5-2001

The effects of an integrated computer program on math and reading improvement in grades three through five

Charles Kenneth Phillips

To the Graduate Council:

I am submitting herewith a dissertation written by Charles Kenneth Phillips entitled "The effects of an integrated computer program on math and reading improvement in grades three through five." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Education.

Glennoh Rowell, Major Professor

We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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C. Glennon Rowell

Glennon Rowell, Major Professor

We have read this dissertation and recommend its acceptance:

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Accepted for the Council:

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Interim Vice Provost and Dean of The Graduate School

The Effects of an Integrated Computer Program
On Math and Reading Improvement
In Grades Three Through Five

A DISSERTATION
Presented for the
Doctor of Education
Degree
The University of Tennessee, Knoxville

Charles Kenneth Phillips
May 2001

ABSTRACT

This study was an investigation of the effects of using an integrated computer program on the improvement of math and reading scores of students in grades three through five. The program used was "Success Maker" from Computer Curriculum Corporation. Students were randomly assigned to one of two groups in each classroom; there were two classrooms at grade three, three at grade four, and two at grade five.

Before students began using the computers, pretests in both reading and math were administered to them; assessments from S.T.A.R. reading and math were utilized for both pretests and posttests. Following the pretest, students in Group 1 used computers each day (each session ≅ 15 minutes) to supplement their reading and math instruction; Group 2 did not use computers for math or reading instruction during this time. At the end of five weeks, students were again given tests. Gains were determined using the scaled scores from the test results. Then Group 2 used the computer program while Group 1 did not. Following this five-week session, tests were again given to the students. During each session, both groups continued to do all non-computer class work and were exposed to the same curricular instruction from the teachers in their respective rooms. This cycle was repeated one more time, so each group used the computers for two alternating cycles and did not use them for two sessions.

Scaled score gains were obtained for each grade for all sessions; in addition, grades were combined and overall reading and math gains were determined. T-tests were conducted for each subgroup for each five-week cycle. Distribution of scores was examined and boxplots were constructed in order to determine abnormal gain scores. Outliers were deleted from the data and t-tests were again performed.

For most sessions, there were no statistically significant gains found favoring either group; there was only one instance in which statistically significant gains were realized with the use of the computer software. However, when gain scores were examined using charts to explore progress, there were some trends toward improvement that suggested that the computer use may have enhanced the instruction, especially in reading. The researcher concluded that there might be practical significance realized in the use of the computer, especially when one considers that students want to use the technology, and that evidence that there could possibly be significant results obtained with longer, sustained use of the software.

ACKNOWLEDGMENTS

A project such as this cannot be successful without input from many people. I would like to publicly acknowledge a few of those who were of great help to me.

First, I would like to thank my wife, Cindi, without whose love and support I would never have been able to complete my program; thank you for believing in me.

I am also indebted to the teachers from grades three through five at my school for cooperating with me to enable their students to serve as the participants for the project. Thank you, Carolyn Ellis, Jill Kincaid, Jason Robinson, Rebecca Gray, Mary Thomason, Stephanie Rountree, Kelli Stevenson, and Robin Slack. I also want to thank the students for their efforts and the parents of those students for allowing me to use the data generated.

Thanks go also to Supervisor Joy Yates and Superintendent David Holloway at our Central Office. Their support was invaluable in my program.

And, of course, I would like to thank the members of my Doctoral Committee - Dr. Glennon Rowell, Chair, Dr. Dan Quarles, Dr. Lloyd Davis, and Dr. Tom George. A special note of gratitude goes to Dr. Davis for his guidance in the statistical analysis of my project. I especially want to express my appreciation to Dr. Quarles for his teaching, guidance, and support.

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INTRODUCTION TO THE STUDY

BACKGROUND OF THE PROBLEM

According to Richard Cosmann in "The Evolution of Educational Computer Software," the "third great revolution - computers and high technology" is here (1996). About twenty years have passed since computers were introduced to public schools. During that time, there has been much debate about how best to utilize this new technology. "We have moved from using the computer as a tool to enhance classes and entertain students to using the computer as a tool to develop a creative learning environment" (Alexander and Clouse, 1997). The software and the computers of today are drastically different from the ones introduced years ago. The average desktop or laptop computer today is much more powerful and faster than the huge mainframes of only a short time ago. With the available memory and gigantic hard drives common now, computer users are able to access, utilize, and present information in formats using multimedia that was accessible to only the rich and powerful in years past.

There is currently an emphasis to redesign and restructure schools in order to prepare students to live and work in the twenty-first century. "By the time that a student progresses through the traditional public school system and is ready for high school graduation, the information base will have quadrupled" (Fisher, 1997). Schools can no longer be expected to teach all the facts and information that a student needs to know in order to thrive after school days are done. It is obvious that a student cannot be expected to commit to memory the huge factual base. The knowledge base of just science today is huge and growing exponentially. Dr. Andrew Molnar, former Director of Applications of Advanced Technologies of the National Science Foundation, estimates that it would take twenty-two centuries to read just the annual biomedical research literature or seven centuries to read a year's chemical literature (Molnar, 1997). Herbert Simon, Nobel Laureate, stated that the developments in science and information processing technologies have changed the meaning of the verb "to know." "It used to mean 'having information stored in one's memory.' It now means the process of having access to information and knowing how to use it" (Molnar). With the gigantic amount of data accessible from any desktop with a modem, students not only should learn where to find information, but maybe even more importantly, be able to discriminate in order to efficiently manage the information and utilize the facts pertinent to their projects. Marion Rice, Director of Teacher Education at The Oregon Museum of Science and Industry said, "The use of technology must be integrated into classroom practice to effectively prepare students for the global economy of the 21st century" (1995). A critical question that society faces is that of how to construct the school for that goal. Many people are insistent that a major component of the new school will and should be designed around the use of technology. "Technology could, and should, play a major role in the efforts to reform and restructure American education" (Alexander and Clouse). From *Kickstart Initiative* (Advance Copy) by the United States Advisory Council on the National Information Infrastructure:

> "American children are capable of learning at substantially higher levels – many at levels previously expected only from those pinpointed by the education system as especially gifted or talented . . . After 35 years of research, it is clear that the children educated in this country can learn more faster, and that technology can be the key to higher levels of achievement."

The report also cites the following:

- A 1995 review of more than 130 recent academic studies found that *using technology to support instruction improved student outcomes in language arts, math, social studies, and science.*
- A congressionally mandated review of 47 comparisons of multimedia instruction with more conventional approaches to instruction *found time savings of 30 percent, improved achievement and cost savings of 30 to 40 percent, and a direct positive link between the amount of interactivity provided and instructional effectiveness.*
- A review of New York City's Computer Pilot Program, which focused on remedial and low-achieving students, showed *gains of 80 percent for reading and 90 percent for math when computers were used to assist in the learning process.*
- In California, students at Chula Vista's Clear View Elementary School went from being in the bottom 10 percent on standardized achievement tests to the 80th percentile, just 2 ½ years after advanced technologies were implemented in the classrooms.

The National Commission on Teaching and America's Future (1996) recommended that teacher education programs should focus standards on, among others, technological skills for supporting student learning and professional learning in the Information Age. Martorella (1996) stated: "Our society has undergone fundamental changes in its character and composition . . . These ultimately will affect everything . . . These trends are fueled by rapid advances in emerging technologies and they have profound implications for the nature of schooling and teacher education in the next century." There is a general consensus that we will be facing a tremendous teacher shortage within the next decade; we will need an abundance of teachers to fill those gaps. They must be technologically ready and have an understanding of the impact that technology will have on classroom instruction. The National Council for Accreditation of Teacher Education (NCATE) task force on Technology and Teacher Education (1997) reported:

> Technology will transform the role of the teacher as thoroughly as did the introduction of printed textbooks. More than in the past, teachers must become advisors to student inquirers, helping them to frame questions for productive investigation, directing them toward information and interpretive sources, helping them to judge the quality of the information they obtain, and coaching them in ways to present their findings effectively to others.

In 1989, the American Association for the Advancement of Science spearheaded a movement for science education reform for the 1980s and 1990s. Project 2061 came out of that effort (Johnson, 1989); among other recommendations, it espoused the integration of technology education, science, and mathematics.

Also in 1989, the National Council of Teachers of Mathematics' Commission on Standards for School Mathematics published standards on curriculum; one of those called for the integration of mathematics with other subjects including industrial technology. As early as the 1950s, Malay was calling for reform in industrial arts, which has now become technology education. He thought that curriculum should be integrated with research, experimentation and problem solving. Malay believed that curriculum integration held three benefits for technology education. As cited in Childress (1994) in The Effects of Technology Education, Science, and Mathematics Integration Upon Eighth Graders' Technological Problem-Solving Ability:

> The first was truly developing an understanding of technology in the student; this would be impossible without linkages with science and mathematics among other areas. Second, he believed that the hands-on experiential learning approach was the key to holistic learning, that might be described as the product of true curriculum integration. Finally, he believed that the recent emphasis on the importance of science and mathematics in education was an opportunity for technology education to become recognized as an important academic discipline. Maley believed this would be achieved through partnerships including curriculum integration.

The computer software selected for this study was developed by Computer Curriculum Corporation; it was chosen through a selection process at the local building level. The principal began looking for an integrated software program that could enhance the curriculum at his school. Several steps were involved before the official choice. The first was a demonstration by interested vendors to the principal; program representatives were invited to schedule a presentation for the principal and central office staff members. Following the initial presentations, the representatives left with the principal a demonstration compact disc. He then demonstrated the programs to his teachers and had them to complete a rating form on the following areas: practice time, remediation, enhancement, collaborative opportunities, multimedia capabilities, and management system. Table 1 presents the results of the ratings.

Table I

Teacher Ratings for Curriculum Software Programs

Criteria Measured	ALS	SkillsBank	CCC
Management	18	10	31
Remediation	27	8	31
Practice	29	7	33
Enhancement	26	7	32
Collaborative	18	6	24
Multimedia	19	9	27
	137	47	178

Computer Curriculum Corporation's (CCC) software was the choice of the teachers; with highest ratings in every category, it totaled 178 points. Advanced Learning System (ALS) was next with 137 points. At the bottom of the rating was SkillsBank with 47 points.

The specific software program from Computer Curriculum Corporation that was evaluated was called "Success Maker." Computer Curriculum Corporation was founded in 1967 by Patrick Suppes and Richard C. Atkinson of Stanford University, and its software has now been used by more than 10 million students worldwide (Report Issued by Computer Curriculum Corporation). CCC is best known for its courseware "SuccessMaker," which focuses on reading and mathematics as well as incorporating a classroom management system. According to the report, "SuccessMaker" enables:

- Instruction, practice, and applications that adapt to student learning needs, including exciting real-world challenges that stimulate critical thinking and problem-solving skills. Guided investigations and simulations provide rich opportunities for individual and collaborative student-centered learning.
- Continuous progress assessment that is related to curriculum goals, with the means to manage and adjust the plan based on data.
- Explorations and enrichment activities.
- Benchmark performance assessments and portfolios (CCC Report).

The "SuccessMaker" program was obtained for the school and was utilized to some extent during the school year 1997 - 98. Teachers were trained in the use of the program and began using it at various levels within their rooms; they were at liberty to utilize it at their discretion. Informal surveys indicated that most teachers and students enjoyed using the program. Contemporary students are visual learners and beg for opportunities to work on computers. "Success Maker" is a multimedia-intensive program and as a result is very motivational to students; the program has integrated sounds and colorful graphics – even at some points animated illustrations and movies.

Computer Curriculum Corporation's mathematics courseware has been correlated to the Tennessee State Mathematics Learning Expectations in kindergarten through grade eight.

STATEMENT OF THE PURPOSE OF THE STUDY

The major purpose of the study was to determine the effects that computer-aided instruction had on the math and reading improvements of elementary students in grades three through five. The computer program was "SuccessMaker" from Computer Curriculum Corporation and is an integrated program that has curricula for reading, math, science, and social studies. "SuccessMaker" is an individualized program in that it will assess the progress of the student and will tailor the sessions to the needs of that student; that is a function of the built-in management component of the program and is not dependent on the teachers having to prescribe individual lessons. The "SuccessMaker" software "adjusts the learning sequence for each student based on that student's individual pattern of responses to the instruction. Thus, although the scope of the instructional content that each student receives in a course may be similar, the sequence of instruction for each student is unique and complex" (CCC Report).

The study focused on reading and math for two reasons. First, those two areas are considered to be priority subjects by most schools and teachers. Second, there were third party computer programs available that could be utilized in order to assess the progress of students; these are programs from Advantage Learning Systems. The S.T.A.R. (Standardized Test for Assessment of Reading) is a diagnostic test that generates a report on the student. Information in the report includes Grade Equivalent and Scaled Score. This test had been used for the previous two years at the school. The same company has completed and released a math assessment test. The school has also obtained this test. Although "Success Maker" has the capability of monitoring the progress of students, the use of a third-party assessment instrument assured that the progress was measured in an unbiased manner. All teachers involved in the study were trained in the use of the programs prior to the beginning of the study.

The reading component used from "Success Maker" was that of "Reader's Workshop." According to Computer Curriculum Corporation, the purpose of "Reader's Workshop" is "to develop basic reading comprehension with an emphasis on higher-order thinking skills" (Courseware Descriptions). It provides practice in specific reading skills and also integrated practice in Passage Comprehension and Thematic Lessons. There are over 500 reading passages. The thematic lessons teach students to analyze text, interpret informational graphics, and integrate vocabulary and comprehension skills. The reading passages cover a wide range of topics in several writing styles while the graphic materials include such items as online tables and graphs. Specific strands include Word Analysis, Word Meaning, Literal Comprehension, Interpretive Comprehension, and Reference Skills (Courseware Descriptions). The built-in management system individualizes each lesson "based on the student's demonstrated strengths and weaknesses in each skill area" (Courseware Descriptions).

