2010

Computer Based Instruction and Its Effects on 21st Century learners

Molly Knaack
Old Dominion University

Computer Based Instruction
Ands Its Effects On 21st Century Learners

A Research Project Presented to the Graduate Faculty of the Department of STEM Education and Professional Studies at Old Dominion University

In Partial Fulfillment of the Requirements for the Master of Science Degree

By

Molly Knaack
May 2010

Signature Page

This research paper was prepared by Molly R. Knaack under the direction of Dr. John Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted as partial fulfillment of the requirements for the Degree of Masters of Science.

APPROVAL BY:_____ _____

Dr. John M. Ritz — Date

Advisor and Graduate
Program Director

Table of Contents

List of Tables

CHAPTER I

Introduction

Why is incorporating technology in the classroom such a burden for some teachers? Does using technology help improve a student's performance on an Algebra Standard of Learning test? Do students who prepare for standardized tests using computer software outperform students that are taught using traditional teaching methods? Using the data provided by two Algebra instructors, the researcher analyzed scores the students received in four categories of Algebra: expressions and operations, relations and functions, equations and inequalities, and statistics.

Teachers can incorporate a wide range of technology elements into their classroom. Computer software is also available to teach all kinds of mathematical concepts. Students no longer have to sit at a desk and watch their teachers perform numerous mathematics problems using only a whiteboard, chalkboard, or overhead. Teachers are able to use technology their students have grown up with to cover concepts. Does the use of computer technology increase student learning?

Statement of Problem

At a high school in southeast Virginia, one Algebra instructor used the Orchard mathematical software program to cover concepts. However, mathematical instructors seem to struggle with the idea of changing their lesson plans to accommodate the new software program. The computer program should not be a hindrance to teachers; they should be embraced it. Teachers should use technology software to facilitate instruction not only for their own progression in the teaching field but to help maximize their student's learning potential. This led the researchers to establish the following research

problem. The problem of this study was to determine if the use of the computer assisted instruction enhanced the performance of students in Algebra 1. As Hannifin (2008) states:

> The pass rates for students that were taught Algebra 1 using the computer-based methods exceed the success of the students taught with traditional methods. In 1999, the pass rate for Algebra 1 improved from 47% to 75% with the introduction of the computer in daily lessons. The instructor was very positive about the impact of the computer and believed it gave students a chance to succeed when more traditional methods had failed. (p. 121)

Hypothesis

This analysis will show there is no direct correlation between computer software usage in the classroom and a student's performance on the Algebra SOL test. When evaluating SOL Algebra 1 data, the researcher determined whether the Orchard software program influences a student's ability to successfully pass their Algebra SOL test. The researcher will also evaluate the student's performance in four key areas of Algebra: expressions and operations, relations and functions, equations and inequalities, and statistics.

To guide this study the researcher established four hypotheses.

HO_1: Algebra 1 students who use the Orchard software program will show no significant improvement in expressions and operations.

HO_2: Algebra 1 students who use the Orchard software program will show no significant improvement in relations and functions.

HO_3: Algebra 1 students who use the Orchard software program will show no significant improvement in equations and inequalities.

HO_4: Algebra 1 students who use the Orchard software will show no significant improvement in statistics.

Background of the Problem

Technology has evolved over the years in many ways. Computers have gotten smaller, faster, and more efficient. Items that accompany the computer such as input and output devices have changed making the computer portable and in turn making it one of the most valuable devices on our planet. Businesses and government offices rely heavily on computers. A sole computer could determine a company's daily success or failure.

