A STUDY OF THE EFFECTIVENESS OF COMPUTER-ASSISTED INSTRUCTION ON ATTITUDES OF NINTH GRADE STUDENTS IN SCIENCE

By
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INTRODUCTION

Statement of the problem

Within the environment of the science classroom, there are many variables that contribute to the learning of science. Variables such as teacher and student expectations, methods of teaching, learning, and attitudes of those involved are just a few. Only when the science teacher recognizes the different levels of learning, will he or she be able to create an environment conducive to learning. What other factors contribute to the ideal learning environment? Some factors contributing to an ideal learning experience include well planned lessons, a variety of teaching resources, patience, and humor. One possible factor often overlooked is the student's attitude toward learning. Is the class boring?, or is he/she excited about returning the next day? This researcher sought to explore the nature of student attitudes regarding the learning of science.

The use of the microcomputer in the classroom is rapidly becoming a very viable asset to today's educational curriculum development. Some evidence exists that Computer-Assisted Instruction (CAI) may be more effective than traditional teaching methods in assisting (or promoting) student learning or attitudes.

Johnson and Swoope (1987) noted that children who have access to computers from an early age are likely to develop skills and attitudes that will give them a distinct advantage over youngsters who lack this experience. Results of a study conducted by Seymour, Sullivan, Story and Mosley (1988), shows that the use of microcomputers in the classroom potentially has a very positive motivational effect.

How successful is computer-assisted instruction at enhancing student achievement and attitudes towards science? To supplement the traditional instruction of the ninth grade Physical Science program with high school students, a Computer-Assisted Instruction Program (CAI) was developed and implemented. The purpose of this study was to test the effect that computer-assisted instruction had on a population of students in a science class and the resulting nature of attitudes that students have for science.

Hypothesis

Through the development and implementation of computer-assisted instructional materials, ninth grade students will develop a positive change of attitude toward science and CAI as measured by a pre-test and post-test survey. A one-tailed t-test (.05 level of significance) was used to determine any change in attitude regarding the learning of science.

Importance of the study

The results of this study could be used for making decisions relative to the development of the freshmen science program in a high school. The selection and implementation of computer-assisted instructional materials will also benefit from this study. The use of CAI materials could also be used as an additional resource to benefit the student by allowing them an opportunity to experience a variety of learning activities.

Assumptions, limitations, and delimitations

Assumptions: The following assumptions were established for the purposes of this study:

1) It was assumed that the group included in this study represented a normal distribution of freshmen students.

2) It was assumed that the pattern of a student's responses on the Pre and Post Tests were consistent with his or her attitudes of the course and the use of Computer-Assisted Instrustional materials.

Limitations:

1) The results of this study were applicable to the ninth grade physical science program at the high school level that were tested.

2) This study did not include computer based teacher management systems.

Delimitations:

1) This research had no validity beyond the ninth grade science program at this high school.

Definition of important terms

1) Computer Assisted Instruction (CAI). For purposes of this study, CAI was defined as the use of the computer for direct instruction of students.
2) Active-engaged Learning time (ALT). Again, for purposes of this study, Active-engaged Learning time refered to the time a student spends on task in a learning situation.

3) Drill and Practice. Drill and Practice follows a basic question and short-answer format, chiefly drilling the student on material he has been taught.

4) Tutorial. This type of program attempts to teach the student something new by text, animated diagrams, questions and answers, and other techniques.

5) Simulation. A computer simulation is a simplified representation of a real event or thing that recreates pertinent characteristics. (Okey, Shaw, and Waugh, 1984)

6) Database. A database program is a file or database of organized collection of information on a particular subject. (Hunter, 1985)

7) Interfacing Hardware. For purposes of this study, interfacing hardware refered to those devices which connect to the computer to extend its capabilities.

8) Attitude. Once again, for purposes of this study, attitude refers to a position or disposition toward science or the use of the computer in the science class.

CHAPTER II
REVIEW OF THE LITERATURE

Introduction

The needed changes in science teaching and learning practices can be achieved through the application of the computer-based methods to science teaching (Ganiel and Idar, 1985). Woodrow (1987) noted that if teachers are to prepare students for this computerized society, then both the teachers and the students must develop and maintain positive attitudes towards the use of and the value of computers in the classroom. Related to the issue of using computers in the science classroom, Okey (1984/85) posed the following questions: Does use of computer-based instruction promote greater student involvement in learning? Are student attitudes toward science influenced differently by computer-based and regular science instruction?

Reported Methods for Utilizing Computer-Assisted Instruction

A current trend in educational teaching-learning strategies pertain to the use of Computer-Assisted Instruction (CAI) in the classroom. While this topic may be popular, there seems to be conflicting research pertaining to the effectiveness of CAI. According to Dence (1980), there is a great deal of confusion as to its place in the curiculum. In an effort to utilize CAI effectively, educators have raised questions concerning the conditions under which, and for whom, CAI is effective.

Why develop CAI materials? Bork and Franklin (1980) noted that the computer is the only educational tool with which we can approach the learning situation in dealing with large numbers of learners. Each learner can proceed at a different pace and can engage in an individual learning process with educational materials responsive to his or her particular needs. Coupled with selected computer-assisted materials, this new trend creates a new and stimulating learning environment.

Bork (1980) states that the computer in education allows us to make learning interactive, with students constantly cast as participants in the process rather than as spectators. Thus, the computer could be used as a tool to increase student participation in class. Bork (1980) continues to say that in many lecture situations the students are passive. Good interactive computer programs can provide a very different environment.

In contrast, Schrock (1984) is concerned that the danger from computers lies in the eagerness to set children down in front of a massive information bank. Without further contact with the real world, the children will forever be frozen to concepts and never move on to a constantly more complex model.

Berger (1982) found that students generally have a high positive attitude toward science until middle school or junior high school. During this period and through the high school years, this attitude appears to decline. Perhaps, with the use of the microcomputer and selected CAI materials, a positive attitude toward science can once again be fostered in our students.

However, Hord (1984) noted that in the case of computers there exists a serious danger of abuse. Because of the computer's sudden popularity and availability, many teachers are tempted to jump right in and prepare lessons in this new medium without considering how they fit existing plans and designs of instruction.