The "Math Concepts and Skills" section of the CCC courseware covers kindergarten through grade eight. There are over 1500 learning objectives with over 330 hours of instruction and practice. Its purpose is "to aid in the development and maintenance of essential concepts, strategies, and skills of K - 8 mathematics" (Courseware Descriptions). It purports to be a comprehensive course that develops and maintains the key strategies, concepts, and skills of mathematics; it provides guided instruction and practice through a highly diverse collection of interactive exercises. According to Courseware Descriptions, "Math Concepts and Skills" provides students with the following tools and resources:

- **Tutorial** presents general tutorials that give instruction or provide an example of how to work a particular type of exercise.
- **Toolbox** includes a ruler, a measuring tape, a protractor, and a calculator, available for all appropriate exercises.
- **Glossary** provides definitions for nearly 200 mathematical terms.
- **Help** completes the current exercise as an example.
- **Audio Repeat** enables the student to listen to the last message again.
- **Student Report** provides an easily understood representation of the student's performance in the current session.
- **Worksheets** can be printed based on student needs or teacher selection.

Computation strands include addition, subtraction, multiplication, division, fractions, decimals, equations, and speed games. Application strands include number concepts, geometry, measurement, word problems, applications, problem-solving strategies, science applications, and probability and statistics. According to <u>Courseware Descriptions</u>, features of "Math Concepts and Skills" include:

- Probability and statistics activities
- Estimation strategies
- Science applications
- Problem-solving strategies
- Critical-thinking skills
- Inferential-reasoning processes
- Pattern finding

- Basic skills acquisition
- Ongoing diagnostic processes
- Flexible, customized curriculum
- Advanced management capabilities
- English- and Spanish-language versions

The course employs "a unique, continuous diagnostic logic that assesses a student's learning level on an ongoing basis and adjusts the learning experience accordingly. This means that each student has a unique path through the curriculum that is based on his or her ongoing requirements, not on any single pretest model or rigid mastery paradigm" (Courseware Descriptions).

Teachers are always encouraged to individualize instruction. With "Success Maker," the management system automatically does this. The placement process locates the appropriate starting level seamlessly and invisibly for the student. It uses the first few lessons to place the student at the appropriate working level - not too easy or too difficult. Once placed, intelligent branching of the program selects the appropriate strategies needed by the individual student. As the student continues to work, dynamic adjustment of level and content guides the student through a steady growth process. When a student has difficulty, there are various instructional strategies that are applied; these include feedback, special tutorials, and demonstrations (Management System). The system adjusts the proportion of material across concept areas so that weaker areas receive more emphasis. Material that is initially difficult for the student is delayed in presentation so that intervening experiences can build the support and background needed (Management

System). Retention checks are utilized periodically to ensure that students do not forget material that may not be used for awhile.

A secondary purpose of the study was to determine if the grade level of students affected the value of the computer programs. By utilizing grades three through five, results could be evaluated in terms of whether the maturity levels of students impacted the development of skills with the use of computers.

RESEARCH QUESTIONS

The study investigated the following research questions:

1. Does the use of an integrated computer curriculum program make a statistically significant difference in the improvement of reading and math skills of students in grades three through five?
2. Does the use of an integrated computer curriculum program result in statistically significant differences of improvement in math and reading skills among students of different grade levels from grades three through five?

SIGNIFICANCE OF THE STUDY

There are several benefits that were obtained from this study. Because of the high costs associated with integrating technology in the schools, it is incumbent on systems to evaluate the effectiveness of programs. Can they expect a high return on their investment? Will their students show gains through using the computers? Other schools in the system can see some effects before they invest in expensive integrated programs. Although there have been some studies, technology is changing at such a rate that results from investigations more than a couple of years old cannot be generalized to today's environments. The sophisticated computer programs now represent much more than the electronic worksheets that were just recently the norm. Because data from various grade levels over a wide range of student abilities were analyzed in the study, it should be representative of many schools across the country.

LIMITATIONS AND DELIMITATIONS OF THE STUDY

There are two limitations and two delimitations for the study. The number of computers in each classroom (two in most) was a limiting factor because students were not able to spend as much time daily on the computer as they possibly should have in order to obtain the optimum benefit of the programs; in addition, because all students were expected to participate in all regular curriculum programs in the classroom, it was difficult for some teachers to let their students work consistently with the program. Delimitations of the study included using students from grades three through five. Another delimitation was that the study focused on one elementary school in rural East Tennessee.

ASSUMPTIONS OF THE STUDY

The following were assumptions formed for the study:

1. Students from grades three through five could be trained to work independently with the software program "Success Maker."
2. Teachers would allow students to work consistently (daily) at the computers.
3. The teachers participating in the study would follow the procedures and schedules outlined for the project.
4. All the teachers in the study were equal in their ability to motivate their students to work diligently with the software.

DEFINITION OF TERMS

The following terms are defined as used specifically within this study:

Integrated computer curriculum program: A software program with various components all integrated and working together; "Success Maker" has modules of math, reading, language, science, social studies, and spelling all regulated by a management system that individualizes lessons for each student based on his or her performance.

Educational technology: The use of modern communication equipment such as computers, televisions, laser discs, CDRoms, etc. in the school or classroom. The Task Force on Definitions and Terminology of the Association for Educational Communications and Technology defines educational technology as "a complex, integrated process involving people, procedures, ideas, devices, and organization, for analyzing problems, and devising, implementing, evaluating, and managing solutions to those problems" (Bruce, 1989).

Infosphere: "A new form of knowledge . . . based on the interaction of people, information, technology and new social organizations (Molnar, 1997).

CAI: Computer-assisted instruction.

SUMMARY OF CHAPTER 1

In Chapter 1, the researcher discussed the background of the problem, placing the use of computers in schools in perspective by looking at some of the history of their uses. The rationale for choosing the computer software program "Success Maker" from Computer Curriculum Corporation was outlined. The rating scale that was used by teachers to choose the program was presented. The purpose of the study was identified as the following: to determine the effects that computer-aided instruction has on the math and reading improvements of elementary students in grades three through five. The two research questions were presented. Following the research questions was a discussion of the significance of the study and then the limitations and delimitations were stated. Next was a statement of the assumptions of the study, followed by the definition of terms.

ORGANIZATION OF THE STUDY

In Chapter I, the problem, purpose, and research questions were introduced. The significance of the study, the limitations and delimitations, and the assumptions of the study were stated. Terms relevant to the study were defined and a summary of the chapter was given.

Chapter II contains an introduction to the chapter, and the findings from a review of related literature are examined. The summary of the chapter follows the review of literature.

Chapter III includes the methods utilized in the study. It begins with an introduction, followed by identifying the subjects used in the study. The methods and procedures are outlined and the instruments utilized in the study are detailed. This is followed by the description of the statistical analysis used in the study.

In Chapter IV, the author discusses the findings of the study and the analysis of the data. It begins with an introduction followed by the findings of the project.

Chapter V contains an introduction to the chapter, a summary of the study, and conclusions drawn from the study. Following that are implications for further research.

The Bibliographic and Supplementary Materials Section presents the list of references with a bibliography, appendix and a vita of the researcher.

CHAPTER 2
REVIEW OF RELATED LITERATURE

INTRODUCTION

The major purpose of this study is an investigation of an integrated computer curriculum program in math and reading to determine its effect on the skill development of students from grades three through five. Many people who advocate the restructuring of American public education have technology as a cornerstone of the "new school." This chapter will look at some of the most recent findings relating to the use of technology in schools.

REVIEW OF RELATED LITERATURE

In "An Introduction to the Waterford Institute," Dustin Heuston said that the trustees (of the Waterford Institute) "believe that the combination of microcomputers, laser storage techniques, and emerging communication and fiber optic networks afford undreamed-of opportunities to improve education" (1996). This report described the Institute's research with computers in kindergarten classrooms and showed some impressive results. One study measured the performance of an at-risk student population in Provo, Utah; the test used was the Waterford Reading Instrument, which is a compilation of standard tasks that kindergarten students are expected to master in preparation for learning to read in first grade. The test was first given to a teacher's class at the end of a school year in which no technology was utilized. Fifty percent of the entire class had successfully mastered the skills, while only 15.6% of the lowest third of students had done so. The following year, students spent fifteen minutes a day working on computers; the teacher changed no other activities. At the end of the year, 91.8% of the entire class had mastered the skills, while 87.5% of the lowest third had done so

(Hueston). Advantages of technology that the Institute discovered from their studies included:

> First, the new multimedia technologies can bring the benefits of instructional approaches identified by the latest research directly to the student, without having to retrain the teacher. Second, we have found that the multimedia format allows for extensive use of art and music in ways that children find interesting and motivating. Third, we have found that we can develop multiple approaches to the same instruction so that different social and musical contexts can be employed in an effort to appeal to all children (Hueston).

From their studies, the Institute proved what teachers have known – that it takes three people to help a student become a successful reader: the parent, the teacher, and the student. Students who are best prepared to become good readers have had parents (specifically mothers) who have spent 3000 hours of preliteracy training with their children before they begin school. This activity begins when mothers (or others) start to talk with and read to their children from birth. Because many parents have not done the necessary 3000 hours of preliteracy training (Hueston), the teacher has assumed the burden of much of that 1/3 of the training; however, with 15 to 25 other students in the classroom, the teacher cannot give that much individualized help to a student. This results in many students not getting a good start in reading. Hueston says, "The genius of technology is that it can always offer a huge work bonus in any area in which it is introduced. The most obvious way that this bonus can be employed in teaching reading is to increase the amount of individualization."

Childress cited a study by Brusic (1991) in which he compared the science achievement and scientific curiosity of 58 fifth grade students who received science instruction integrated with a technology education activity and 65 science students who did not receive the technology activity. The treatment was given over a 10-day period with an average of almost five and one-half hours per day. The results indicated no significant differences between the groups in science achievement. According to Childress, Brusic's findings correspond with those who have found that the integration of technology education activities with another subject show no significant improvements in achievement in short-term treatments. Childress goes on to state that studies that have found significant differences with the use of integrating technology tend to favor large samples and long treatment periods.

In "Computers in Education: A Brief History," Dr. Andrew Molnar looked at the history of computer use in education. He cites a meta-analysis that James Kilik at the University of Michigan compiled on studies in a wide variety of fields at the elementary, secondary, higher- and adult-education levels. Kulik concluded the following:

> . . . computer-based education can increase scores from 10 to 20 percentile points and reduce time necessary to achieve goals by one-third. He found that computers improved class performance by about one-half a standard deviation, less than the one sigma difference that could be accomplished by peer tutoring. However, this analysis did not include newer studies utilizing advanced technologies and newer educational paradigms. But, this study *did* answer the question, do computer technologies work? They most certainly do (Molnar).

R. J. Coley also reviewed studies done by James Kulik, who aggregated the findings of over 500 individual studies related to prior research showing the effectiveness of school technology and its limitations. Conclusions included the following:

- Students usually learn more in less time using computer-based instruction.
- Students like their classes more and develop more positive attitudes toward computers when they use computer-based instruction (cited in Gasiorowski).

The author concluded, however, that students using computer-based instruction do not develop more positive attitudes toward subject matter (cited in Gasiorowski). However, again, most of the studies reviewed by Kulik were completed before 1990. Gasiorowski went on to say:

> More recently, a report released by the Software Publishers Associations analyzed another 176 studies that were conducted from 1990 to 1995. This report shows "that students in technology-rich environments experienced positive effects on achievement in all major subject areas, preschool through higher education . . . Student attitudes toward learning and students' own self-concepts improved consistently when computers were used for instruction (Coley, 1997)."

The report also stated that as computers have been added to the schools, there have been drops in absenteeism and dropout rates have fallen. In addition, students have become more challenged and engaged in learning as schools become more technology-rich (Gasiorowski).

Gasiorowski reviewed several individual studies comparing technology use in schools. Summaries of those follow:

1. Grimm (1995) compared academic achievement and attitude between students in technology-rich schools and those in traditional schools. He concluded that technology-rich environments contributed to increased

academic achievement of 4th grade, 6th grade, and 11th grade students and contributed to positive student attitudes toward school, technology, and overall attitude for 6th - grade and 11th -grade students.

2. Parker (1989) concluded that students in honors level high school geometry classes with supplemental computer assisted instruction showed significant achievement differences compared to students in regular classes.

   Arunyakanon (1991) reported a positive impact on the achievement of second and third graders who used an electronic learning aid, Speak and Math.

3. Dyer (1994) found that computer assisted graphic and numerical representations resulted in students being able to analyze a larger variety of functions than those normally done by college algebra students.

4. Orabuchi (1992) studied first and second graders who used computers with interactive software programs to teach higher-order thinking skills. She found a statistically significant difference between CAI and non-CAI groups in math problem solving and in attitude. The impact of CAI on students' overall academic achievement, however, was not found to be statistically significant.

5. Valenza (1997) examined gender differences in computer use and cited male-oriented software as a positive reason that girls dislike computers. She suggested all-female computer and math classes to encourage females, plus integrating technology into content areas.

6. Pisapia (1994) studied teaching roles and technology. He found that teachers who adopt a technology-based approach normally progress from being a "presenter of knowledge" to being a "coordinator of learning resources." He states that teacher-centered teachers tended to use traditional instructional methods and to regard learning technologies as basic skill reinforcers, motivators, or special treats. Learner-centered teachers, on the other hand, usually choose individualized or collaborative approaches to engage students. For successful technology use, teachers must be flexible in the roles they play.

In the 1970's, John Anderson of Carnegie Mellon University developed ICAI (intelligent computer-aided instruction) tutors in algebra, geometry, and teaching computer programming languages. His goal was to achieve a one sigma difference in school performance; results showed a one letter-grade improvement for all students participating (Molnar).