Schools have realized that in order to compete globally, students must be exposed to technology. Many local school boards have allocated millions of dollars to be spent on computers. Additional personnel have also been hired to make sure teachers and students are knowledgeable of how to use various forms of technology. High schools in southeast Virginia are staffed with a computer repair specialist to make repairs and updates to the computers. As Menosky (2009) states:

> Certainly teachers have a great deal to gain from a universal acceptance of computer literacy. Microcomputer firms selling hardware, textbook companies selling educational software, organizations selling worker and teacher retraining courses, and writers and publishers selling books and instructional guides have done a brilliant, if morally indefensible, job of commercial promotion. (p. 21)

Significance of Study

If this research study determines using the Orchard software program is beneficial to a student's overall achievement, teachers should embrace the concept of teaching Algebra via a computer. Teachers should rally together to educate themselves on using

the software program. Lastly, everyone will benefit from this new teaching practice. Students will be engaged and better prepared for the 21st century. As Podell (1992) explains:

> There are a myriad of reasons for teachers to encourage their students to use computers in conjunction with learning objects. In some settings, students gain more from computer-based lessons than other instructional methods. One example where gains were noted was in arithmetic skills. The National Research Council expects students to be able to access, gather, and store using hardware and software. Finally students that enter the job market will be disadvantaged when they enter the job market. (p. 123)

Procedures

The researcher planned on analyzing data from two Algebra 1 instructors. The data that will be analyzed is from the winter 2009 Algebra 1, part A, Virginia Standards of Learning (SOL) examination. Both teachers taught three classes of Algebra 1, part A. The data will be analyzed using a t-test analysis to determine the significant gains in performance made in the Algebra 1 course in the areas of expressions and operations, relations and functions, equations and inequalities, and statistics.

Background on Instructors

In this study, one of the instructors is a very dynamic male and revered Algebra teacher. He is the varsity soccer coach and liked by all of his students. He does not use technology in the classroom, but yearly generates a very good rapport with his students and in turn they perform very well on their SOL test. He has even won the school's teacher of the year award. One researcher (1996) explains:

> Based on an analysis of data collected over a 2-year period, Moye argues that the relationship established between the teacher and her students motivates them to engage in activities. If a teacher cares deeply about her students' success, students will sense and appreciate the teacher's caring for them and responded positively to the strategies she teaches. (p. 172)

The second teacher is not dynamic in the classroom, but she daily uses technology. She prefers to use the computer software program called Orchard to teach her algebraic lessons. The technology specialist in our school recorded this particular teacher using the computer lab at least four times a week with her students. Thomas (1996) asserts:

> Interviews, questionnaires, and observations of mathematics teachers in their implementation of computers in their classroom found using computers is unlikely to result in changes in learning or teaching unless the personal philosophy of classroom practice held by each teacher undergoes a major transformation. (p. 38)

Definition of Terms

The following terms are defined to provide consistency in this study.

1. Computer-device used for inputting and outputting data and information.
2. Equations and inequalities-calculating the equivalence of two systems.
3. Expressions and operations-subtracting, adding, multiplying, and dividing at least one variable.
4. Relations and functions-calculating the domain and range of polynomials.

5. Standards of Learning (SOL)-end of the course test required by the Virginia Department of Education.
6. Statistics-a branch of applied mathematics concerned with the collection and interpretation of quantitative data and the use of probability theory.
7. Technology-a broad range of items used to facilitate learning in a classroom, i.e., computers, printers, scanners, software, etc.

Summary

The teachers studied in this analysis allowed the researcher the opportunity to witness the affects of their teaching style and the application of computer technology. Both teachers were prepared for there classes. They attended in-services and training to help their students achieve optimum success. Teachers are responsible for having 100% of their students pass their end of the course SOL test. Their evaluation is based on their students' scores. This puts a great deal of pressure on a teacher's need to succeed.

Following will be Chapter II, which will review the literature on teacher attitudes towards using technology in the classroom, teacher and student behavior, and the Orchard software program. Chapter III will contain information pertaining to the Methods and Procedures used for the data collection. Chapter IV will contain the Findings, while Chapter V will draw Summary, Conclusions, and Recommendations.

CHAPTER II

Literature of Review

Every teacher has a different method for covering their subject matter. Some instructors prepare intensive lessons that will capture their student's attention with Power Point presentations, smart board lessons, or hands on activities. Other teachers use traditional teaching methods such as the overhead projector and notes given via the chalk/white board. Do lessons that are prepared in a fun and interesting way allow the learner to perform better? What influences students' overall performance on a standardized test, the teacher's delivery of the material or the methods used to cover the material? Does a teacher's behavior in the classroom or their use of encouragement and praise influence a student's performance?