By what methods could CAI be used to enhance student achievement and attitudes toward science? Okey (1984/85) identified the following list of skills for classroom science teachers to effectively intergrate computers into their instruction:

1) use drill and tutorial programs to bolster achievement.
2) use computer simulations to provide experiences that supplement science laboratory programs.
3) collect, print, and display data from investigations.
4) use computers as tools in development of rational and logical thinking skills.
5) use programming to assist students in developing solutions to science problems.
6) expand the resources of the classroom and laboratory by accessing databases.

The variable most important in affecting student achievement according to Alessi (1984), is the completeness of the model of instruction used by teachers. According to Alessi, four phases make up the complete model of instruction:

1) Present the information or model of skills.
2) Guide the student in initial acquistion of the material.
3) Provide practice for the student to enhance fluency and retention.
4) Assess achievement to provide remediation or end instruction.

Allessi's model of instruction certainly agrees with the current methods of ITIP (Instructional Theory Into Practice) (Hunter, 1976). One should agree with this model of instruction, recognizing the fact, that the use of the computer in the classroom lends itself well to this practice.

Selected software programs such as Drill, Tutorial, and Simulation are used to put students in contact with course and procedures. Drills and tutorials have the potential to involve each student in learning. Classroom group instruction is too often characterized by one or two students interacting with the teacher while twenty-three other students watch. Intellectual engagement with course content and activities is necessary for learning. Computer drills and tutorials have the potential to increase the involvement of individuals and thereby increase their learning. (Okey, 1984/85)

One must consider however, that the most common mistake in computer-based instruction is to use drill programs to teach new information. This will lead to frustration and failure for many students. (Alessi, 1984)

Kirschner (1983) found that many students tend to finish labs at different rates-often those who are done first may be those who understand the least. Computers can evaluate a student's understanding of a laboratory, freeing the instructor to monitor the rest of the class. Thus, more students are involved in the learning experience which leads to the improvement of active-engaged learning time.

Interfacing hardware and databases offer another method of using CAI. This relatively new use of the computer in the science lab can make experiments more accurate, efficient, and meaningful. Data can be received and stored or graphed automatically. Students can obtain more samples during a lab period and carry out a wider variety of experiments. Most importantly, students enjoy computer-based experiments because they see more clearly the relationship between classroom theory and laboratory reality. (Graef, 1983)

There are many aspects of CAI that are of value to the educational system. However, the problem exists that the programming language used to write CAI materials are more complex. Therefore, teachers usually are not qualified to write their own programs. Much of the software presently available was written by people who knew computer programming, but had little education background. (Beebe, 1983) However, new and easy-to-understand languages are now available to help teachers write programs that meet their own needs.

Doyle and Lunetta (1982), found that the effects of computer-based programs on achievement, cognitive development, and attitudes must be explored more carefully. While computers can enhance verbal learning, the wisdom of replacing hands-on experience with computer simulation is questionable. Microcomputers should complement and extend, but not replace, laboratory investigations.

Reported Methods for Studying Student Attitudes in Science

Interesting to note are the findings reported by Germann (1988) that attitude toward science in school accounts for about 16% of the variation (evaluations of a multiple of assignments) compared to 7% or less for pretest and summative scores. Germann continues to suggest this is explained by the fact that students with more positive attitudes attend better to classroom instruction, lab excerises, studying and homework than students with a less positive attitude. Once again, as mentioned in the previous chapter, attitude refers to the degree to which students like or enjoy science.

Johnson and Swoope (1987) designed an interest inventory to determine how children perceive male's and female's interest in using computers. A forty-six-item inventory was used to measure the samples response (interests) in using the listed items. A five-point rating scale ranging from very little interest (1) to very high interest (5) was used to measure the degree of interests that the sample had. This interest inventory was administered to approximately 300 students in grades 1,3,5,7,9, and 12.

From the Johnson and Swoope (1987) study, mean interest-level scores were tabulated and results indicated that computers were interesting to both sexes. Interesting to note is the fact that this study also showed that both sexes perceived boys' interest in general as significantly higher than girls' interest. Therefore, this finding suggests that we must be careful to avoid reinforcing this belief.

Enochs (1984) examined the effect on the general attitudes of fifth graders toward computers. In the Enochs study, the questions that were addressed were similar to the Johnson and Swoope study. In addition, Enochs pursued questions related to measuring any significant difference in general attitudes toward computers following beginning computer programming instruction. Also addressed in his study were the differences in attitudes toward computers between students who had home computers and those who did not.

In Enochs' study forty nine students made up the sample. A one-group pretest-post test questionnaire was used to measure attitudes toward computers. This Likert response scale consisted of ten items with a scoring ranging from strongly agree (5) to strongly disagree(1).

Results indicate that introduction to beginning programming can contribute to fostering positive attitudes toward computers. Interesting to note, Enochs' (1984) study showed that there is no significant difference in general attitudes between boys and girls.

In conclusion, Enoch (1984) recognizes the need for fostering a positive attitude toward math and science and that such attitudes are related to achievement. This statement suggests that the computer should be integrated into the math and science curriculum.

Does the computer hold much promise as a tool to enhance student achievement in science? What of the more traditional approach of lectures, laboratory work, and text assignments? Comparing the effectiveness of using the computer simulation with that of the more traditional hands-on laboratory experiences was the main focus of a study conducted by Choi and Gennaro (1987). In this study, the teaching of the concept of volume displacement to junior high students was selected because of its vital importance to the understanding of other concepts as density and Archimedes' Principle.

The Choi and Gennaro (1987) study consisted of a sample of approximately 128 students (63 males and 65 females) selected from five eighth-grade earth sciences classes. Findings indicated all subjects in this study had had previous experiences with computers in their math and science classes.

In conducting the experiment, the boys and girls were assigned to one of two treatment groups, the microcomputer-simulated experience group (experimental) and the hands-on laboratory experience group (control). Both groups were taught the same volume displacement concepts. The experimental groups were taught those concepts using the computer which made use of graphics, animation and color, as well as immediate feedback to enhance learning. the control groups were taught those same concepts using hands-on laboratory experiences.

After a two day experimental period, a twenty item post-test was administered to students of both groups. Choi and Gennaro (1987) found that computer simulated experiences were as effective as hands-on laboratory experiences. The results of the Choi and Gennaro study lend itself to perhaps examining the results after a longer treatment period.