Molnar's studies led him to conclude that computers must begin to play a major role in the education of our students. He stated that the world of education has changed from an orderly world of disciplines and courses to an infosphere in which communication technologies are increasingly important. He acknowledged that education is changing, but made the claim that it is not changing fast enough. "It is clear that in the future we will see a major restructuring of our social, industrial and educational institutions, and an increased reliance on computers and telecommunications for work and education." (Molnar)

In "Computers Support Algebraic Thinking" (1997), Clements looked at whether computers can help to develop algebraic thinking in unique ways for elementary school students. His conclusions were positive, finding that students can build on their informal methods and learn to formalize so that they can "talk to" the computer. He concluded that the computer specifically contributes in the following ways:

- Computers operate with a clear, unambiguous syntax. Symbols used with a computer are consistent in their interpretation of symbols, which is why they require explicitness.
- Computers represent an active model. One cannot "run" an equation on paper; on a computer, an equation can be run, which allows students to test, debug, and explore. This encourages active participation and reflective thinking.
- Computers offer immediate feedback. Students do not have to wait for a teacher to collect papers, find time to grade them, and then give them back out.
- Computers can help students formalize ideas. Students can explore, express, and formalize their ideas. "One ten-year old stated, 'I think that it helps you because you put what you think in and then you can check to see if you are right . . .' (Sutherland and Rojano 1993; 380)." (Clements,)

Childress (1994) investigated the effects of technology education, science, and mathematics curriculum integration on the problem-solving ability of eighth-grade technology students. He used a quasi-experimental control group design to compare the performance of students receiving correlated technology, science, and mathematics (TSM) integration to those not receiving integration. Childress used samples from a middle school in rural south-central Virginia for the pilot study; the study sample was then drawn from a middle school in a suburb of Richmond, Virginia. Analysis of the results from the study indicated no significant difference between the treatment and control groups in the area of technological problem solving. Childress concluded that TSM curriculum integration may promote the application of science and mathematics concepts to technological problem solving and does not hinder the technological problem solving of eighth grade technology education students.

Barker and Torgesen (1995) looked at ways in which CAI (computer-assisted instruction) can help children with learning disabilities learn to read more effectively. ". . . we strongly believe that computer-based instructional technologies have the potential to make important contributions to the education of children with learning disabilities" (Barker and Torgesen, 1995). The information from this study dealt specifically with children who demonstrate the type of learning problems that "involve substantial discrepancies between general learning ability and reading skill, which are part of the most widely accepted definitions of learning disabilities" (Hammill, 1990; cited in Barker and Torgesen). Stanovich (1986) and Vellutino (1991) conclude that "for elementary-aged children with reading disabilities, and for older children who continue to have decoding difficulties," inefficient word reading skills are the first, or primary, cause of their reading comprehension problems (cited in Barker and Torgesen). There were several consequences identified that result from difficulties in acquiring early word identification skills. Students in that category actually receive less practice in reading than do children who develop those skills more easily. Not only do they read fewer words in class, but they spend less time outside of school reading (Allington, 1980, cited in Barker and Torgesen). Second, students with poor word identification skills often try to read materials too difficult for them; this interferes with their comprehension and pleasure (Stanovich, 1986, cited in Torgesen and Barker). Third, the reading assignments and lessons for children with reading disabilities focus on correction of word reading problems to a much greater level than those of normal readers. Normal readers move on to interesting skill development of comprehension and thinking skills while students with disabilities spend time on correcting word reading problems and are delayed in getting to the development of comprehension and higher order reading skills (Brown, Palincsar, & Purcell, 1986; cited in Barker and Torgesen).

Drill and practice take time for teachers and special education personnel to individually work with students. The computer can be substituted for much of this time. When it is used in drill and practice, it provides repeated learning or practice trials to assist children in acquiring basic facts and skills. In addition to the mundane practice of skills, children with learning disabilities should be given the opportunity to interact with computer programs that are designed to enhance creativity, teach complex concepts, and to build strategic problem-solving skills. The programs reported by Barker and Torgesen address three areas: "development of phonological awareness as prereading skill; delivery of high-quality, context-free practice on specific word identification skills; and delivery of supportive, informative practice in reading as a complete skill oriented toward comprehension." The computer programs used were *DaisyQuest* and *Castle Quest* and were both written for Macintosh computers; they made extensive use of high-quality digitized speech and colorful graphics. Children received instruction and practice; all responses were made with the manipulation of a mouse, which even the young children could do without the constant supervision of a teacher.

In the first two studies cited with the use of those programs (Foster et al, 1994), random samples of preschool and kindergarten children were used, while in a third (Barker and Torgesen), first-grade students were examined. The performance of the children in the experimental group compared favorably to those obtained in teacher-led training. In the third study, 54 first-grade children who were behind their peers were selected. The test administered was the Word Analysis subtest from the *Woodcock Reading Mastery Test–Revised.* Average raw score was less than 1 (.72). Those children were then randomly assigned to one of three groups. One group was the DaisyQuest (DQ) group and received approximately eight hours of training with *DaisyQuest* and *Castle Quest.* The Hint and Hunt (HH) group received an equivalent amount of training on a program that provides practice in learning to decode vowel sounds. The third group, the Math Control (C) group spent an equal amount of time working math programs on the computer. Results showed a significant increase in the ability to read simple real words by the DQ group (Barker and Torgesen). The authors suggested that the most promising of all computer-assisted aids for reading acquisition involves computer-assisted text reading that allows children with reading difficulties to receive feedback on words that are difficult for them. They said:

> The most recent work with this program suggests that children with reading disabilities can make substantial gains in their alphabetic reading skills through as little as 6-8 hours of exposure to this program. Not only do children improve significantly in the number of real words they can read after exposure to this type

of reading experience, their phonological decoding skills also improve significantly.

They concluded by stating that at this time conclusions are tentative because the studies thus far have been based on relatively short-term studies of narrow treatment packages.

Carnine in "Teaching Complex Content to Learning Disabled Students: The Role of Technology" documented how a comprehensive intervention program reduced "performance differences between students with learning disabilities and their peers, while using technology to minimize, or even, reduce, the demands placed on the teacher" (1989). By reducing the time and effort required to implement interventions, more instructional time could be realized by teachers. Five instructional designs were investigated with three of them based on computer-assisted-simulation or -instruction; the other two utilized videodisc models. One design was a computer-assisted instructional program that taught individual remedial and learning-disabled secondary students to draw syllogistic conclusions and critique arguments. It operated on a learning mastery procedure that presented each missed item later in the lesson, until the student answered the item correctly. Process feedback led to higher scores on the posttest and a transfer test, but did not result in students taking significantly more time to complete the program. Another design focused on the teaching of vocabulary. The CAI program incorporated the following design principles and procedures:

(a) test students to identify the words requiring instruction so that instruction can be matched to student needs; (b) review previously introduced words; (c) maintain a teaching set of seven unknown words – a large enough set to prevent students from developing a successful guessing strategy, but not so large as to overwhelm the students; (d) when a student responds correctly to a word twice in each of two consecutive lessons, move the word to a review pool, and add another unfamiliar word to the teaching set (Carnine).

Of the students in the experimental group, 83% mastered all fifty words; 67% of students working with another computer program learned the words. The experimental group of learning-disabled students was compared to that of 30 general education tenth graders in an English class; the mean score on a test of the words was 86% for the learning-disabled students while the regular-education students scored 81%. Carnine concluded that direct instruction with a computer can reduce performance differences between handicapped and nonhandicapped students. The use of computers, if able to free the teacher from delivering drill and practice instruction, could lead to higher efficiency.

Carnine cited another study (Gleason, Carnine, & Boriero, in press) that found a Direct Instruction CAI program on word problem analysis "taught students with learning disabilities as effectively as an expert teacher who presented the same material. The pre-post change was 51% to 93% for the expert teacher group and 49% to 91% for the CAI group."

Childress completed a study to investigate the effects of technology education, science, and mathematics curriculum integration on the technological problem-solving abilities of eighth grade students. He compared the performance of students receiving correlated science and mathematics instruction to those not receiving correlated instruction in an adapted TSM Integration Activity. The technology teachers taught with the same materials and in the same way during the study. The results indicated that there was no significant difference between the treatment and control groups at the posttest.

The researcher concluded that the integration of technology education, science, and mathematics appeared to have no effect on the technological problem-solving ability of the students (Childress, 1994).

Blankenship (1998) conducted a study to determine the extent to which computer use by teachers in the classroom was influenced by the following factors:

> attitudes of teachers toward computers in the classroom, access by teachers and students to computers, training of teachers in computer use, support of teachers in their use of computers, age of the teacher, grade level in which the teacher teaches, curriculum area in which the teacher teaches, gender of the teacher, and number of years the teacher is from retirement.

Computer use was measured in five ways: over-all computer use and use in drill and practice, whole class instruction, student-directed learning, and computer skills instruction. Results showed that the factors that predict computer use varied by grade level. Training was the most common predictor. This was followed by attitude, support, access, and age of teacher. The researcher concluded that training must be specifically targeted to the grade level and curriculum area in order to be effective.

Christmann, Badgett, and Lucking (1997) discussed their meta-analysis that compared the academic achievement of students in grades six through twelve who received either traditional instruction or traditional instruction along with computer-assisted instruction (CAI); they looked across eight curricular areas. The researchers concluded that students who received traditional instruction supplemented with CAI attained higher academic achievement than 58.2 percent of those receiving only traditional instruction. Mean effect sizes for the various areas included: science, 0.639; reading, 0.262; music, 0.230; special education, 0.214; social studies, 0.205; math, 0.179; vocational education, - 0. 080; and English, - 0.420. Twenty-seven publications out of a pool of more than a thousand studies met the following criteria to be included in the meta-analysis:

- they were conducted in secondary schools;
- they included quantitative results in which academic achievement was the dependent variable and computer-assisted instruction was the treatment;
- they were of an experimental, quasi-experimental, or correlated research design; and
- the sample sizes had a combined minimum of twenty students in the experimental and control groups.

The studies and the forty-two conclusions generated by the original authors were separated into three categories. The first was significant positive, where the CAI group achieved statistically significantly higher gains than did the control group; the next was significant negative, where the control group exposed to traditional methods of instruction achieved significantly higher gains over the group exposed to CAI; the last was no significant difference. A percentage of 57 were significantly positive, 10 percent were significantly negative, and 33 percent showed no statistically significantly difference between the two methods. Conclusions by the researchers indicate that there seems to be a great difference in the effectiveness of CAI among the different subject areas, and there may exist a difference in the effectiveness of CAI related to the type setting for the school.

This last statement seems to be borne out with the article "A Comparative Analysis of the Effects of Computer-Assisted Instruction on Student Achievement in Differing Science and Demographical Areas" by Edwin Christmann and John Badgett. It is a report of a study done to compare science students who were exposed to traditional methodology with those who received traditional methodology supplemented with computer-assisted instruction. Differences in educational settings were analyzed and indicated that CAI is most effective among science students in urban areas followed by those in suburban areas; weakest differences were found in rural areas.

SUMMARY OF REVIEW OF RELATED LITERATURE

There have been mixed results of studies looking at the benefit of using technology in the classroom. A lot of variables impact the learning of students, and it is difficult to isolate the use of technology to compare its effect. In addition, with the tremendous change within the technological field, any study analyzing the use of computer hardware and software can almost be out of date before it is complete. However, as educators spend tax dollars, they still must investigate the effects of any programs brought into the schools.

CHAPTER 3
METHODOLOGY OF THE STUDY

INTRODUCTION

The methodological chapter is divided into two sections. The first section deals with the process used to identify the participants involved in the study. The second section outlines the methods and procedures utilized to analyze the data collected.

SUBJECTS OF THE STUDY

The participants in this study were students from a small elementary school in Southeast Tennessee; the data were collected during the school year 1998 - 1999. The school has kindergarten through the fifth grade and serves a low socioeconomic population with about 67% of the students eligible for the federal free/reduced lunch program; because of the economic background and accompanying low education levels of the home, most students did not have access to computers at home. The school is in a rural area with almost all students Caucasian. Students from the third grade through the fifth grade were chosen to participate. Although the school has kindergarten, first, and second grade students and the computer program for them, third grade was chosen as the point to begin the study because it was felt that those students could use the computers independently without having to have a teacher constantly monitoring them to help them navigate the programs. There were 38 students from 3rd grade, 33 students from 4th grade, and 28 students from 5th grade for a total of 99 students with permission to participate in the study. Students from all academic levels participated in the project, ranging in abilities from special education (mostly Learning Disabled) to gifted, with most falling into the average to low-average range; there were approximately twenty special needs students. There were no significant differences between the gender composition of the students.

Even though all students had access to the programs and used them in the daily procedures of the classes, signed statements were obtained from parents giving permission for results of the assessments for their children to be used in the study. They were assured that no one other than teachers giving the assessments and the researcher would have access to individual scores and that there would be no indication in the reporting of results that could identify individual students. Only those data from students whose parents have given permission were evaluated in this study. The study was approved by the University of Tennessee Institutional Review Board for the Protection of Human Subjects. Authorization was granted for the data to be collected from the school by the Superintendent of Schools.

METHODS AND PROCEDURES

There were seven classrooms in grades three through five. One teacher left at the end of the first semester, so with her replacement, eight teachers were involved in the project. Seven were female and one was male; all teachers in the study were Caucasian. They varied in their experience of teaching - four had less than five years experience; one had six years experience; and three had more than twenty years in the classroom. All teachers involved agreed to let their students participate in the study. There were approximately 100 students when the study began; that number changed as a result of students moving in and out of the school. Students from each classroom were randomly assigned to one of two groups, using a table of random numbers to select the students for each group. Because the students were selected in this randomization process, it was assumed that the means of the two groups were equal.