In Chapter II the following topics will be reviewed: computers in schools, change in mindset, use of encouragement and praise, teacher behavior, student self perception, Orchard software program, past performance, gender, and summary. Many scholars have written on the topic of computer software usage in schools. Educators feel strongly regarding technology usage in the classroom. It is definitely easy to change your opinion on the subject after reading their compelling articles. Some educators feel technology hinders a student's performance and does not allow students the freedom to think and problem solve on their own. As Koblitz (1996) stated: "The researcher will argue, however, that there has been too much hype about technology in math education and it is time to consider the downside. In my opinion computers should not be a major component in math education reform" (p. 2).

On the other hand Barrow, Markman, and Rouse (2008) believe there might be some evidence to computer-aided instruction and its benefit in increasing the amount of individual instruction a student receives. "Teachers that use technology frequently tend to believe that computers help reinforce and keep some hard to reach students focused on the material they are trying to teach" (p. 42).

Young adults today are growing up surrounded by technology. The down side to this exposure is students' perception of what school should entail. Some students are now left with the impression that they should be entertained at school. They hold the belief that school should be a social and entertaining atmosphere. These beliefs cause problems for teachers who are set in their ways and unable to try new things in the classroom.

Change of Mindset

Some students thrive in classes that provide a strong reinforcement of lessons using technology. Teachers that use technology seem to be more dynamic in the classroom and are able to vary their lessons to meet the needs of all students in their classroom. Some realize that teachers that incorporate technology regularly into their classroom use it as filler rather than a facilitator. This study selected a teacher who used the computer lab daily to instruct student's Algebra via the computer. The teacher relied on the computer to provide instruction to students. The students do not receive individual instruction from the teacher. The students complete algebra problems that will be on their SOL test using a computer software program titled Orchard.

The second teacher for this comparative study was outgoing. Test scores were very good with several students receiving advance placement scores. This teacher does

not use any technology in the classroom. The teacher strictly uses the overhead projector and interacts constantly with his students. The students are also given several hands-on activities to supplement the material covered.

Use of Encouragement and Praise

Both instructors in this study believe in rewarding their students for their academic performance. The instructor that uses technology offers verbal praise for a job well done. If students behave she acknowledges their behavior through positive verbal reinforcement and the students that perform well on the chapter quizzes and tests are given homework passes. These passes allow the students a free night without homework. The students seem to like the idea of not having homework if they perform well on a test or quiz.

The other teacher does not use technology but also goes out of his way to reward students. He buys them treats regularly for their academic performance. If his student's display good character they are acknowledged on the morning announcements. It seems from watching his classes that he has much more classroom control and respect from his students.

Teacher Behavior

Does a teacher's behavior in the classroom affect a student's performance in their course? Students seem to excel in a course if they believe that their teacher cares about their overall success. As Belmont and Skinner (1993) state: "Students who are behaviorally disengaged receive teacher response that undermines their motivation. The importance of the student teacher relationship, especially interpersonal involvement, is optimizing student motivation" (p. 67).

The two teachers selected for this research study have very different teaching styles that influence their student's performance in the course. The teacher that uses technology daily is frequently absent due to health issues. This teacher is able to be absent and have her course taught by a guest teacher. The students are able to complete their lessons via the computer and specialized software for the course.

Student Self Perception

Students in both classes perceive their teachers as being competent in the subject matter. The teachers in this research study shared the same amount of teaching experience, ten years. A large number of the students had a hard time relating to the teacher that utilizes the computer software program to instruct her class. She does not have a good rapport with her students. After observing this teacher, the researcher felt she was not interested in establishing one either. She believed her primary job was to teach her students Algebra and have them successfully pass the Algebra SOL test.

The second teacher seemed to be well liked by his students. His students seemed to enjoy coming to class. The rapport that he has established with his students seemed effective. He demonstrated to his students daily that he liked his job and took their performance on the Algebra SOL test serious. He believed teaching was more than a job; it was a passion.