Dalton and Hannafin (1988) examined the effects of various learning-teaching methods involving combinations of teacher and computer-based instruction as well as to assess the attitudes toward instruction.

In the Dalton and Hannafin study, the sample population consisted of 117 students from an eighth grade math course. The lesson used for their study dealt with the concept of computing the area of a circle. Four lesson variations were used to assess the effects of varied instruction. Traditional instruction with both traditional remediation and computer remediation. Computer instruction with computer remediation and traditional remediation made up the last two lesson variations. Upon completion of the lesson, each of the two groups, traditional and computer-based, were given a 10 item quiz. For those students falling below the mastery level (70%), they were provided remedial instruction with both traditional teacher directed methods and computer-based instruction. In addition to the achievement test administered at the conclusion of the experiment, the participants were also given a 20 item Likert-type survey to assess attitudes toward the method of instruction that they received.

In their study, Dalton and Hannafin (1988) found that students performed better when the method of instruction, traditional or computer-based, was varied from initial to remediation. This study also revealed that students receiving computer-based instruction reported more favorable attitudes than those receiving initial traditional instruction from the teacher. The results of this study suggest that both traditional and computer-based teaching methods are of greatest value when complementing one another (1988).

Menis (1984) examined the question as to whether the computer has an effect on the development of student attitudes toward the sciences by encouraging the students' levels of curiosity. In conducting his study, Menis placed sixty-five students into two groups, an experimental group and a control group. The experimental group had Apple II computers at their disposal while in the control group there were no computers.

A general attitude questionnaire and curiosity questionnaire were administered to both groups at the beginning of the school year (pretest) and after half a year (posttest). The structure of the questionnaires were such that there were five responses possible. A response of a 1 indicates the most positive , and a five the most negative.

Menis (1984) found from his study that in comparing attitudes of pupils in the experimental group and control groups there was very little differences observed before the beginning of the experiment (mean control =2.62, std dev. = .052; mean experimental = 2.66, std. dev. = 0.58). However, the difference in attitude after the experiment was considerable (mean experiment = 1.58, std. dev. = 0.50; mean control = 2.72, std. dev. = 0.62) . Therefore, Menis concluded that the use of computers provides an opportunity to develop personal curiosity and thus improve attitudes toward the sciences.

CHAPTER III

METHOD OF STUDY

Introduction

A Computer-Assisted Instructional program was developed and implemented for use in the ninth grade science curriculum at a rural high school in western Oregon with an enrollment of approximately 1160 students in four grades. The CAI program used by those involved in the study supplemented the instruction of physical science for approximately 220 students.

Subjects

The students involved in the study were placed into one of two groups. The Experimental Group included those students that were exposed to the use of computers, while the Control Group included those students that did not have the opportunity to use the computer. Because of class size, course scheduling and the number of physical science sections taught by individual teachers, an attempt was made to balance the population for each group. With the help of the high school counselors, class size was equally distributed (as much as possible) between the control and experimental groups.

For purposes of this study, three teachers instructed the experimental group, and one teacher instructed the control group. Both groups were involved in the study of the same material. Lectures, laboratory experiments, homework, review, and evaluation activities were used by the total population involved in the study.

The students involved in the study were informed as to the purpose of the survey (opinionnaire). They were told that the survey was to be used to examine student attitudes toward science and the use of computers in science. Students were informed at the beginning that the researcher would share the survey results with the students. Teachers involved in the study will also have the opportunity to review the results.

The population used in this study consisted of 222 students. The total sample comes from a variety of educational backgrounds. There are five elementary schools and one junior high school that feed into the high school. Because of the varied learning background that this sample brought to the high school, this researcher expected that a small percentage of the sample would have some degree of familiarity with computers.

Human Subjects Proctection

The names of all students and teachers involved in the study remained anonymous. Utilizing a coding system enabled this researcher to not only protect the identity of the teachers involved in the study, but to inventory the survey results as well. Teacher A and the class periods involved in the study were identified by A-1 and A-7. Teacher B and the class periods were identified by B-2, B-3, B-6, B-7, and B-8. Codes C-3, C-5 and D-8 were used to identify teachers C and D. Teachers A,C, and D were identified as instructors for the experimental group and Teacher B as the instructor for the controlled group.

Procedures

During the early part of the first quarter of school during the 1989-90 school year, the students were given an opportunity to respond to a 20 statement opinionnaire devised by this researcher (Appendix A). The papers were filled out anonymously. Once the pre-test (survey) results were tabulated and group means and standard deviations calculated, they were stored on computer disks for use at the conclusion of the study. After the pre-test results were measured, the study was in progress.

Measuring mass, length, and volume are skills typically experienced by freshmen science students at the beginning of the school year. Students often experience difficulty and frustration with such concepts such as mass, volume, and density. Does the computer enhance student learning? To measure any change in attitudes toward science, the first unit of study dealt with the concepts of mass, volume, and density.

Both the experimental and the control groups were first presented with text material utilizing lectures and demonstrations. Teachers used the same demonstrations, i.e., using a metric ruler, triple beam balance, and a graduated cylinder to measure mass and volume. Proceeding this, skills to measure mass, length, and volume were practiced in laboratory work. After the students became familiar with the mentioned skills, the students in both groups applied those skills in calculating densities of various objects.

To begin measuring any change in attitudes toward science, the experimental group supplemented their learning by working in pairs with a tutorial software program, *Measuring Mass, Length, and Volume* (Blake, 1984) from Focus Media . The control group used additional lab experiences to practice and to master the skills of using a metric ruler, triple beam balance, and a graduated cylinder.

In developing research skills, the control group was scheduled time in the school library. The objective of the lesson; to research and gather information related to the properties of the elements (metals and non-metals) and the relationship to their position on the periodic table. With the gathered information, group reports were then written and presented to the class. The experimental group, presented with the same objective, utilized the computer lab and selected software programs to gather their information. The *Physical Science Data Bases* (McLeod and Hunter, 1985) by Scholastic allowed the experimental group to work with several database activities. *Periodic Table* (Goth, 1986) also from Prentice-Hall provided the experimental group with an opportunity to work with a computer simulation. Just as with the control group, the experimental group also presented group reports to the class.

Other computer-assisted instructional programs employed in this study consisted of programs written commercially and purchased for use in the school's computer lab.