The assessments in reading and math were given as a pretest before any students worked with the "Success Maker" software. The Standardized Test for Assessment of Reading (S.T.A.R.) uses Adaptive Branching to individualize testing sessions to students in choosing test items that closely match their current levels of proficiency. According to the Norms/Technical Manual accompanying the S.T.A.R. reading test, "For reasons of efficiency of assessment, objectivity, and simplicity of scoring, and breadth of construct coverage, the vocabulary-in-context format was finally selected as providing the optimal mode for assessment." There are three arguments given that support the use of this format from the Norms/Technical Manual:

1. The individual test items, while using a common format for assessing reading vocabulary, require reading comprehension. Each test item is a complete, contextual sentence with a tightly controlled vocabulary level. The semantics and syntax of each context sentence are arranged to provide clues as to the correct cloze word; the student must actually interpret the meaning of (in other words, comprehend) the sentence in order to choose the correct answer because all of the answer choices "fit" the context sentence either semantically or syntactically. In effect, each sentence provides a mini-selection on which the student demonstrates the ability to interpret the correct meaning. This is, after all, what most reading theorists believe reading comprehension to be - the ability to draw meaning from text.
2. In the course of taking S.T.A.R. tests, students read and respond to a

significant amount of text. S.T.A.R. typically asks the student to demonstrate comprehension of material that ranges over 6 to 8 grade levels. Students read, use context clues, interpret the meaning, and attempt to answer 30 to 40 cloze sentences across these levels, generally totaling more than 400 words. The student must select the correct word from sets of words that are all the same reading level, and that at least partially fit the sentence context. Students clearly must demonstrate reading comprehension to correctly respond to S.T.A.R. questions.

3. A child's level of vocabulary development is a major - perhaps *the* major - factor in determining his or her ability to comprehend written material. Decades of reading research have consistently demonstrated that a student's level of vocabulary knowledge is the most important single element in determining the child's ability to read with comprehension. Tests of vocabulary knowledge typically correlate better than do any other components of reading with valid assessments of reading comprehension. In fact, vocabulary tests often relate more closely with sound measures of reading comprehension than do various measures of comprehension to each other. Knowledge of word meaning is simply a fundamental component of reading comprehension.

In taking tests, student input is limited to only four numeric keys and the Enter (or return) key. This ensures that reading assessments do not become assessments of keyboarding skills. As a result, computer-literate students have no advantage over those with limited computer experience. The student begins with a practice session that continues until he or she has answered three consecutive questions correctly. This allows the student to become familiar with and comfortable with the program before the actual test begins. S.T.A.R. was designed to yield test results for both the criterion-referenced and norm-referenced components by adjusting item difficulty to the responses of the student being tested. Once a testing session is underway, S.T.A.R. administers items of varying difficulty based on the student responses until it gathers sufficient information to obtain a reliable scaled score and to determine the student's reading level. Normally, a student will answer about 30 items, but it can vary substantially. Students can test with S.T.A.R. up to five times per year without concern for previous exposure to the items. Because S.T.A.R. keeps track of specific items presented to each student from test session to test session, item reuse is kept to a minimum.

The STAR Math test assessment is basically patterned after the S.T.A.R. reading assessment. It also uses Adaptive Branching to individualize the test to each student based on his or her responses. Both tests generate reports giving Scaled Scores (SS) and Grade Equivalent (GE). Scale scores range from 50 to 1350. Once a scaled score is generated, a grade equivalent is converted. An Instructional Reading Level (IRL) is an estimate of the most appropriate reading level of reading materials for instruction. For the researcher's purposes for this study, Scaled Scores were used for assessment. Figure 1 shows a sample Test Record Report for reading; the STAR Math Test Record Report is similar in design and information presented.

2/1/99 S.T.A.R

Page 1

- Test Record Report -

Any School Elementary School

City, State

Student Name: Student, Sample
Student ID: 333
Grade: 5
Teacher: Smith, John
Section:

Start Date: 08/16/98
End Date: 05/31/90
Historical Data: Included

Test Date	Grade	Teacher	IRL	GE	PR	NCE	Scaled Score
08/16/98	5	Smith, John	2	2.2	39	44.1	255
11/23/98	5.2	Smith, John	4	3.1	57	53.7	423
01/25/99	5.4	Smith, John	4	3.6	58	37.7	450
03/13/99	5.7	Smith, John	5	4.4	47	41.3	494
05/30/99	5.9	Smith, John	5	4.5	50	46.3	508

Number of Tests: 5

Figure 1. Example of S.T.A.R. Test Report

After the selection process and the first testing session, for the next five weeks, students from Group 1 worked daily on the computers, using the "Success Maker" software for math and reading; during this period of time, students from Group 2 did not use the computers for these programs. Both groups participated in the normal curricula of the classroom during the school day, including using computers for the Accelerated Reader Program; this is a program to test students over books that they have checked out of the library and to allow them to collect points to use to purchase incentive items. For example, a typical day began with checking roll, getting lunch count and the various other daily activities. During the day, the teacher had some large group instruction. Math normally would have been about a thirty-minute session; the class may have spent as long as an hour on reading activities. Science, Social Studies, and spelling may have been taught, depending on the daily schedule. Both groups participated in all large-group instructional activities. About one half the day, students were working individually or in small-groups; during these times, the students from Group 1 followed a posted schedule to complete "Success Maker" lessons. At the end of this five-week period, all students were again given the reading and math assessments to determine growth in skills. The computerized assessment program takes about ten minutes per student for each area (math and reading); a week was set aside for this testing. Then the groups were switched, with Group 2 using the "Success Maker" software while Group 1 did not. Again, after a five-week period, the students were retested with the reading and math testing programs from Advantage Learning Systems. The following week, the same schedule began, with Group 1 on the computers. This schedule allowed each group to alternate using the computers through two cycles, with assessments before and after each period of using the computer software.

The assessment scores for those students whose parents have granted permission to participate in the study were analyzed using S.P.S.S., a computer statistical program. There were two reasons for using the double cycle for computer use. The first was that students did not have to wait so long to utilize the computers and software. The second reason was that a repeated cycle could validate the findings of the first cycle. With the rotation of each group through the program twice, it was expected that any variations in math and reading skill development using the computer program would be demonstrated in the tests. By using the double cycle, the possibility of significant effects showing up by chance were minimized; in effect, the second cycle served as a direct replication of the first session (Gay, 1996). Not only could a determination be made of whether the computer usage significantly improved the scores in math and reading, the effects at different grade levels could also be ascertained.

To answer the research questions, the following data analyses were performed:

- Was there a statistically significant difference in the gains comparing groups of same-grade level students? A series of independent t-tests were conducted comparing gains from pretest to posttest scores at the conclusion of each computer cycle within each grade level. Subgroups tested were grades three, four, and five.
- Was there a statistically significant gain between the two groups for the group as a whole? A t-test was conducted comparing the pretest and posttest scores for the group as a whole following each cycle.

CHAPTER 4
FINDINGS OF THE STUDY AND ANALYSIS OF DATA

INTRODUCTION

This chapter presents the data and shares the analysis. The gains for both reading and math for each grade participating in the study are presented for each cycle of computer use compared with non-computer use for the groups. There are two classes at the third grade level, three at the fourth grade level, and two at the fifth grade level. The last analysis is that of combining all grade levels and comparing the gains of the two groups.

The statistical data were generated using S.P.S.S. Independent Samples T-Tests were conducted for each cycle. In addition to returning the significance value, the 95% Confidence Intervals were created. Levene's Test for Equality of Variances was also conducted for each test. Additional data were obtained by using the Explore function of S.P.S.S. For each group, this gave the following information that was used in this study:

- Mean
- 95% Confidence Interval (lower and upper bounds)
- Median
- Standard Deviation
- Minimum value
- Maximum value
- Range
- Interquartile Range

FINDINGS OF THE STUDY

Third Grade Reading

The first grade to be analyzed is that of the third grade level, using a non-directional .05 alpha level. Figure 2 illustrates the reading gains for cycle 1. Group 1 began using the computer; Group 2 did not use the software.

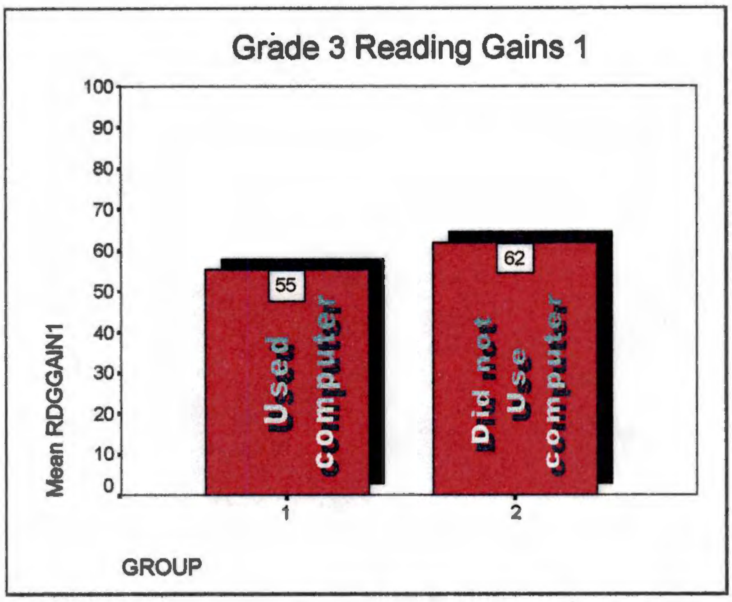

Figure 2. Grade 3 Reading Gains 1

There were 16 students in Group 1 who completed the pretest and posttest for cycle one; group 2 had 19 students. The mean reading gain for Group 1 was 55.38 and the mean reading gain for Group 2 was 61.95. The standard deviation for Group 1 was 44.24 and for Group 2 was 40.22. Based on Levene's Test for Equality of Variances, the hypotheses that the two population variances were equal could not be rejected (significance = .342). With 33 degrees of freedom, the significance (two-tailed) for equality of means was .648. The results were interpreted to indicate no significant differences in the two groups (.648 > .05). At the level of significance ($\alpha = .05$), the confidence interval was -35.63 to 22.49. The probability that the observed difference between the sample means would have occurred by chance is greater than .05; the researcher is 95 percent confident that this interval contains the true difference between the means for Group 1 and Group 2. Figure 3 shows the results of running the t-test for the first cycle of reading.

	Lavene's Test for Equality of Variances		Grade 3 Reading t-test for Equality of Means						
	F	Sig	t	Df	Sig (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Mean	
								Lower	Upper
RDGGAIN 1 Equal Variances assumed	.931	.342	-.460	33	.648	-6.57	14.28	-35.63	22.49
Equal Variances not assumed			-.456	30.739	.651	-6.57	14.40	-35.96	22.81

Figure 3. Independent Samples T-test for Grade 3 showing Reading Gains 1

The researcher then looked at the distribution of scores for the two groups. Group 1 had a minimum score of -21 and a maximum score of 118; this gave a range of 139. The range from the 25th percentile to the 75th percentile (interquartile range) was 87.75. The median for Group 1 was 62.50. Group 2 had a minimum score of 5 and a maximum score of 178; the range was 173. The interquartile range was 44.00. The median for Group 2 was 60.00. A boxplot was generated for the scores of each cycle in order to help identify extreme values (outliers) for the groups. For cycle one (Reading Gains 1), there was one outlier score from Group 2. Figure 4 shows the boxplot.

If the outlier score (identified on the boxplot as being from student identification number 804) from Group 2 is omitted from the analysis, the gains are even more similar. The mean reading gain for Group 1 was 55.38 and for Group 3 was 55.50. This is illustrated in Figure 5.

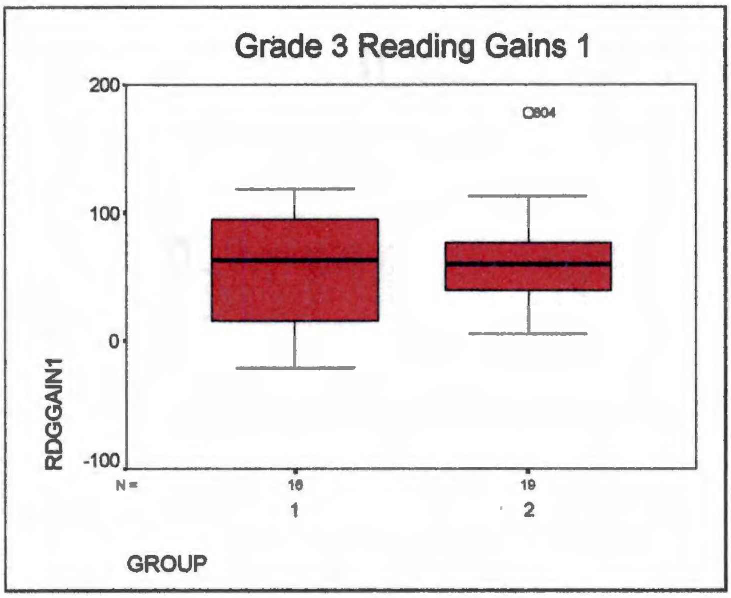

Figure 4. Boxplot: Grade 3 Reading Gains 1

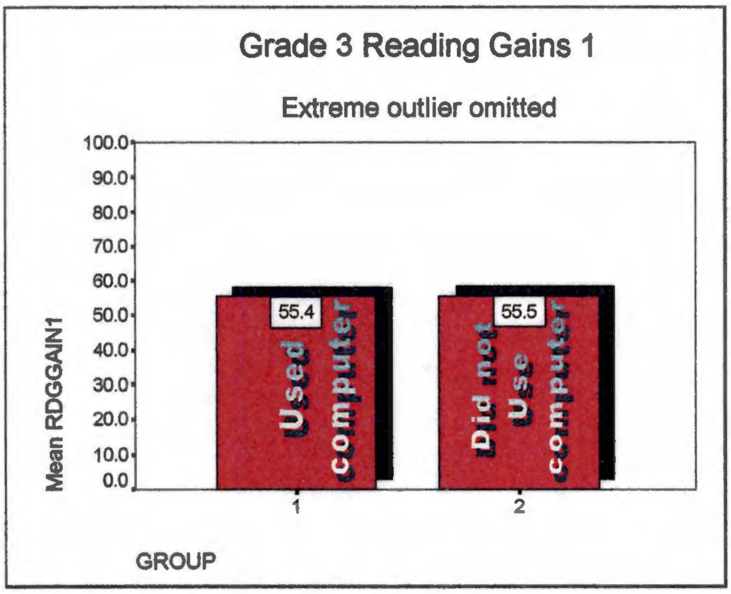

Figure 5. Grade 3 Reading Gains 1 Outlier Omitted

	Lavene's Test for Equality of Variances		Grade 3 Reading t-test for Equality of Means Outlier Omitted						
	F	Sig	T	Df	Sig (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Mean	
								Lower	Upper
RDGGAIN 1 Equal Variances assumed	3.949	.056	.010	32	.992	-.13	12.78	-26.15	25.90
Equal Variances not assumed			-.010	25.725	.992	-.13	13.08	-27.02	26.77

Figure 6. T-test: Grade 3 Reading Gains 1 Outlier Omitted

The standard deviation for Group 1 was 44.24 and for Group 2 was 29.61. Levene's Test for Equality of Variances showed no significant differences (significance = .056). Degrees of freedom were 32; the t-test for equality of means was .992. This indicated no significant difference at the .05 level (.992 > .05). The Confidence Interval was CI_{95} = (-26.15, 25.90). The researcher was 95% confident that the confidence interval contained the true mean difference in the two groups. Figure 6 shows the results.