Orchard Software Program

The Orchard software program provides Algebra instruction for grades 9-12. This program combines formative and benchmark assessments aligned with the Virginia Standards of Learning test. The Orchard software program has become the preferred software choice for thousands of schools across the country looking to improve annual

yearly progress. It provides schools with a powerful solution that enables educators to adapt and deliver both individualized and whole class instruction that meets the needs of all students, including those with special needs. The program covers four key areas that are included on the SOL test: equations, inequalities, statistics, and functions.

Past Performance

The teacher who uses the Orchard software program has changed her way of teaching over the years. She originally only used the class text and overhead projector to teach Algebra. Observations showed an intense math lesson by the amount of marker ink that she accumulated on her forearm by the end of the day. She worked hard and well with her students, but the researcher realizes teaching was not her passion. App (1993) stated: "Teachers need to expect that learners will discover the meaning of learning from the heart and teachers will learn how to develop their own such learning and then to explore ways that they can teach from the heart" (p. 54).

The second teacher does not use any form of technology in his Algebra classes. He was awarded the teacher of the year his second year of teaching. He attends required training sessions, but he does not feel compelled to apply these new methods in his classroom. He believes in reaching his students using his own methods. This passage from LaBoskey (1995) sums up his teaching philosophy:

> According to my definition, the reflective teacher is one who questions and examines, as much and as often as possible, the reasons behind and the implications of her knowledge, beliefs, and practices. She recognizes teaching as a moral and political act and therefore, tries always to teach with tact, to interpret events and ideas from multiple perspectives. Since, I believe that reflection in

> teaching is not only a means for coming to know, but also a means for monitoring the moral and ethical ramifications of that knowledge, preparing my students to be reflective about their work is my primary purpose as a teacher. (p. 67)

Gender

Good (2003) stated in his research:

"Data show that male and female teachers behave differently in some ways, although they show similar patterns in their treatment of boys and girls. High-achieving boys, relative to other students, received the most favorable teacher treatment. But low-achieving boys received the poorest contact patterns with both male and female teachers." (p. 89)

With relation to the above study, the researcher believes there is some validity to what is stated. No matter what the data suggests, it is a teacher's job to reach every student in his or her classroom. On the same point, it is the student's job to learn the material presented. The teacher does not bare the brunt of taking full responsibility of a student's success in the classroom. In Hyde's study (1999) he states:

> Gender differences were smallest and actually favored females in samples of the general population, grew larger with increasingly selective samples, and were largest for highly selected samples and samples of highly precocious persons. The magnitude of the gender difference has declined over the years. Gender differences in mathematics performance are small. Nonetheless, the lower performance of women in problem solving is evident in high school. (p. 341)

A teacher's teaching style greatly affects a student's ability to perform in the classroom. Students strive for perfection in a class that they feel respected and challenged. They also appreciate if the material being taught has real world applications. Often if a student is asked why their grade in a specific subject is not good their response is to blame their performance on the teacher's ability to instruct them. Students respond better to instructors that keep them interested in the subject matter being taught and have thought provoking lessons that require student and teacher interaction.

Summary

The researcher has witnessed the benefits of positive reinforcement and a nurturing student teacher relationship. This behavior and relationship allows students to achieve optimum performance on their standardized tests. Teachers who set high expectations for their students and reward their progress build relationships that warrant success.

In Chapter III the following topics will be reviewed: methods and procedures, population, and statistical analysis. This chapter will address how the data is collected and summarize and how the students performed in the four categories of the Algebra SOL test.

CHAPTER III

Methods of Data Collection

This chapter explains how the data will be collected from two teachers participating in the research study. Each teacher is given a detailed printout illustrating how each one of their classes performed on the Algebra SOL test. The printout is compiled immediately after the students take the test. The test is given on the computer so the data is easily accessible by a school administrator after each class completes the test. Data will be collected to show how the students performed in the four key areas of the test: expressions and operations, relations and functions, equations and inequalities, and statistics. This chapter will contain information regarding student population, methods of data collection, statistical analysis, and summary.