In the unit of study related to speed, velocity, and acceleration, once again both groups were presented with similiar lectures, demonstrations, and labwork. The experimental group supplemented their learning by working in small groups using *Newton's Laws of Motion* (Bailey, 1986) from Prentice-Hall, as a simulation of some lab work and lecture presentations. To evaluate the students understanding, both groups conducted the same lab. The objective, to design and conduct a lab to measure the acceleration of a free-falling object. The control group designed, conducted, and reported their results using a lab report format which included data and graphs related to the experimental data. The experimental group utilized *Precision Timer* and *Graphical Analysis III* (Vernier, 1986) from Vernier Software which provided the experimental group an opportunity to interface with the computer in conducting and analyzing laboratory data. Lab reports as well were generated.

Upon completion of the course (end of the first semester), the students responded to another copy of the same opinionnaire, again anonymously. After the results were recorded, this researcher was able to stastistically analyze the data which would indicate any possible changes in attitude toward science.

Analysis of Data

Utilizing the computer as an instructional tool and with the development and implementation of computer-assisted instructional materials, students did develop a positive change in attitude toward science.

Individual survey items were analyzed by the frequency of positive responses (scores of 4 or 5 on survey), by the percentage of positive responses, and by calculating means and standard deviations for all groups. Appendix B shows the method of scoring the survey items.

Objectively, this research shows a direction of difference in a students attitude toward science. This change in attitude is demonstrated by using a one-tailed test of significance. The difference between pre and post test scores were evaluated by calculating the t-ratio for non-independent means using a one-tailed test of significance with a probability of .05 as the designated level of significance. As mentioned, the Likert-Type Opinionnaire used by this researcher was composed of 20 questions with directions on how to take the test. A sample of this opinionnaire is found in Appendix A.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

Does the use of Computer-Assisted Instructional materials enhance student attitudes toward science? This study addressed the effect that computers have in regards to student perceptions of science.

To measure student attitudes and perceptions of science in the control and experimental groups in this study, pre-test results and post-test results were analyzed. To aid the reader, several different figures are included, showing the percent responding (strongly agree or agree) of students in both the control group and the experimental group. Additional tables are included to show comparisions of mean scores. Appendix C shows the results and calculations of the t-test.

Table I shows the percent responding positively throughout the study. A comparision can be easily made regarding the differences between pre-test and post-test scores following treatment for the expermental group. Once again, percent responding positively refers to the sum of four's and five's (strongly agree and agree) as identified on the pre and post-test opinionnaire.

Table I. Student Perceptions of Their Science Classes:

Percent Responding Positively (Strongly Agree & Agree)

Situation		Pre-Test		Post-Test	
	GROUP:	Control	Experimental	Control	Experimental
	n=	114	108	103	111
A. Science Teachers:					
1) makes science exciting		31.9%	19.3%	6.8%	65.2%
2) knows a lot about science		76.5%	79.1%	74.8%	92.0%
3) likes me to ask questions		53.3%	51.9%	37.5%	83.6%
4) encourages me to share ideas		42.0%	27.8%	22.3%	68.5%
B. Science Classes:					
1) are interesting		31.1%	31.8%	24.0%	49.5%
2) makes me feel successful		23.8%	20.9%	16.5%	34.2%
3) reading is difficult		35.2%	34.5%	41.9%	38.4%
4) dislike coming to		39.5%	26.4%	52.4%	18.0%
5) take no more than needed		52.1%	33.6%	54.9%	27.0%
C. Science Course Content:					
1) are useful		27.5%	34.5%	17.5%	50.0%
2) will be useful in future		34.7%	50.9%	28.2%	55.7%
3) too much time spent on exper.		14.4%	7.3%	11.5%	11.0%
4) enjoy science experiments		80.7%	68.5%	73.8%	82.4%
5) exper. are hard to understand		20.0%	15.5%	22.3%	19.3%
D. Use of Microcomputer:					
1) desire more		49.6%	41.1%	51.9%	48.6%
2) did not help learning		21.5%	12.6%	23.5%	25.0%
3) do not feel comfortable		17.5%	20.0%	10.7%	13.8%
4) CAI is motivating		26.7%	21.9%	27.9%	45.5%
5) lessons well prepared		27.5%	16.7%	28.8%	50.9%
6) CAI was useful		28.9%	20.8%	23.8%	52.7%
Average %		36.7%	31.8%	32.6%	46.6%

Following the administration of the post-test survey, each item was analyzed and mean scores were computed and compared. Results of the mean scores are found in Table II.

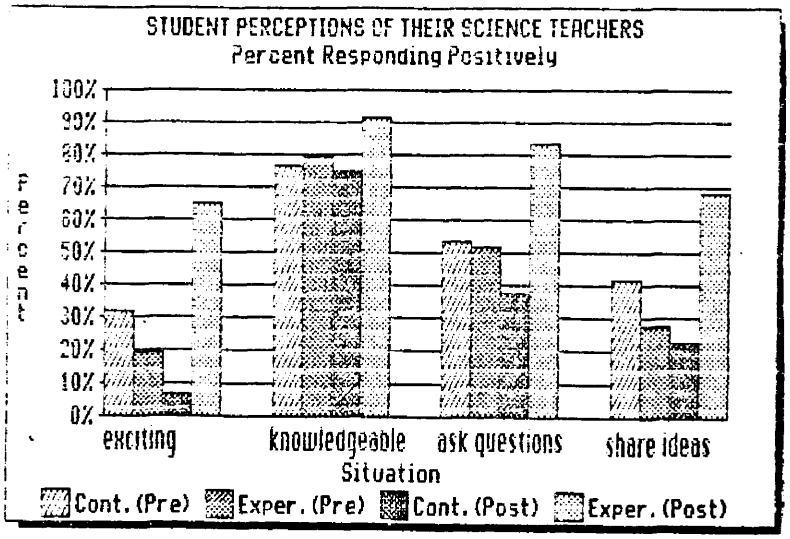
Table II. Mean scores calculated for each survey item:

	Pre-Test		Post-Test	
Item #	Control	Experimental	Control	Experimental
1)	2.9	2.3	2.1	3.7
2)	4.0	4.1	4.0	4.5
3)	3.5	3.3	3.2	4.1
4)	3.2	2.7	2.8	3.7
5)	2.5	2.4	2.4	3.3
6)	2.5	2.3	2.2	3.2
7)	2.3	3.0	2.5	3.0
8)	2.9	3.0	2.5	3.1
9)	2.1	2.6	2.0	2.8
10)	2.7	2.8	2.2	3.3
11)	3.1	3.4	2.6	3.6
12)	1.9	2.2	2.6	1.8
13)	4.8	4.5	4.5	4.7
14)	2.8	3.2	2.7	2.4
15)	3.7	3.4	3.7	3.7
16)	3.0	1.8	3.0	2.2
17)	1.8	2.7	2.9	2.7
18)	3.0	2.5	2.9	3.3
19)	2.9	2.2	2.7	3.5
20)	3.0	2.6	3.0	3.3
Total	58.6	56.8	56.5	66.0

At the conclusion of the study, survey items relating to science teachers making science exciting show a dramatic increase (46 %) for the experimental group. A twenty five percent drop in positive responses was noted for the control group. Utilizing a new and different media (CAI materials) suggests a possible explanation for the wide differences between groups.

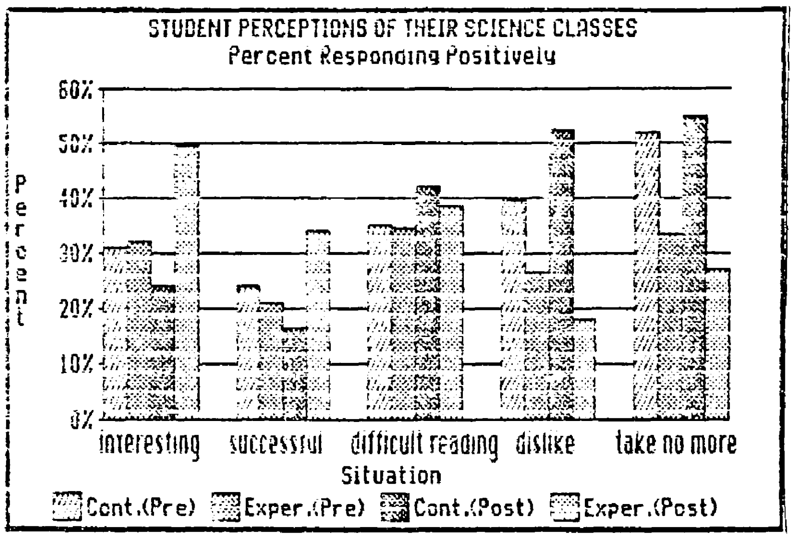
Figure 1. shows an increase in general for the experimental groups and their perceptions of science teachers. Compared to the control group, there is a significant difference (increase) for each item. However, both groups favored a high percentage of positve responses relating to a science teachers knowledge of the subject matter.

Figure 1.



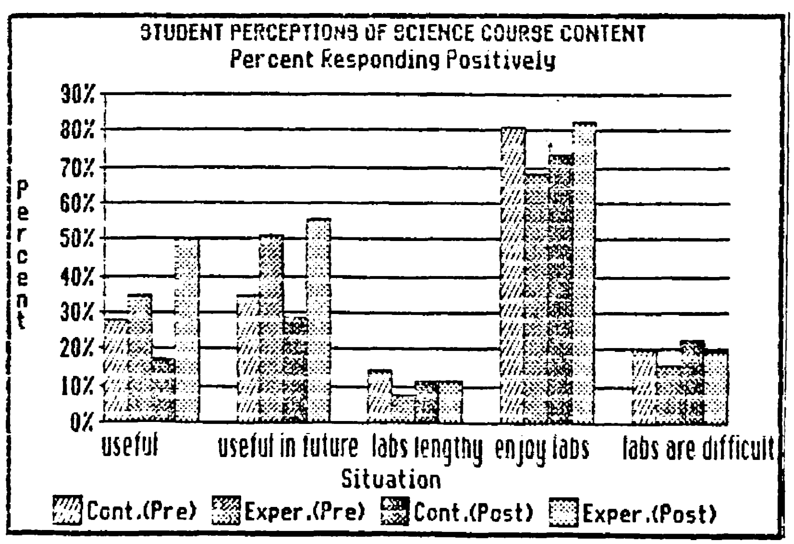
Survey items five through nine measured the students' attitude toward their science classes. Results related to both the control and experimental groups perceptions are shown in Figure 2. Interesting to note, student interest and success in science shows approximately a twenty five percent and fifteen percent increase for the experimental group respectively. Concerning the reading of science (seven percent increase) and dislike for science (thirteen percent increase) the study revealed a decrease in positive responses for the control group. Post survey results for the experimental group also indicate an increase (small) in the difficulty of reading science. However, when students were asked to respond to items relating to their dislike and taking no more than needed, a dramatic difference was revealed. A decrease in percentage points for the experimental group reflects a positive growth concerning these items (dislike and take no more than needed), while an increase in percentage points reflects the control group's growth in negative attitudes.

Figure 2.



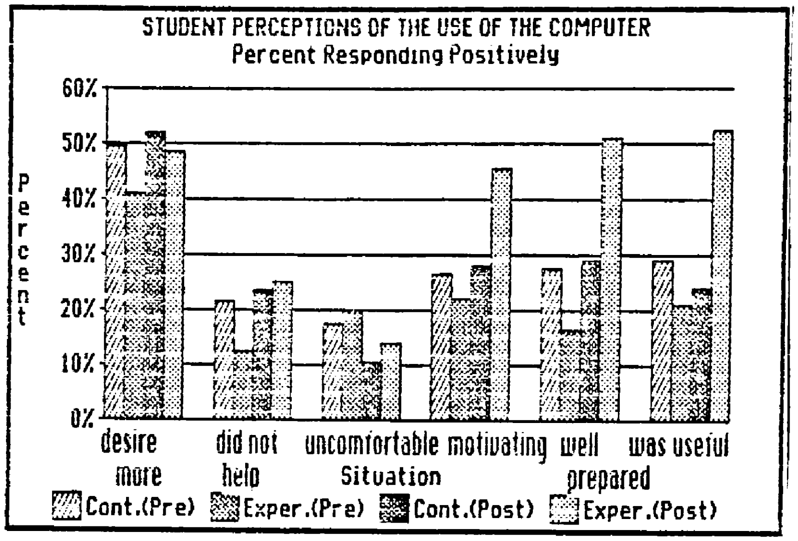
Results of this study show similiar attitudes/perceptions related to laboratory work. However, as shown in Figure 3, a difference is noted regarding the usefulness of science and science being useful in the future.