Similar data were obtained for each cycle of each grade and then for each cycle with all grades (3, 4 and 5) combined. In order to avoid redundancy, the rest of the data have been compiled in tables and presented in this chapter; data with outliers omitted are given. See tables II – IX. For the interested reader, the data with outliers present are presented in the Appendix .

Table II

Grade 3 Reading: Group 1 and Group 2

GRADE 3 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	16	18	10	16	11	11	8	15
Min. Gain	-21	5	-28	-23	-11	-29	-26	-29
Max. Gain	118	113	105	183	150	39	91	95
Range	139	108	133	206	161	68	117	124
Interquartile Range	87.75	41.25	103.50	53.50	121	52	64.75	61
Median	62.50	55.50	-2	41	58	6	65	23
Std. Deviation	44.24	29.61	82.99	51.38	59.31	26.20	41.05	36.78
Mean Gain	55.38	55.50	17.20	35.75	71.27	7.55	52.50	25.67
Mean Diff.	-.12		-18.55		63.73		26.83	
Deg. Freedom	32		24		20		21	
T-test Value	-.01		-1.06		3.26		1.60	
Sig. Value	.99		.30		.004		.124	
95% C.I.	(-26.15, 25.90)		(-54.81, 17.71)		(22.94, 104.51)		(-8.00, 61.66)	
Sig.Difference	No (.99 > .05)		No (.30 > .05)		Yes (.004 < .05)		No (.124 > .05)	

Table III

Grade 4 Reading: Group 1 and Group 2

GRADE 4 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	12	13	10	8	10	14	12	17
Min. Gain	-29	17	-12	-14	-20	-18	-6	-22
Max. Gain	156	159	161	106	188	149	190	169
Range	185	142	173	120	208	167	196	191
Interquartile Range	56.60	74.50	101.25	71.75	97.50	56.75	105	93
Median	63.50	84	79	59.50	60	36	60.50	72
Std. Deviation	49.14	44.12	58.83	42.09	65.79	44.25	58.44	51.43
Mean Gain	57.67	82.08	74.60	45.25	66.20	45.36	67.50	80.35
Mean Diff.	-24.41		31.15		20.84		-12.85	
Deg. Freedom	23		16		22		27	
T-test Value	-1.309		1.259		.930		-.627	
Sig. Value	.204		.226		.362		.536	
95% C.I.	(-62.99, 14.17)		(-23.31, 83.61)		(-25.62, 67.30)		(-54.93, 29.23)	
Sig.Difference	No (.204 > .05)		No (.226 > .05)		No (.362 > .05)		No (.536 > .05)	

Table IV

Grade 5 Reading: Group 1 and Group 2

GRADE 5 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	12	8	14	8	7	8	5	3
Min. Gain	-25	-28	-28	-10	-10	-20	-9	-6
Max. Gain	223	113	224	178	176	99	539	160
Range	248	141	252	188	186	119	548	166
Interquartile Range	111.75	86	85.25	112.75	118	78	419	Not given
Median	29.50	50	42	133.50	54	30	12	70
Std. Deviation	75.55	49.04	68.91	66.07	65.65	42.63	242.83	83.10
Mean Gain	53.25	47.13	52.64	111.50	63.57	28.38	169.20	74.67
Mean Diff.	6.13		-58.86		35.20		94.53	
Deg. Freedom	18		20		13		6	
T-test Value	.202		-1.955		1.248		.635	
Sig. Value	.842		.065		.234		.549	
95% C.I.	(-57.65, 69.90)		(-121.66, 3.94)		(-25.71, 96.10)		(-269.99, 459.06)	
Sig.Difference	No (.842 > .05)		No (.065 > .05)		No (.234 > .05)		No (.549 > .05)	

Table V

Grades 3, 4, and 5 Reading: Group 1 and Group 2

GRADES 3, 4, & 5 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	**Yes**	**No**	**No**	**Yes**	**Yes**	**No**	**No**	**Yes**
Number	40	44	31	34	24	33	24	31
Min. Gain	**-25**	**-28**	**-28**	**-23**	**-20**	-29	**-29**	-29
Max. Gain	223	178	240	183	188	149	270	160
Range	**248**	**206**	**268**	**206**	**208**	**178**	**299**	**189**
Interquartile Range	96	57.75	102	87	90	62.50	68.75	78
Median	**52.50**	**65**	**64**	**51**	**58**	**27**	**55.50**	**46**
Std. Deviation	57.99	46.99	70.47	60.47	59.60	41.02	63.50	51.53
Mean Gain	**58.38**	**66.36**	**63.29**	**63.62**	**62.42**	**28.64**	**58**	**54.06**
Mean Diff.	-7.99		-.33		33.78		3.94	
Deg. Freedom	**82**		**63**		**55**		53	
T-test Value	.696		.020		2.536		.254	
Sig. Value	**.488**		**.984**		**.014**		**.801**	
95% C.I.	(-30.81, 14.83)		(-32.79, 32.14)		(7.09, 60.47)		(-27.17, 35.04)	
Sig.Difference	**No (.488 > .05)**		**No (.984 > .05)**		**Yes (.014 < .05)**		**No (.801 > .05)**	

Table VI

Grade 3 Math: Group 1 and Group 2

GRADE 3 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	13	20	7	13	10	15	12	14
Min. Gain	-20	-14	-19	-21	-11	-23	-12	-19
Max. Gain	86	123	143	51	121	229	112	157
Range	106	137	162	72	132	252	124	176
Interquartile Range	39.50	61	115	47	78	118	49.50	95.75
Median	23	13	47	23	68	47	46	32
Std. Deviation	31.45	41.20	60.10	24.45	45.11	85.21	36.79	54.92
Mean Gain	25.38	27.15	49	18.23	63.90	68.60	37.92	44.14
Mean Diff.	-1.77		30.77		-4.70		-6.23	
Deg. Freedom	31		18		23		24	
T-test Value	-.131		1.640		-.159		-.333	
Sig. Value	.896		.118		.875		.742	
95% C.I.	(-29.18, 25.65)		(-8.66, 70.20)		(-65.69, 56.29)		(-44.78, 32.32)	
Sig.Difference	No (.896 > .05)		No (.118 > .05)		No (.875 > .05)		No (.742 > .05)	

Table VII

Grade 4 Math: Group 1 and Group 2

GRADE 4 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	13	16	12	18	13	13	4	10
Min. Gain	-19	-17	-26	-27	-22	-7	-29	-21
Max. Gain	89	61	101	175	93	82	30	116
Range	108	78	127	202	115	89	59	137
Interquartile Range	59	50.25	84.25	78.50	62.50	52	54.50	65.50
Median	14	18	21.50	29.50	25	46	-4.50	-4.50
Std. Deviation	33.77	27.57	45.35	54.72	37.57	31.01	29.47	47.65
Mean Gain	20.46	20.81	28.83	44.72	34.23	32.31	-2	18.80
Mean Diff.	-.35		-15.89		1.92		-20.80	
Deg. Freedom	27		28		24		12	
T-test Value	-.031		-.832		.142		-.802	
Sig. Value	.976		.412		.888		.438	
95% C.I.	(-23.70, 23)		(-55.01, 23.23)		(-25.96, 29.81)		(-77.28, 35.68)	
Sig.Difference	No (.976 > .05)		No (.412 > .05)		No (.888 > .05)		No (.438 > .05)	

Table VIII

Grade 5 Math: Group 1 and Group 2

GRADE 5 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4*	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	9	8	13	9	6	8	N/A	N/A
Min. Gain	-17	-19	-12	-20	-18	22	N/A	N/A
Max. Gain	84	14	154	208	24	69	N/A	N/A
Range	101	33	166	228	42	47	N/A	N/A
Interquartile Range	42.50	25.75	65	121.50	33	33	N/A	N/A
Median	1	-8	39	41	13.50	53	N/A	N/A
Std. Deviation	32.02	13.21	44.58	77.27	17.39	17.80	N/A	N/A
Mean Gain	13.67	-4.25	54.69	53.44	5.83	50.13	N/A	N/A
Mean Diff.	17.92		1.25		-44.29		N/A	
Deg. Freedom	15		20		12		N/A	
T-test Value	1.471		.048		-4.651		N/A	
Sig. Value	.162		.962		.001		N/A	
95% C.I.	(-8.04, 43.87)		(-52.88, 55.37)		(-65.04, -23.54)		N/A	
Sig.Difference	No (.162 > .05)		No (.962 > .05)		Yes (.001< .05)		N/A	

Table IX

<u>Grades 3, 4, and 5 Math: Group 1 and Group 2</u>

GRADES 3, 4, & 5 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	**Yes**	**No**	**No**	**Yes**	**Yes**	**No**	**No**	**Yes**
Number	35	42	32	43	30	34	17	26
Min. Gain	**-20**	**-19**	**-26**	**-61**	**-22**	**-23**	**-29**	-21
Max. Gain	89	76	154	208	121	154	112	157
Range	**109**	**95**	**180**	**269**	**143**	**177**	**141**	**178**
Interquartile Range	44	44.25	69.25	65	74	59.50	56	77
Median	**15**	8	**34.50**	**31**	**28**	**46**	**30**	**24**
Std. Deviation	31.85	26.52	48.38	58.25	42.32	41.99	40.23	50.74
Mean Gain	**20.54**	**14.29**	**43.75**	**40.30**	**40.13**	**40.97**	**31.59**	**32.38**
Mean Diff.	6.26		3.45		-.84		-.80	
Deg. Freedom	**75**		**73**		**62**		41	
T-test Value	.941		.272		-.079		-.054	
Sig. Value	**.350**		**.786**		**.937**		**.957**	
95% C.I.	(-6.99, 19.50)		(-21.81, 28.70)		(-21.94, 20.26)		(-30.35, 28.76)	
Sig.Difference	**No (.350 > .05)**		**No (.786 > .5)**		**No (.937 > .05)**		**No (.957 > .05)**	

ANALYSIS OF THE DATA

The findings for Grade 3 are discussed first. There were two teachers whose classrooms participated in the study. There was only one of the cycles that produced significant results as indicated by the t-test. Table X summarizes the significance levels for Grade 3.

As can be determined by Table X, there were no significant gains indicated in three of the four sessions. However, the third cycle showed significant differences and the fourth session a movement toward significance over the first two cycles. When one looks at how "Success Maker" works, this is not surprising. The first few sessions that students complete using "Success Maker" determine the levels at which the students are capable of working. Thus, it takes some time for the appropriate level at which students can be successful yet be challenged to be determined. In other words, the first cycle for each group basically established the baselines for students. This is the way that the "Success Maker" software individualizes the program.

In addition to the initial t-tests conducted for the groups, the researcher also looked at the distribution of scores and constructed boxplots showing the distribution; extreme scores (outliers) were noted and additional t-tests were conducted omitting the outliers. Figure 7 illustrates the gains for all four sessions.