Population

The population consists of both boys and girls in grades ninth through twelfth. The student's ages ranged from fourteen to eighteen. Each of the Algebra 1 classes consisted of approximately twenty students. All of the classes contained students with special needs. These students meet with a resource teacher at the conclusion of the day to review work given by the instructor and prepare for upcoming tests and quizzes. A total of fifty-five students will be evaluated in this research study. Thirty-six of the fifty-five used the Orchard software program daily.

Methods of Data Collection

The data will be collected from both teachers participating in the research study. They are given the data from the assistant principal of instruction following the test. The data are compiled using the Perspective software program. This is the online software

program that is the used to administer all SOL tests. The data gathered from Perspective will show the students name, student's identification number, scaled score, performance level, and the reporting category scaled scores. The reporting category scaled scores are the four categories that the researcher will be comparing between the two classes. The researcher will only receive student scores from both teachers with no student identifiers.

Statistical Analysis

After inputting the data into a statistical software package, the researcher will analyze the finding concentrating on four categories. As Ross states:

> Learning styles significantly affected learning outcomes, as indicated by a significant main effect, as well as an interaction effect between dominant learning style and achievement scores. It would appear that abstract random learners might be at-risk for doing poorly with certain forms of computer-aided instruction. Based on the review of literature and results found in this study, it was concluded that computer-aided instruction might not be the most appropriate method of learning for all students. (p. 81)

The t-test was used for testing differences between two means. The t-test is a measurement of different groups and a comparison to a known population. Comparing a sample mean to a known population is a test that appears in many statistical programs. The most common application of the t-test is testing the difference between independent groups or testing the difference between dependent groups.

Summary

The data gathered will illustrate the student's performance on the Algebra SOL test using two very different teaching styles. The data will show how each student performed on the SOL test in the four categories being evaluated. The data will also reveal whether using the Orchard software program is beneficial to a student's overall performance on the test. In Chapter IV, the researcher will compare the finding and test the hypotheses.

CHAPTER IV
Findings

Using a statistical program the researcher will evaluate the data gathered from the Algebra SOL course. The data will show how the students performed in the four categories of the test. The paired sample table illustrates the descriptive statistics for each of the four categories evaluated on the Algebra Standard of Learning test. The researcher will compare the scores the students received in the four categories being evaluated in each class, those using computer software and those who did not. A total of fifty-five students will be evaluated.

Group Not Using Software

The researcher compared the mean values of the four groups that did not use the software program. Nineteen students were evaluated. Table 1 illustrates the students who did not use the Orchard software program. The table shows how the students performed in the four categories of the Algebra SOL test. The descriptive statistics for each of the four groups as defined by the grouping of the variables were calculated. The averages of the four categories are displayed in the mean column.

Table 1

Students Not Using the Orchard Software Program

Category	Mean	N	
Expressions Operations	40.63	19	.
Relations and Operations	36.80	19	
Equations and Inequalities	37.89	19	.
Statistics	36.42	19	.

Students that Used the Orchard Software Program

The researcher compared the mean values of the four groups that did not use the software program. Thirty-five students were evaluated. Table 2 illustrates the mean for the students who used the Orchard Software program. The N column shows the number of students that participated in the test. As shown by the table, the students who used the Orchard software program did not perform as well on the test.

Table 2

Students That Used the Orchard Software Program

Category	**Mean**	**N**
Expressions and Operations	24.33	34
Relations and Operations	20.14	34
Equations and Inequalities	22.94	34
Statistics	27.20	34

Expressions and Operations

The mean for the category for expressions and operations was 24.33 for students that used the Orchard software program. The mean value for the students that did not use the software for expressions and operations was 40.63. The t value was calculated to be 8.01. The level of significance at the .01 level was 2.40. The Orchard software program does not show significant improvement in this category.

Relations and Operations

The mean for the category of relations and operations was 20.14 for the students that used the orchard software program. The mean for the students who did not use the software for relations and operations was 36.80. The t value was calculated to be 7.6.

The level of significance at the .01 level was 2.40. The software does not show significant improvement in this category.