Figure 3.



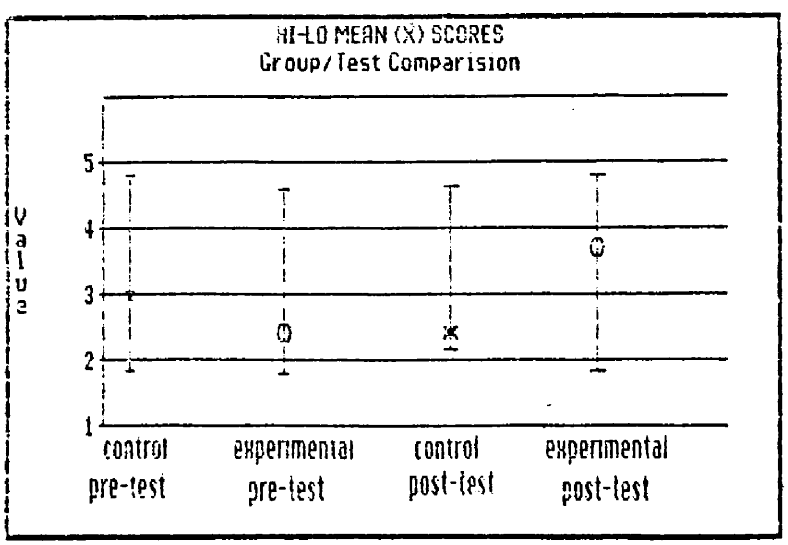
Results of the survey also indicate that the use of CAI material reflects an increase in motivation as well as being useful as shown in Figure 4. As described in the study, the control group did not have the opportunity to use the computer or any computer-assisted instructional materials. The difference in percentage points, small increase in positive responses for the control group, suggests that those students had some familiarity with the computer.

Figure 4.



Group and test comparisions are shown in Figure 5. The high and low scores are respresented on the graph which includes the mean scores. One can see from this information, that there is an increase in the mean item score for the experimental group and a drop in the mean score for the control group. Further analysis shows that the range of high/low scores decrease for the control group while they appear to remain about the same for the experimental group.

Figure 5.



Looking at the source of students responding positively, one can easily recognize the effect that CAI has on motivating students in science as well as being useful (shown in Figure 6 and 7).

Figure 6.

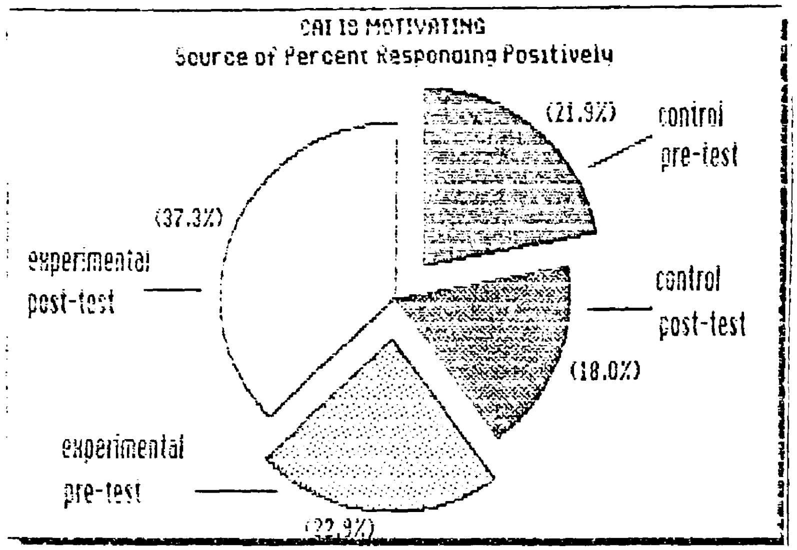
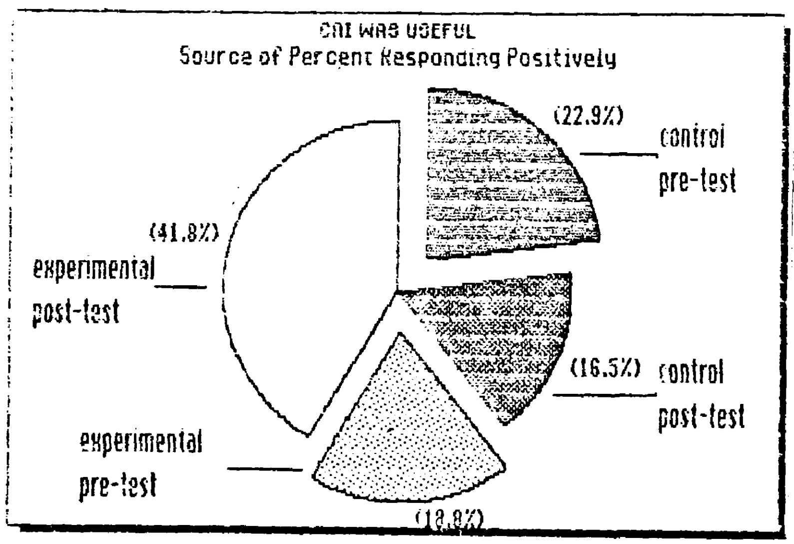


Figure 7.



In contrast, the results of this study show an increase in the sample's attitudes toward their science class for the experimental group, while no change was noted in the control group (Figure 8). Related to this evidence, Figure 9 shows a decrease for the experimental group for their dislike in coming to science class (considered positive).

Figure 8.