Table X

Grade 3 Reading Gains: T-test Significance Values

Grade 3 Reading Gains: T-test Significance Levels			
Reading Gains 1	Reading Gains 2	Reading Gains 3	Reading Gains 4
.992	.302	.004	.124

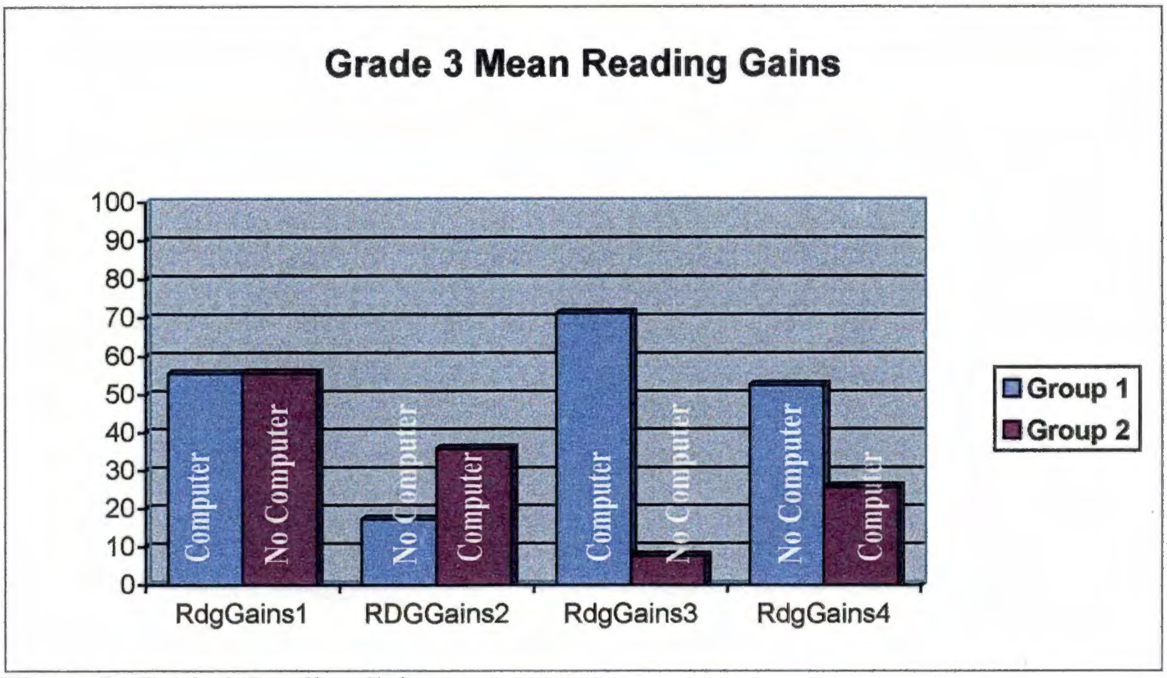

Figure 7. Grade 3 Reading Gains

Group 1 had significant gains over Group 2 for the third iteration (.004 < .05). But what else can be discerned from looking at all the scores? Looking at Figure 7, one can see a trend for the Group using the computer software to make gains compared to the other group, even though the gains are not significant for any cycle except for the third iteration. Perhaps with a longer time period (more than 5 weeks at each cycle), one could see more significant findings.

The fourth grade reading mean gains were the next scores to be analyzed. There were 3 teachers at this grade. No significant differences were produced by the t-tests for Grade 4. As can be seen in Figure 8, Group 1 showed no tendency to gain more for the sessions in which it is using the computers. Group 2 was up or down related to the cycle for its use of the software. Group 1 used the computers for RdgGains1 and RdgGains3; Group 2 used the software for RdgGains2 and RdgGains4.

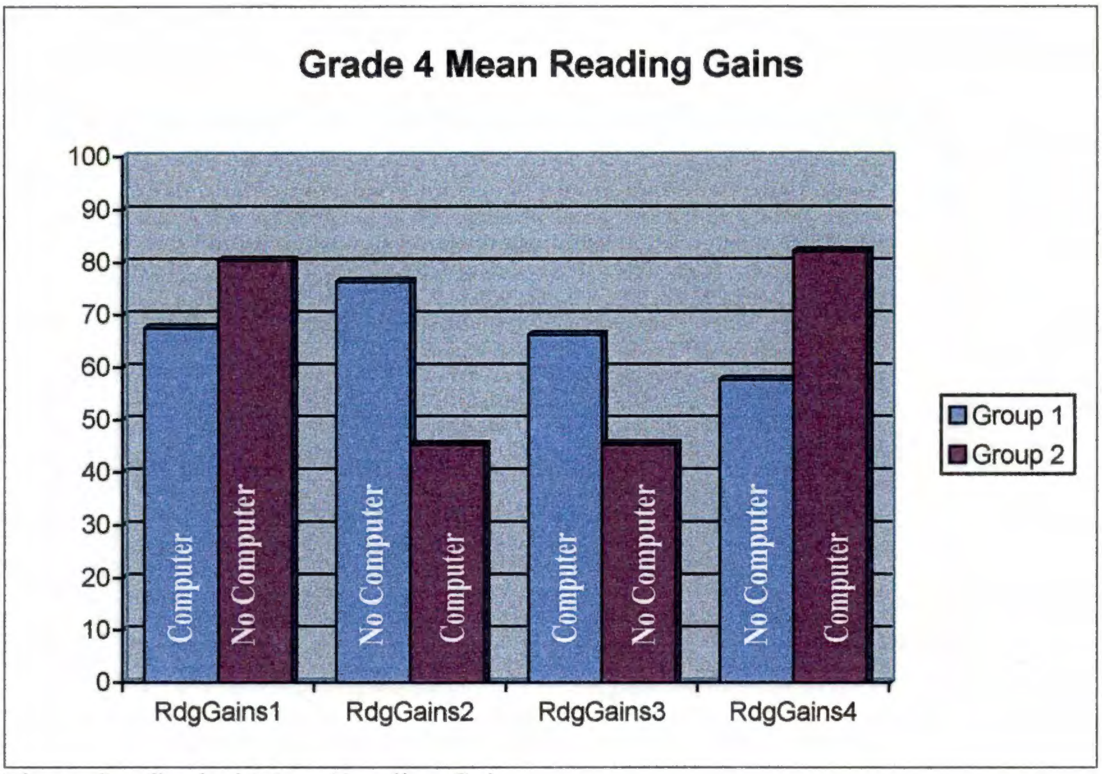

Figure 8. Grade 4 Mean Reading Gains

The fifth grade scores were the next groups to be analyzed. There were 2 teachers whose rooms participated in the study. These classes were not as diligent about getting all the testing and computer work done as the others. One of the original teachers left after the first semester; her replacement did not have as much experience in the classroom and particularly with the software. As a result, there were not as many participants who completed each session in the fifth grade. As was the case for Grades 3 and 4, the later sessions show values that are getting closer to being significant. This may indicate that longer sessions would be more beneficial for students.

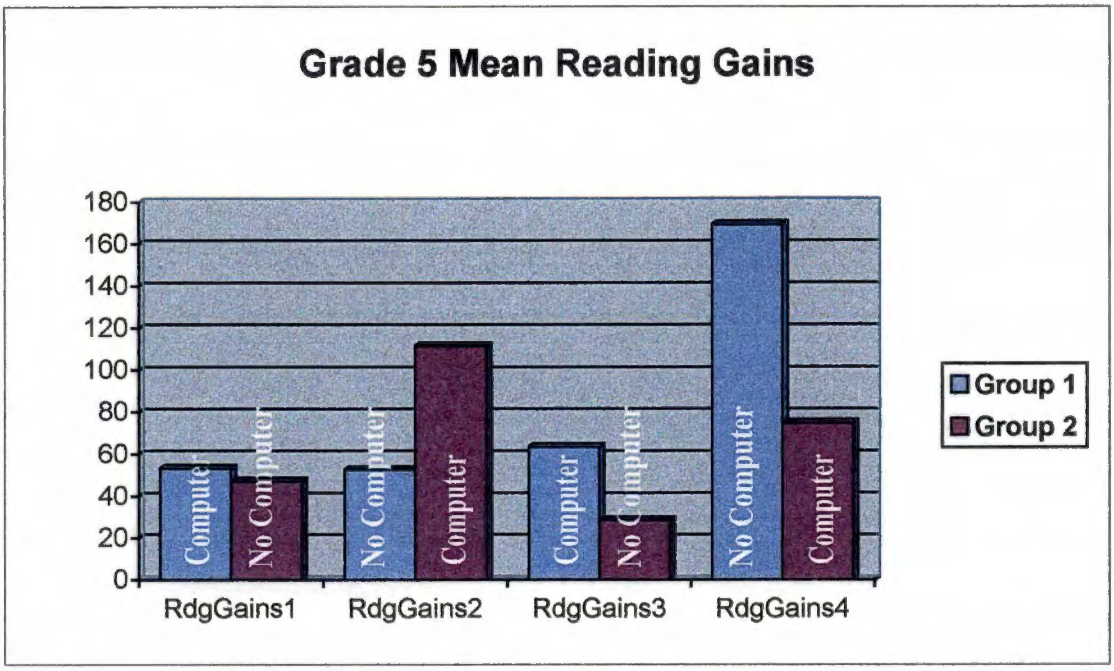

Figure 9. Grade 5 Mean Reading Gains (Outliers Omitted)

For Grade 5, there were no consistent trends between the two groups (see Figure 9). Group 1 did not seem to have enhanced gains relative to the computer use as their two sessions using the computers are RdgGains1 and RdgGains3. Group 2 did seem to show stronger gains concurrent with its use of the software (RdgGains2 and RdgGains4).

The last reading values to be considered were those of Grades 3, 4, and 5 combined (see Figure 10). This combination gave larger numbers to be tested; therefore, the significance was less affected by abnormal gains from 1 or 2 students. Only in the third iteration was there a significant difference obtained by the t-test (.043 < .05). With the grades combined, there is more consistency in the significance levels from one session to another. With the outliers omitted, the significance levels for Reading Gains 2 and Reading Gains 4 are higher. Group 1 does not show gains relative to the use of the computer (RdgGains1 and RdgGains3). The values for Group 2 showed stronger gains for the sessions in which it used the software (RdgGains2 and RdgGains4).

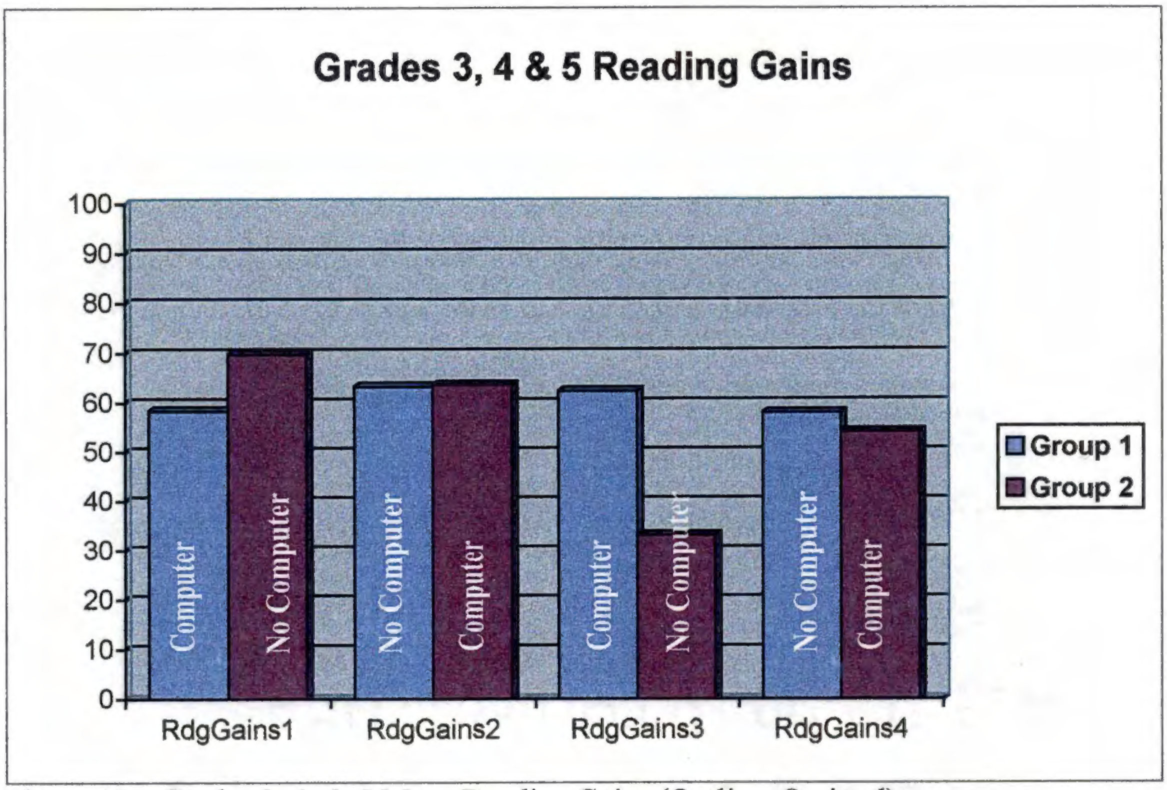

Figure 10. Grades 3, 4, & 5 Mean Reading Gains (Outliers Omitted)

The next section reveals the math gains. Each of the two groups alternated using the Math Concepts and Skills strands from the "Success Maker" software from Computer Curriculum Corporation. Group 1 began with the software while Group 2 did not use it; each daily math session was about 15 minutes long. Before either group began, the students were given an assessment from STAR Math. Then, after a five-week period in which Group 1 used the software, the students were again given the math assessment. Following that, Group 2 worked with the computers while Group 1 did not. The groups alternated like this through four sessions; each group used the software two cycles. Mean gain scores were obtained and two-tailed t-tests were administered at alpha .05. As in reading, the significance values were obtained for math gains for each grade level (3-5) and then for all three grades combined. The values for Grade 3 are discussed first and are presented in Figure 11.