Equations and Operations

The mean for the category of equations and inequalities was 22.94 for the students that used the Orchard software program. The mean for the students who did not use the computer software program for equations and operations was 37.89. The t value that was calculated was 7.14. The level of significance at the .01 level was 2.40. The Orchard software program does not show significant improvement in this category.

Statistics

The mean for the category for students that used the software was 27.20 in the area of statistics. For those students who did not use the orchard software the mean value for statistics was 36.42. The t value was calculated to be 3.70. The level of significance at the .01 level was 2.40. The Orchard software program does not show significant improvement in this category.

Summary

The data presented showed that the students who did not use the Orchard software program outperformed the students that used the software program daily. In all four categories, the data showed the software program did not help the students perform better on the Algebra SOL test. The data showed how the students performed in the four categories of the test. A total of fifty-five students were evaluated. The t values were

compared and the degrees of freedoms were established. In Chapter V the conclusions will be drawn based upon these findings.

Chapter V

Summary, Conclusion, and Recommendations

In this chapter the research will summarize the study, draw conclusions based upon the findings, and then make recommendations based upon the results of this study.

Summary

The problem of this study was to determine if the use of the computer assisted instruction enhanced the performance of students in Algebra 1. This research study explored using technology in the classroom to determine if student's scored better on the winter Algebra 1 SOL test. A teacher's techniques in the classroom appear to be the main factor that influences a student's performance. Using the Algebra 1 Orchard software program did not impact the student's overall scores in each of the four categories of the test. Students that are challenged in the classroom using an interactive, hands-on approach to the subject matter will perform better than students who repetitively using the computer to grasp concepts. Students need a challenge and change to make lessons interesting and appealing. They must also grasp how the subject matter has real-life applications. The data helped the researcher determine how students performed in the four categories of the Algebra 1 SOL test. Since the test is given on the computer in an untimed setting, the researcher assumed the students that used the Orchard software program would outperform the students taught using traditional methods. The data collected from the teachers who participated in the study showed that using the Orchard Software program does not have an effect on a students overall performance. The teachers provided the data from one of their Algebra I classes. The data was inputted into a statistical program and analyzed. After analyzing the data, the

researcher was able to deduce that using computer software does not have a direct impact on a student's performance on the Algebra SOL test.

Conclusion

The researcher has learned the following from the data gathered from the research study.

HO_1: Algebra 1 students who use the Orchard software program will show no significant improvement in expressions and operations.

As the data analysis illustrated, the students that used the Orchard software program had a mean score of 24.33. The students that did not use the software program had a mean score of 40.63. The t value was 8.01. It exceeded the .01 level of significance at 2.40. The Algebra 1 Orchard software program does not show significant improvement in the category of expressions and operations, therefore this hypothesis is accepted. The researcher concludes that the Orchard software program did not help students improve their score in the category of expressions and operations.

HO_2*:* Algebra 1 students who use the Orchard software program will show no significant improvement in relations and operations.

As the data analysis illustrated, the students that used the Orchard software program had a mean score of 20.14 in the category of relations and operations. The mean for the group that did not use the Orchard software program was 36.68. The t value was 7.60. The hypothesis can be accepted at the .01 value of 2.40. The researcher concludes that the Orchard software program did not help students improve scores in relations and functions of the Algebra 1 course.

HO_3: Algebra 1 students who use the Orchard software program will show no significant improvement in equations and inequalities.

As the data analysis illustrated, the mean score for students that used the Orchard software program is 22.94. The mean for the group that did not use the software was 37.89. The t value is 7.14. The hypothesis can be accepted at the .01 value of 2.40. The researcher concludes that the Orchard software program did not help students improve scores in the category of equations and inequalities; therefore this null hypothesis was accepted.

HO_4: Algebra 1 students who use the Orchard software will show no significant improvement in statistics.

The mean for students who used the Orchard software program was 27.20. The mean for the group that did not use the software was 36.42. The t value was 3.70. The hypothesis can be accepted at the .01 value of 2.40. The researcher concludes that the Orchard software program did not improve students' scores in statistics, therefore this hypothesis was accepted.