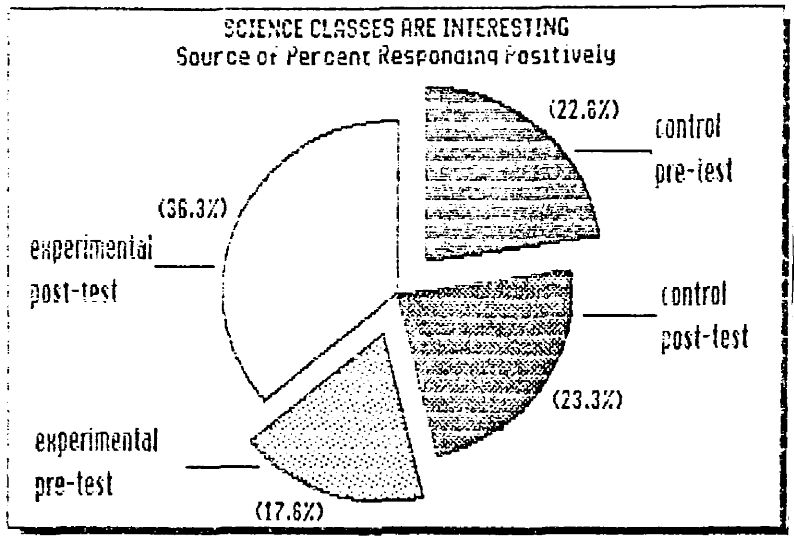
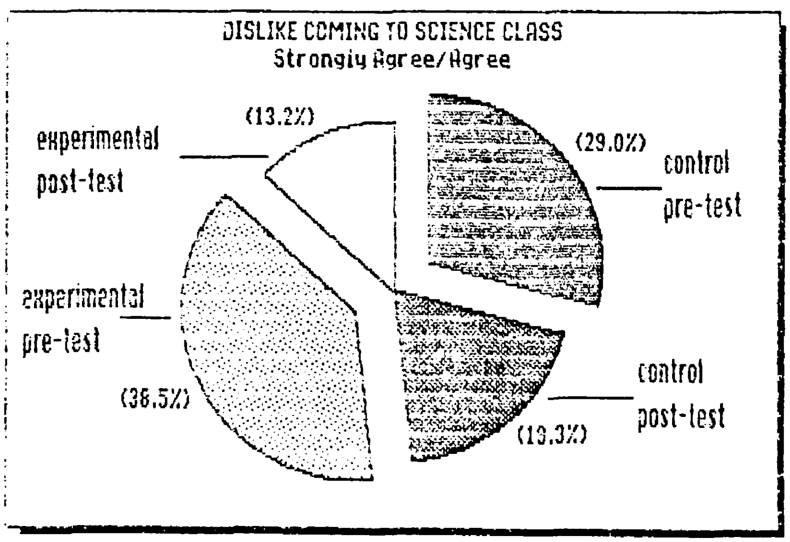
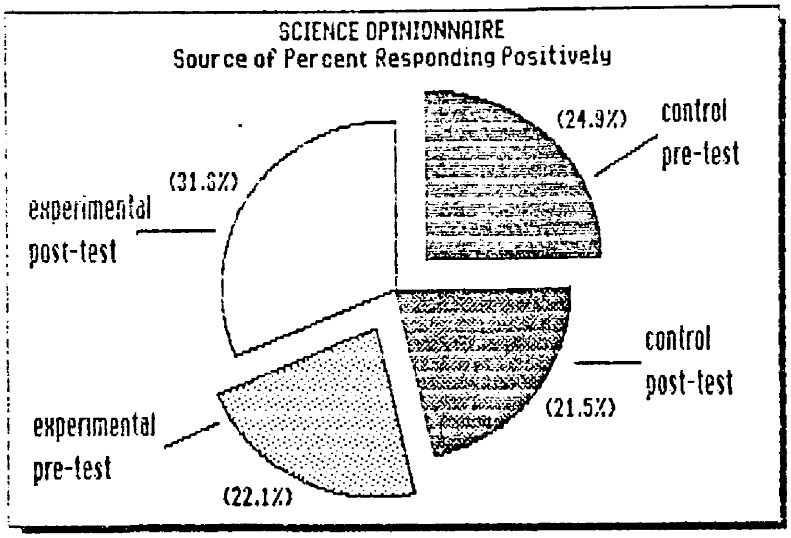


Figure 9.



Helping to suggest that the computer and CAI materials did contribute to a positive change in attitudes, the number of positive responses (four's and five's) were tabulated for both groups. After data analysis, this researcher found an interesting result. This study revealed a significant increase in the number of positive responses for the experimental group compared to a decrease for the control group (shown in Figure 10).

Figure 10.



The results of the study showing the group differences in the mean scores and standard deviation for the pre-test and post-test are shown in Appendix C of which, was used in calculating t-test scores (one-tailed test at .05 level of significance).

CHAPTER V

DISCUSSION and RECOMMENDATIONS

Discussion

Does the use of the computer help motivate students, perhaps even help develop positive attitudes toward science? This study evaluated the effect that the computer and selected computer-assisted instructional materials have on students' attitudes and perceptions of science.

With the availability and importance of computers in todays society, there is a need to utilize this medium in the educational setting. At the high school, an attempt is being made to incorporate the use of computers into the science curriculum.

How are these computers and CAI materials to be used in the classroom? Does the use of the computer and computer-assisted instructional materials really enhance a student's perception of science? The purpose of this study was to determine the effect that the computer and CAI materials have on student attitudes of science. It is the belief of this researcher, that if attitudes toward science can be improved, so can achievement.

To help measure the effect that the computer and CAI materials have on students attitudes toward science, the tested population was placed into one of two groups. Those groups, the experimental group (regular curriculum supplemented with CAI materials), and the control group (regular curriculum without the use of the computer and CAI materials) were identified at the beginning of the first semester of the 1989-90 school year. At the beginning of the study, both groups responded to a 20 item survey (pre-test). At the conclusion of the study, (end of the first semester) the sample once again responded to the same 20 item survey (post-test). Results of the survey were evaluated by calculating the t-ratio for non-independent means using a one tailed test with .05 as the designiated level of significance.

Results from the two groups suggest that computers do enhance student attitudes toward science. When examining items related to science classes, the data reveals an increase of about 18 % in positive responses for the experimental group compared to a decrease of 7% for the control group. This study also reveals convincing evidence that supports the use of CAI materials in the science curriculum. Figure 4 shows a growth of 24% for the experimental group related to the motiviational effect that the CAI materials had on their attitudes. Even more dramatic, is a growth of approximately 32% in the experimental groups response to the usefulness of CAI materials, as noted in Figure 4. In support of this statement, one can also see from Table II, that item number eighteen which pertains to whether the CAI materials used in this study was motivating, reveals an increase of a mean score of 2.5 to 3.3. Once again, this information reflects a growth in positive attitudes for the experimental group only. Compare this increase in the experimental group to a decrease of 0.1 point for the same item analysis for the control group.