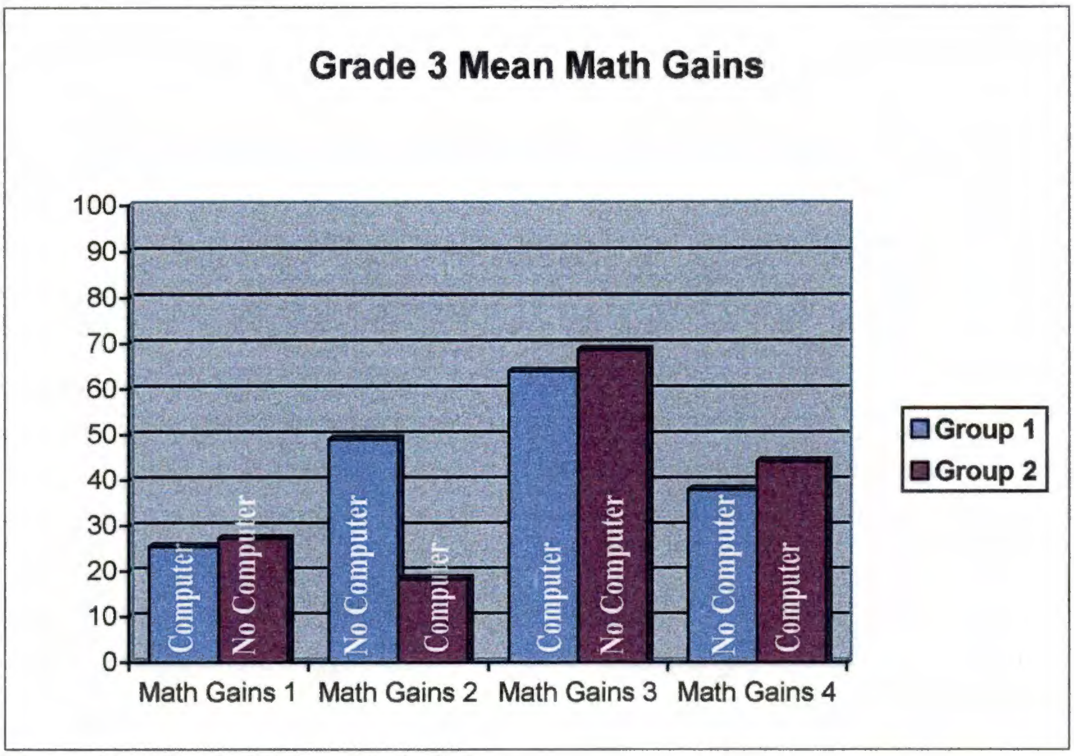

Figure 11. Grade 3 Mean Math Gains

Two classrooms participated in the study at Grade 3. There were no sessions in which significant results (mean gains < .05) were found. The distribution of scores was also examined for extreme values that may have skewed the t-test findings; boxplots were constructed and outliers were identified.

Three classes participated at the fourth grade level. Boxplots were constructed using S.P.S.S. and outliers were identified. In session 3 (Math Gains 3) and session 4 (Math Gains 4), Group 1's mean gains relate to the times when computers were being used. The scores for Group 1 were up in cycle 3 when the students were utilizing the computer program and down in cycle 4 when they were not using them. However, the opposite was true for Group 2. The mean gain is up in iteration 2 while it is down in session 1; in sessions 3 and 4, the scores for Group 2 are inversely related to the use of the software. These findings are illustrated in Figure 12.

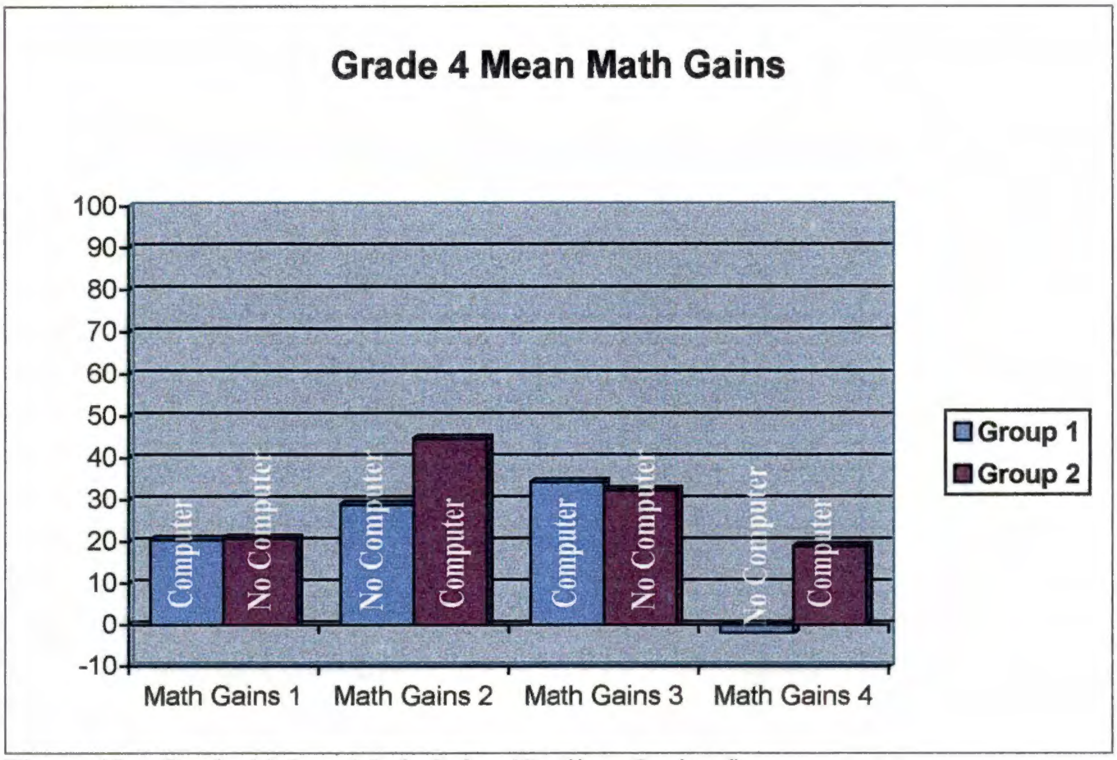

Figure 12. Grade 4 Mean Math Gains (Outliers Omitted)

There were no trends or practical significance that could be identified for Grade 4 math gains.

This section considers the values for Grade 5. The cycle labeled Math Gains 3 shows a significant difference in the mean math gains. However, the difference is a result of Group 2's having the strongest gain for Math Gains 3; Group 2 did not use the computers during this session. The first two sessions are not significantly different. For Grade 5, there was not enough data in order to get a valid score for iteration 4. Grade 5 had a change in teachers during the second semester when most of the data were to be collected. As a result, students did not participate daily in using the math software. When the outliers were removed from consideration, the significance for Math Gains 3 dropped to .001; this indicates even more significant difference between the groups (.001 < .05). However, this significance is inversely related to the use of the software.

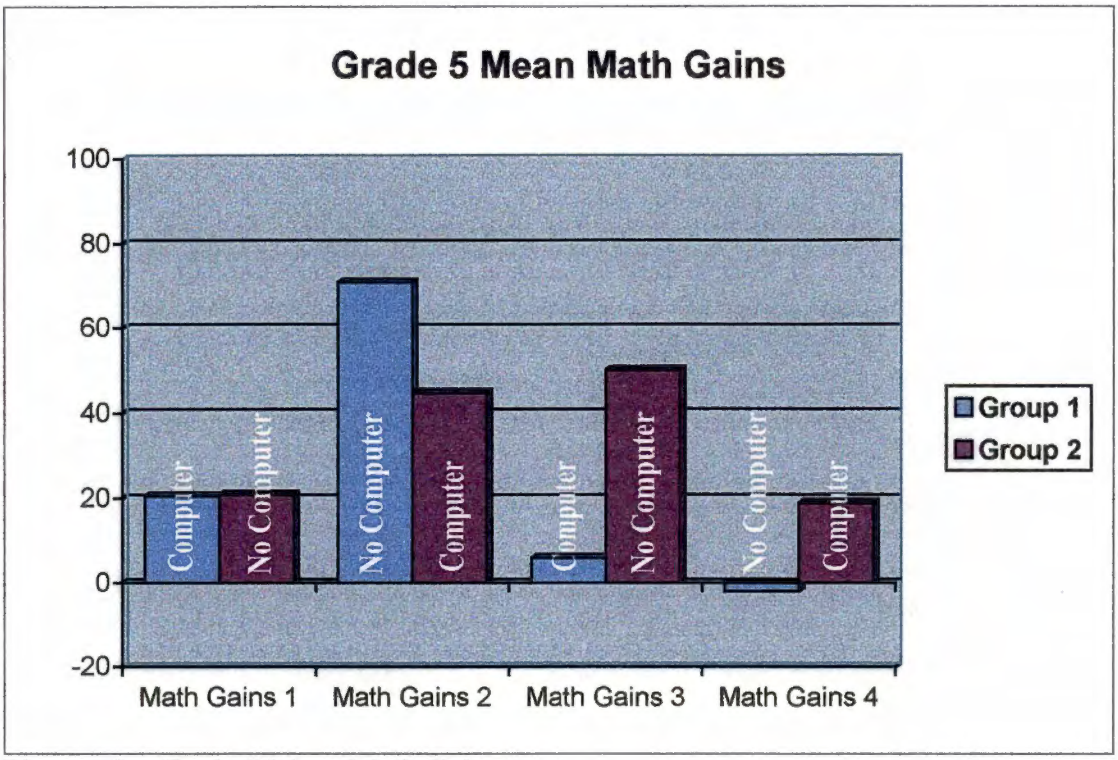

Figure 13. Grade 5 Mean Math Gains

As Figure 13 indicates, Group 2 did show much gain from session 1 to session 2; this is consistent with its use of the computer. Group 1's strongest gains did not coincide with the use of the computer.

The math data for Grades 3, 4, and 5 were combined in order to consider the gains for all the students. T-tests were conducted to find the difference between the mean gains. The values were all relatively high and indicated no pattern of improvement. One cannot conclude from this data that the computer program made any significant or practical difference in the scores of students in Grades 3, 4, and 5 combined. Figure 14 represents graphically the mean math gain values for Grades 3, 4, and 5.

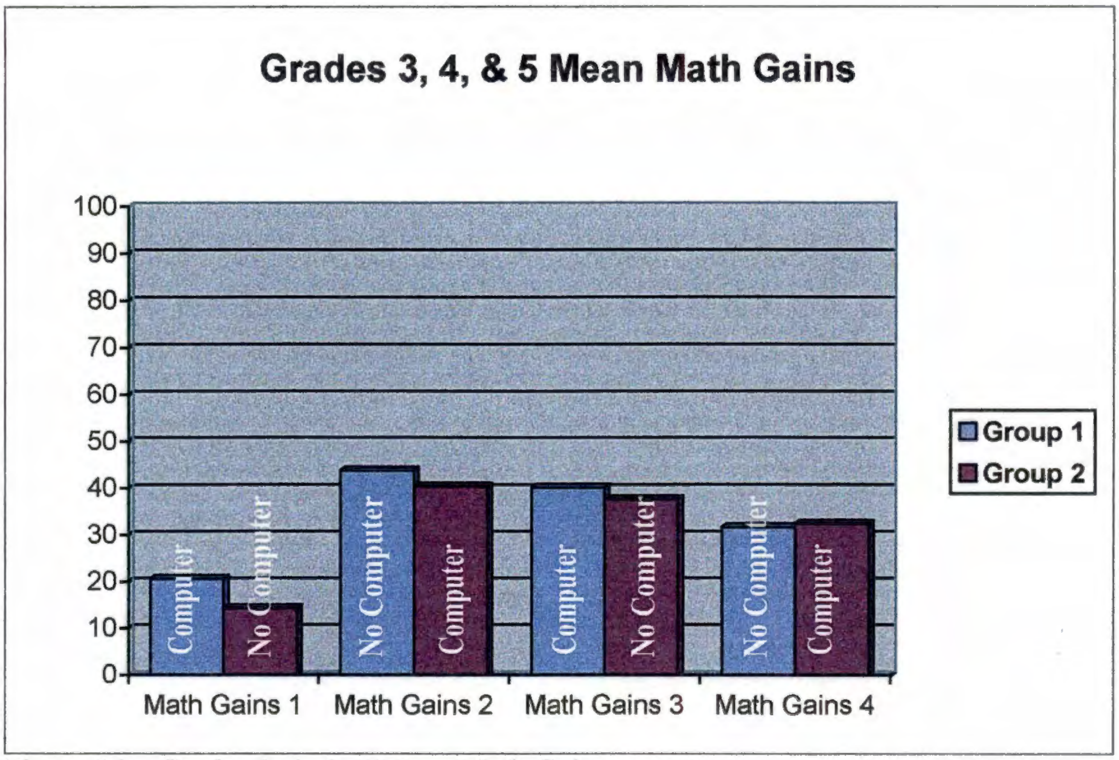

Figure 14. Grades 3, 4, & 5 Mean Math Gains

The only pattern discernable from looking at Figure 14 is that both groups seem to gain or lose strength together – not with computer use. This may indicate that the math scores were more influenced by what was going on in the classroom (teacher effects) than with the use of the computer program.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER RESEARCH

INTRODUCTION

In Chapter 5, the researcher will present a summary of the project, discuss his conclusions drawn from the study, and outline implications for further research for the topic.

SUMMARY OF THE STUDY

This study compared the effects of using a computer software program (Computer Curriculum Corporation's "Success Maker") on the improvement of reading and math scores for students in grades 3, 4 and 5. For reading, the component within the program that was used was "Reader's Workshop;" for math, it was "Math Concepts and Skills." Within each classroom involved in the study, students were randomly assigned to 1 of 2 groups. The groups then alternated using the software for a period of 5 weeks. All other regular curricula activities were completed by both groups. A pretest and posttest for both reading and math were given for each cycle. Mean gain scores were obtained and t-tests were conducted at alpha .05; two-tailed tests were utilized to determine not only if the use of computer programs produced positive gains, but also to establish whether the use of the software led to negative gains. The tests were done first for each grade level and then for Groups 1 and 2 combined across grade levels.

For most sessions, there were no statistically significant differences indicated for the use of the computer programs; the exceptions were for reading cycle three in grade three and reading cycle three for grades 3, 4, and 5 combined. However, when gain scores were examined using charts to explore progress, there were some trends toward improvement that suggested that the use of the software may have enhanced instruction, especially in reading. There was a tendency for higher relative gains for the group that corresponded to the sessions in which those students used the computers. This also seemed to indicate that more time for each session may have led to producing significant differences in the mean gains between the two groups.

