similar with regard to both the simulated and traditional laboratory instruction. Findings revealed that a significant difference did exist between the computer aided instruction (MyMathLab) and the traditional method of instructions indicated by the mean scores of the posttest II with posttest I as a covariate. The result indicated that the experimental group scored significantly higher than the control (traditional) group. Because the treatment groups switched after three weeks, perhaps the sequence of the instruction was an important factor. Also, a significant difference was found between the pretest and the posttest mean scores of the experimental and control groups. This indicated that both instructional methods contributed to higher posttest III scores. The results of this study indicated that integration of the computer aided instruction with the traditional method of instruction significantly increased the students' understanding of the elementary algebra concepts. The findings indicated that the sequence of computer aided instruction was a significant factor. Students learned more mathematical concepts when they utilized the traditional method of instruction and then used computer method of instruction. Also, the findings revealed that the computer based learning program could be used in an integrating mode rather than in the experiencing mode as it was in this study. From this study, the researchers conclude the following (1) students learned mathematical concepts more when they utilized normal classroom lecture, and then used computer lab session instructions, and (2) computer lab session instruction can be used to extend the traditional methods of instruction.

9. Recommendation

1. This study should be replicated with a randomly selected and larger population of students. This would assist the generalizability of the findings to a broader student population.

2. More research should be conducted with a larger group of students, which examine the effects of computer aided instruction on other mathematics courses such as calculus, plane geometry, and trigonometry.

3. One instructor should provide all phases of instruction to groups, the treatment as well as the control group, to eliminate instructor's bias.

References

[1] Aiken, R.L. (2000). Psychological Testing and Assessment, 10th Ed. Allyn and Bacon, Boston, MA.

[2] Baker, S., Gersten, R., & Lee, D. (2002). A Synthesis of Empirical Research on Teaching Mathematics to low-achieving students. Elementary School Journal, 103,1, 51-73.

[3] Borg, W. R., & Gall, M. D. (1989). Educational Research: An introduction (6th ed.). White Plains, NY: Longman.

[4] Chang, K. E, Sung, V. F., & Lim, S. F. (2006). Computer Assisted Learning For Mathematical Problem Solving. Computers & Education, 46(2), 140 – 151.

[5] Bowen, G. M., & Roth, W. M. (1998). Lecturing graphing: What features of lectures contribute to student difficulties in learning to interpret graphs? Research in Science Education, 28, (1), 77-90.

[6] Diem, D.C. (1982). The effectiveness of computer-assisted instruction in college algebra. Dissertation Abstracts International, 34 05A.

[7] Dreyfus, T. (1993). Didactic design of computer-based learning environments. In C. Keitel & K. Ruthven (Eds.), Learning from computers :Mathematics education and technology. 101-130, New York: SpringerVerlag.

[8] Fey, James T. (1982). Mathematics education. In H. E. Mitzel (Ed), Encyclopedia of Educational Research (5th), 3, pp1166-1180. New York: Free Press

[9] Mathews, J. Maryland and Virginia are Rated Tops in Preparing Students For Advanced Placement Exams (2009). [OnLine].

Availablehttp://www.parentadvocates.org/index.cfm?fuseaction=article&article

ID=6716

[10] Ganguli, A.B. (1990). The microcomputer as a demonstration tool for instruction in mathematics. Journal for Research in Mathematics Education, 21, 154-159.students' attitudes of the computer as a teaching aid. Educational Studies in Mathematics, 23, 611-618.

[11] Graff, L. G. (1987). Computer managed learning evaluated in a test project with adult mathematics learners. In Proceedings, International Conference on CAI in Post-Secondary Education 275-277. Calgary: University of Calgary.

[12] Reed, S. K. (1984). Estimating answers to algebra word problems. Journal of Experimental Psychology: Learning, Memory, & Cognition, 10, 778–790.

[13] Taghavi, S.E. & Colen, C. Jr. (2009). Computer Simulation Laborator Instruction Versus Traditional Laboratory Instruction in Digital Electronics. Journal of Information Technology Impact 9, 1, 25-36.

[14] Tilidetzke, R (1992). A Comparison of CAI and Traditional Instruction in a College Algebra Course. Journal of Computers in Mathematics and Science Teaching, v11 n1 p 53-62.

[15] Vosniadou, S. & Verschaffel, L. (2004) (eds.). The Conceptual Change Approach to Mathematics Learning and Teaching. Learning and Instruction 14, 5, 445–548.

[16] Yushau, B. (2006). The Montana Mathematics Enthusiast. The Effects of Blended E-Learning on Mathematics and Computer Attitudes in Pre-CalculusAlgebra, 3, 2, 176-183.