In comparing the post study data, this study seemed to indicate no major difference in student attitudes toward the amount of laboratory work or the difficulty of laboratory work. A noticeable difference might have possibly been detected but was restricted by the limited number of interfacing software programs available at the time of this study.

Statistically, this study indicates, that computers have a positive effect on the attitudes/perceptions of ninth grade students in science. Because of the large size of the test population, a one-tailed test was used to determine if there was a difference in attitudes. The t-test result (one-tailed test at .05 level of significance) of 1.829 exceeds 1.64, critical value for rejection (Best, 1981). Data and calculations are found in Appendix C. Therefore, this study provides strong evidence that the use of the computer and CAI materials do make a difference in student attitudes and the teaching of science.

Limitations

Unforeseen, transfers between classes did occur during the study. Soon after the beginning of the study three students transfered classes, this change was requested by the school counselors because of conflicts with other classes. Student add/drops occurred due to transfers was experienced as well. The effect that these factors had on the outcome of the study was considered small because of the small number of students involved. The size of the total test population at the beginning of the study as noted was two hundred twenty two students. At the end of the study the size of the test population was two hundred fourteen students, a difference of eight students, a change of less than one percent.

Teacher personalities although not measured in this study, did affect the outcome of the study to some degree. Responses from the test population on item twenty one indicated to some extent that the control group experienced some frustration because of not having the opportunity to use the CAI materials. This factor needs to be controlled but was not considered in this study.

However, it should be noted that those teachers involved in the study found that the computer had a positive effect on attitude, though the effect on achievement and learning rate varied. This factor perhaps could be related to teacher-student expectations as well as teacher personalities.

Recommendations

This study suggests that the use of computers and computer-assisted instructional materials do enhance student attitudes toward science. Results obtained here support the Dalton and Hannafin (1988) study which states students that are exposed to computer-based instruction favor more positive attitudes than those experiencing the more traditional approach. This study suggests that the traditional science class could supplement the instructional methods with a variety of computer and CAI experiences which would lead to an increase in positives attitudes toward science.

Suggestions for Further Research

Although this study concerned itself with the effects that CAI materials had on student attitudes toward science, other factors became evident during the course of this study.

One should examine the influence that CAI materials have on student achievement. Varying the type of software programs, i.e., tutorial, drill and practice, and simulations, to measure student achievement could offer valuable information for the educator.

APPENDICES

APPENDIX A
SCIENCE OPINIONNAIRE

SCIENCE OPINIONNAIRE

Directions: Please rate the following statements based on how you feel about science and the use of the computer in the science class. Answer as honestly as possible by circling the number which best describes your impressions. Your comments and suggestions are invited on the reverse of this form.

DO NOT SIGN YOUR NAME.

	High				Low
1. My teacher makes studying science exciting	5	4	3	2	1
2. My teacher knows alot about science	5	4	3	2	1
3. My teacher likes me to ask questions about science	5	4	3	2	1
4. My teacher encourages me to share ideas	5	4	3	2	1
5. When studying science, I find it interesting	5	4	3	2	1
6. Science makes me feel successful	5	4	3	2	1
7. Reading science is difficult	5	4	3	2	1
8. I dislike coming to science	5	4	3	2	1
9. I do not want to take any more science classes than I have to take	5	4	3	2	1
10. Things I learn in science are useful to me when I am not at school	5	4	3	2	1
11. I think that knowing alot about science will help me in the future	5	4	3	2	1
12. I think we spend too much time on experiments	5	4	3	2	1
13. I enjoy doing the science experiments	5	4	3	2	1
14. Experiments are hard to understand	5	4	3	2	1
15. I desire to do more computer work	5	4	3	2	1
16. The CAI materials used in science did not help my learning	5	4	3	2	1
17. I do not feel comfortable with the computer	5	4	3	2	1
18. The CAI materials are more motivating to me than the traditional methods of instruction	5	4	3	2	1
19. The CAI materials were well prepared	5	4	3	2	1
20. The CAI materials were useful in increasing my comprehension of the concepts presented	5	4	3	2	1

21. Complete this sentence any way you wish. Please write on this paper.

I think science class ______________________________

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____

____

APPENDIX B

LIKERT-TYPE OPINIONNAIRE TEST SCORING METHOD

Item #	Strongly Agree (High)	Agree	Undecided	Disagree	Strongly Disagree (Low)
1.	5	4	3	2	1
2.	5	4	3	2	1
3.	5	4	3	2	1
4.	5	4	3	2	1
5.	5	4	3	2	1
6.	5	4	3	2	1
7.	1	2	3	4	5
8.	1	2	3	4	5
9.	1	2	3	4	5
10.	5	4	3	2	1
11.	5	4	3	2	1
12.	1	2	3	4	5
13.	5	4	3	2	1
14.	1	2	3	4	5
15.	5	4	3	2	1
16.	1	2	3	4	5
17.	1	2	3	4	5
18.	5	4	3	2	1
19.	5	4	3	2	1
20.	5	4	3	2	1

APPENDIX C
STATISTICS and t-TEST COMPUTATION

	Population (N)	Mean raw score (X)	Std. deviation
Pre-control group	114	2.93	.69
Pre-experimental group	108	2.85	.64
Post-control group	103	2.83	.62
Post-experimental	111	3.30	.70

Post-test results:

$$\frac{\text{Mean}_{(\text{experimental})} - \text{Mean}_{(\text{control})}}{\sqrt{\dfrac{\text{Standard deviation}_{(\text{experimental})}}{\#\text{ items}} + \dfrac{\text{Standard deviation}_{(\text{control})}}{\#\text{ items}}}}$$

$$\frac{3.30 - 2.83}{\sqrt{\dfrac{.70}{20} + \dfrac{.62}{20}}} = 1.829$$

The results of 1.829 exceed 1.64, the critical value considered for rejection (Best, 1981). Therefore, this value indicates statistcal evidence that the use of the computer and CAI materials did make attitudinal differences regarding students' perception of science.

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