CONCLUSIONS

There can be several conclusions that can be drawn about the use of curriculum software used in classrooms as a result of this study. The length of the cycles will be discussed; reading will be considered first, followed by math. In addition to overall mean gains, grade levels will be compared to see if there is a difference in the gains related to different grade levels. Finally, the program will be considered in terms of the practicality of the use of computers. The conclusions are:

1. The session length of five weeks was not long enough to establish whether trends in improvement would translate into statistically significant differences when students used computer software to enhance their math and reading in Grades 3, 4, and 5.
2. There were no significant differences in the gains for different grade levels and as a result, there would be no advantages in selecting particular grades for using the computer software. The author concluded that all students from grades three through five could be equally successful in utilizing the software.
3. Even though there was little statistically significant advantage in gain scores using the computers, their use had a practical advantage. The data show that there were no adverse effects in using the software as a

supplement to the curricula in math and reading. During the times that students were working at the computers, teachers had fewer students with whom to give guidance and individual help. Thus, in effect, during these times, the teacher to student ratio was lowered.

The first conclusion for the study relates to the length of each cycle. For the project, each session lasted 5 weeks. After examining the results of the study, the author concluded that the cycles should have been set for longer, sustained use of the computer software. The trends in reading especially lead to this judgment. Although there were isolated instances where the use of the computer program "Success Maker" seemed to enhance the mean gains of students in reading, overall there was no indication that the use of computers led to significant differences in mean gains. This was the conclusion from considering the significance values of the t-tests performed. Only during the third cycle of Grade 3 Reading was there a significant difference found in favor of the use of the computers (.004 < .050). However, when the researcher looked at the distribution of scores for both groups from one session to another, there were some trends that were revealed related to the use of computers. If one considers that the software utilized the first two cycles in order to establish the ideal working levels for the students, then the last two sessions should have the most potential for being most effective. For Grade 3, this was the case. In looking back at Figure 7, one can see that for both groups, cycles three and four gains were directly related to the use of the software. The gains for Group 1 were up in cycle 3 (using computer) and down in cycle 4 (not using computer); the gains for Group 2 were down for cycle 3 (not using computer) but up for cycle 4 (using computer). The same pattern was established for Grade 4 (see Figure 8). For Grade 5, only Group 2 followed this trend (see Figure 9). When the grades were combined, the same pattern (as Grades 3 and 4) can be observed (see Figure 10). The researcher concluded that there were some positive indications for using the computer software for reading and that a longer period of use may have actually produced more significant gains.

Next, the author examined the math data. From this study, the researcher cannot come to a conclusion that the use of the math program can make any significant or even practical differences in the gains of students in grades three through five. There were no trends that seemed to suggest that the math gains were in any way related to the use of the "Success Maker" software. When one examines cycles 3 and 4, only about 50% of the time does a rise or fall in gain scores relate to the use of the computer. Therefore, the conclusion for determining significant or practical differences in mean gains for math is that the use of the computer software cannot be shown to be effective.

Another conclusion is that there seems to be not much difference in the effectiveness of the software related to the grade level of students. Only in Grade 5 did there seem to be a difference in patterns established and the variable of a new teacher entering the program during the project may have given rise to that disparity. As a result, the author concluded that students from any of the three grade levels could successfully use the computer software.

The last conclusion was that there was a practical advantage in allowing students to use computers in the classroom. One of the critical criteria relating to the effectiveness of the teacher is that of teacher to student ratio. Much research has been done to establish the benefits of lowering the numbers of students that teachers are responsible to teach in a class. Thus, if there are times during the day when the computer can "teach" students, then the number remaining for the teacher to supervise and attempt to help one-on-one is effectively reduced. Thus, although the use of the software did not produce consistently statistically significant gains, there was shown to be no adverse effects in using the software, and, as a result, there were practical advantages for the students to use the computers.

RECOMMENDATIONS FOR FURTHER STUDY

The researcher believes that more studies need to be done using the computer and appropriate software. A longer session of computer use (more than five weeks at a time) may reveal whether the practical trends would transfer into significant differences. Technology is expensive and administrators need to be as frugal with school and taxpayer money as possible. In order to determine the effectiveness of computer and software investment, more studies need to be done, particularly in the areas of software usefulness.

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APPENDIX

APPENDIX

Table XI

Grade 3 Reading: Group 1 and Group 2 (All Scores)

GRADE 3 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	16	19	11	17	11	12	8	15
Min. Gain	-21	5	-28	-23	-11	-29	-26	-29
Max. Gain	118	178	240	183	150	181	91	95
Range	139	173	268	206	161	210	117	124
Interquartile Range	87.75	44	110	53.50	121	53.50	64.75	61
Median	62.50	60	7	41	58	16.50	65	23
St. Deviation	44.24	40.22	82.99	25.02	59.31	55.96	41.05	36.78
Mean Gain	55.38	61.95	37.45	44.41	71.27	22	52.50	25.67
Mean Diff.	-6.57		-6.96		49.27		26.83	
Deg. Freedom	33		26		21		21	
T-test Value	-.460		-.275		2.050		1.602	
Sig. Value	.648		.785		.053		.124	
95% C.I.	(-35.63, 22.49)		(-58.96, 45.04)		(-.71, 99.26)		(-8, 61.66)	
Sig.Difference	No (.648 > .05)		No (.785 > .05)		No (.053 > .05)		No (.124 > .05)	

Table XII

Grade 4 Reading: Group 1 and Group 2 (All Scores)

GRADE 4 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	12	17	10	8	10	14	13	14
Min. Gain	-6	-22	-12	-14	-20	-18	-29	17
Max. Gain	190	169	161	106	188	149	270	359
Range	196	191	173	120	208	167	299	342
Interquartile Range	105	93	101.25	71.75	97.50	56.75	69	78
Median	60.50	72	79	59.50	60	36	69	90.50
St. Deviation	58.44	51.43	58.83	42.09	65.79	44.25	75.38	85.29
Mean Gain	67.50	80.35	76.40	45.25	66.20	45.36	74	101.86
Mean Diff.	-12.85		31.15		20.84		-27.86	
Deg. Freedom	27		16		22		25	
T-test Value	-.627		1.259		.930		-.896	
Sig. Value	.536		.226		.362		.379	
95% C.I.	(-54.93, 29.93)		(-21.31, 83.61)		(-25.62, 67.30)		(-91.86, 36.15)	
Sig.Difference	No (.536 > .05)		No (.226 > .05)		No (.362 > .05)		No (.379 > .05)	

Table XIII

Grade 5 Reading: Group 1 and Group 2 (All Scores)

GRADE 5 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	12	9	15	8	7	8	5	3
Min. Gain	-25	-28	-28	-10	-10	-20	-9	-6
Max. Gain	223	220	569	178	176	99	539	160
Range	248	248	597	188	186	119	548	166
Interquartile Range	111.75	94	117	112.75	118	78	419	Not given
Median	29.50	69	48	133.50	54	30	12	70
St. Deviation	75.55	73.65	148.94	66.07	65.65	42.63	242.83	83.10
Mean Gain	53.25	66.33	87.07	111.50	63.57	28.38	169.20	74.67
Mean Diff.	-13.08		-24.43		35.20		94.53	
Deg. Freedom	19		21		13		6	
T-test Value	-.397		-.438		1.248		.635	
Sig. Value	.696		.666		.234		.549	
95% C.I.	(-82.08, 55.91)		(-140.47, 91.61)		(-25.71, 96.10)		(-269.99, 459.06)	
Sig.Difference	No (.696 > .05)		No (.666 > .05)		No (.234 > .05)		No (.549 > .05)	

Table XIV

Grades 3, 4, and 5 Reading: Group 1 and Group 2 (All Scores)

GRADES 3, 4, & 5 READING								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	40	45	32	34	24	34	26	32
Min. Gain	-25	-28	-28	-23	-20	-29	-29	-29
Max. Gain	223	220	569	183	188	181	539	359
Range	248	246	597	206	208	210	568	388
Interquartile Range	96	60	112	87	90	71.50	74.50	79
Median	52.50	66	65.50	51	58	28	63.50	46.50
St. Deviation	57.99	51.79	113.13	60.47	59.60	48.11	120.22	23.58
Mean Gain	58.38	69.78	79.09	63.62	62.42	33.12	85.69	63.59
Mean Diff.	-11.40		15.48		29.30		22.10	
Deg. Freedom	83		64		56		56	
T-test Value	-.958		.699		2.068		.859	
Sig. Value	.341		.487		.043		.394	
95% C.I.	(-35.08, 12.28)		(-28.76, 59.72)		(.92, 57.67)		(-29.41, 73.60)	
Sig.Difference	No (.341 > .05)		No (.487 > .05)		Yes (.043 < .05)		No (.394 > .05)	

Table XV

Grade 3 Math: Group 1 and Group 2 (All Scores)

GRADE 3 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	13	21	7	15	10	15	12	14
Min. Gain	-20	-14	-19	-21	-11	-23	-12	-19
Max. Gain	86	164	143	139	121	229	112	157
Range	106	178	162	160	132	252	124	176
Interquartile Range	39.50	64	115	55	78	118	49.50	95.75
Median	23	16	47	31	68	47	46	32
St. Deviation	31.45	50.04	60.10	47.08	45.11	85.21	36.79	54.92
Mean Gain	25.38	33.67	49	33.87	63.90	68.60	37.92	44.14
Mean Diff.	-8.28		15.13		-4.70		-6.23	
Deg. Freedom	32		20		22.165		24	
T-test Value			.644		-.179[a]		.178	
Sig. Value	.597		.527		.859		.742	
95% C.I.	(-39.91, 23.35)		(-33.88, 64.15)		(-59.06, 49.66)		(-44.78, 32.32)	
Sig.Difference	No (.597 > .05)		No (.527 > .05)		No (.859 > .05)		No (.742 > .05)	

[a] Note: Equal variances not assumed (Levene's Test for Equality of Variances)

Table XVI

Grade 4 Math: Group 1 and Group 2 (All Scores)

GRADE 4 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	13	16	13	18	14	14	4	10
Min. Gain	-19	-17	-26	-27	-22	-7	-29	-21
Max. Gain	89	61	575	175	238	160	30	116
Range	108	78	601	202	260	167	59	137
Interquartile Range	59	50.25	95.50	78.50	72.75	55.75	54.50	65.50
Median	14	18	25	29.50	28.50	48.50	-4.50	-4.50
St. Deviation	33.77	27.57	157.58	54.72	65.34	45.30	29.47	47.65
Mean Gain	20.46	20.81	70.85	44.72	48.79	41.43	-2.00	18.80
Mean Diff.	-.35		26.12		7.36		-20.80	
Deg. Freedom	27		29		26		12	
T-test Value	-.031		.654		.346		-.802	
Sig. Value	.976		.518		.732		.438	
95% C.I.	(-23.70, 23)		(-55.53, 107.77)		(-36.32, 51.03)		(-77.28, 35.68)	
Sig.Difference	No (.976 > .05)		No (.518 > .05)		No (.732 > .05)		No (.438 > .05)	

Table XVII

Grade 5 Math: Group 1 and Group 2 (All Scores)

GRADE 5 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	9	8	13	9	7	8	[a]	[a]
Min. Gain	-17	-19	-12	-20	-18	22		
Max. Gain	84	14	154	208	85	69		
Range	101	33	166	228	103	47		
Interquartile Range	42.50	25.75	65	121.50	38	33		
Median	1.00	-8.00	39	41	14	53		
St. Deviation	32.02	13.21	44.58	77.27	33.87	17.80		
Mean Gain	13.67	-4.25	54.69	53.44	17.14	50.13		
Mean Diff.	17.92		1.25		-32.98			
Deg. Freedom	15		20		13			
T-test Value	1.471		.048		-2.408			
Sig. Value	.162		.962		.032			
95% C.I.	(-8.04, 43.87)		(-52.88, 55.37)		(-62.57, -3.39)			
Sig.Difference	No (.162 > .05)		No (.962 > .05)		Yes (.032 < .05)			

[a] Note: Insufficient data to analyze

Table XVIII

Grades 3, 4, and 5 Math: Group 1 and Group 2 (All Scores)

GRADES 3, 4, & 5 MATH								
	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Computer Use	Yes	No	No	Yes	Yes	No	No	Yes
Number	35	44	33	43	31	37	17	26
Min. Gain	-20	-19	-26	-61	-22	-23	-29	-21
Max. Gain	89	123	575	208	238	229	112	157
Range	109	142	601	269	260	252	141	178
Interquartile Range	44	52	76.50	65	74	61	56	77
Median	15	9	36	31	31	47	30	24
St. Deviation	31.85	34.30	104.02	58.25	54.72	61.48	40.23	50.74
Mean Gain	20.54	19.14	59.85	40.30	46.52	54.32	31.59	32.38
Mean Diff.	1.41		19.55		-7.81		-.80	
Deg. Freedom	77		74		66		41	
T-test Value	.187		1.039		-.548		-.054	
Sig. Value	.852		.302		.585		.957	
95% C.I.	(-13.58, 16.40)		(-17.93, 57.02)		(-36.25, 20.63)		(-30.35, 28.76)	
Sig.Difference	No (.852 > .05)		No (.302 > .05)		No (.585 > .05)		No (.957 > .05)	

VITA

Charles Kenneth Phillips is the author of this document. A native of Cleveland, Tennessee, he attended Bradley Central High School and was graduated in 1964. He received his B.S. degree from Lee College in 1968, majoring in English. Mr. Phillips began his teaching career at Hopewell Elementary School in the fall of 1968. In 1976, he obtained a Master's Degree in Physical Education, Health, and Safety from Middle Tennessee State University. That fall, he transferred to Bradley Central High School, teaching in the English Department and coaching basketball and cross-country. While at Bradley, he also began and coached the women's softball program. During the years of 1986 – 88, the author attended the University of Tennessee at Chattanooga; he obtained his Plus 45 and gained certification in Administration and Supervision for Elementary and Secondary Schools. In the fall of 1988, Mr. Phillips transferred to Taylor Elementary School as principal; he has remained in that position until the present. In 1997, the author began a doctoral program at the University of Tennessee, Knoxville.

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