As shown through the above four hypothesises, the students that used the Algebra software program daily did not outperform the students who were instructed using traditional teaching methods. The students that used the software program performed well, but the data concludes that their scores were not significantly better.

Recommendations

Students who are engaged in the classroom with the material being taught will usually perform well on a standardized test. Students at times must be entertained and

instructed in a dynamic setting with hands-on activities that require interaction by both the teacher and student. The teacher that captures their audience and makes learning fun and enjoyable to the student will have a captive audience. Sitting behind a computer daily computing repetitive algebra problems using the Orchard software program is not a substitute to the interaction gained from an instructor. The researcher suggests that both instructors use the Algebra Orchard software program as a supplement for a marginal amount of Algebra lessons. This can then be used to reinforce what they have learned and assist them in practicing for the standards examination in algebra. Daily lessons using the software does not benefit students nor does it increase their scores on the test. Further research needs to be undertaken regarding the benefits of the Orchard software program.

REFERENCES

Belmont, C. (1993). Mathematics for teachers an interactive approach. *Educational media and technology: The Year in Review, 23,* 67.

Coltheart, M., Curtis, B., Atkins, P., & Haller, M. (1993). Models of reading aloud: dual-route and parallel-distributed-processing approaches. *Psychological Review, 100*, 608.

Ely, D. P. (1991). Computers in schools and universities in the United States. *Educational Media and Technology: The Year in Review,* 25.

Ester, D. P. (1995). CAI, Lecture, and Student Learning Style: The differential effects of Instructional Method. *Journal of Research on Computing in Education, 27* (2), 129.

Goodson, I., & Mangan, M. (1991). The use of computers for classroom learning. *Curriculum and Context in the Use of Computers for Classroom Learning, 2*, 82.

Good, J. (2003). Computers and mathematics. *Educational Media and Technology: The Year in Review*, *34*, 89.

Jobst, J. W., & McNinch, T.L. (1994). The effectiveness of two case study versions: printed versus computer –assisted instruction. *Journal of Technical Writing and Communication*, *24*(4), 433.

Hannifin, R. (2008). Computer based instruction's rediscovered role in k-12. *Journal of Research on Computing in Education*, *29*(3), 121.

Hyde, W. (1999). Interfacing modeling and simulation with mathematical and computational sciences. *Journal of Research*, *34*, 341.

Keeler, C. M. (1996). Networked instructional computers in the elementary classroom and their effect on the learning environment: a qualitative evaluation. *Journal of Research on Computing in Education, 28*(3), 345.

Koblitz, J. (1996). The case against computers in the classroom. *Journal of the Mathematical Intelligencer*, *18*(1), 2.

Kulik, C. C., & Kulik, J. A. (1986). Effectiveness of computer-based education in colleges. *AEDS Journal*, *19-20*(1), 81-108.

LaBoskey, (1995). *A good teacher in every classroom: preparing the highly qualified teachers our children deserve,* 23, 67.

Linn, S. E. (1997). The effectiveness of interactive maps in the classroom: a selected example in studying Africa. *Journal of Geography, 96*(3), 164 – 170.

Menosky, J. (2009). The case against computers in education. *Journal of the Mathematical Intelligencer,* 18(1), 21.

Moye, J. (1992). Mathematics and computer education. *Australian Journal of Math,* 172.

Oyen, A.S., & Bebko, J. M. (1996). The effects of computer games and lesson contexts on children's mnemonic strategies. *Journal of Experimental Child Psychology, 62*(2),189.

Podell, K. (1992). Preparing teachers to use technology. *Journal of Mathematics, 58*(3), 123.

Price, R. L., & Murvin, H. J. (1992). Computers can help student retention in introductory college accounting. Business Education Forum, *47*(1), 27.

Ross, K. (1993). Abstract harmonic analysis. *Journal of the American Mathematical Society*, 81.

Thomas, (1996) Computing technology for math excellence. *Journal of the Mathematical Intelligencer, 1,* 38.