EFFECTS OF COMPUTER INTEGRATED INSTRUCTION ON STUDENT ACHIEVEMENT IN EIGHTH GRADE MATHEMATICS

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Abstract

The purpose of this study was to determine the effect of computer-aided instruction on student achievement in eighth grade mathematics using the “I CAN Learn” computer system created by John R. Lee and marketed by JRL Enterprises, Inc. The study conducted in the Hickman Mills School District, State of Missouri included 589 students who received math instruction using the computer program, and 363 students who received traditional instruction in a “chalk-and-talk” classroom setting.

This study used math scores from the Missouri Assessment Program (MAP). Eighth grade mathematics achievement was compared between students using a specific computer-aided instruction system, “I CAN Learn” or ICL, and students taught in traditional classes. In addition to comparing student achievement in classes using the “I CAN Learn” computer system and classes using traditional lesson delivery, the study focused on student achievement based on gender, free and reduced lunch, and students with special educational needs.

A *t*-test for independent samples was used to compare the means for the quantitative study to test five hypothesis statements. The results from the statistical analysis rejected the null hypotheses and showed differences between MAP scores at the 0.05 level of significance. Students who received instruction using the “I CAN Learn” computer program scored higher than students who did not use the “I CAN Learn” computer system including male, female, special educational needs, and SES status subcategories.

Dedication

As I begin to think of all individuals who influenced my work and dedication to this program, it was difficult to mention only one. Should I thank a friend who was always there for me? Should I thank my parents and family for their sacrifices and patience, or my advisor who never gave up on me and never let me down?

I dedicate this work to God for allowing everyone who influenced this work to be at the right place, saying the right thing at the right moment.

This work is also dedicated to my parents, Mohamed and Sobhia Aql, and to my mentor, my idol, my oldest brother Mazin. Throughout my life, with all its ups and downs, you made me feel important and worthy. Your continuous encouragement and trust in me made me who I am today. I hope I can continue making you proud and promise, to the best of my ability, to direct my knowledge, experience, and expertise for good causes and serve education wherever I may be.

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To my wife, Samira (you are the best), and my small family, Mazin, Zeena, Mohamed, Marwah, and Ibraheem, I give you all a heartwarming "thank you" filled with love and loyalty. You guys have always been my pride and joy and thank you for enduring and sacrificing during this journey. I hope I can always make you proud and live up to your expectations.

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Chapter One

Introduction

In today's highly changed and technologically dependent world, education has its fair share of modern challenges. Old teaching methods such as "chalk-and-talk," known as a traditional teaching method in which teachers address students by using a board to provide examples or illustrations, are giving way to newer strategies (Chalk and Talk, n.d.). Traditional methods of teaching have been undergoing changes influenced by new techniques and technologies. Since the spread and development of electronics and computers, computer-aided instruction is an initiative that has been investigated as a means to close achievement gaps (Daniel, 1999). For many reasons, most related in some way to poverty, these gaps persist among diverse groups of students.

Educators, in general, have been searching for teaching techniques, strategies, and methods to close achievement gaps, including those that occur between inner-city students attending schools in low-socioeconomic areas and their suburban counterparts, who are, in general, scoring higher on state standardized tests. Government officials who are involved in the legislation process have attempted to find solutions as well. The No Child Left Behind Act of 2001 (NCLB) focused on improving student achievement in Mathematics, Reading, and Science. The purpose of NCLB was to minimize and close the achievement gap between groups of students within American schools (U.S. Department of Education, 2004).

Research studies, such as Kulik (1994) and Wenglinsky (1998), addressed the use of technology in teaching and learning. Their study reveals that students who received instruction using computer technology score higher than students who received instruction in traditional classes. Short (2002) examined the effect of the Middle School Math Explorer computer program on student achievement. The program was designed to address specific school district math standards for the Long Beach Unified School District. The results showed significant differences in pre- and post-test results. Math Explorer is a computer aided instruction software similar to the "I CAN Learn" computer system. The Short (2002) study also suggested that students indicated noticeable gains with exposure to the Math Explorer computer program. Another study, conducted by Kigsley and Boone (2008), noted that students who used computers in addition to textbooks in instruction scored higher on a standardized state test.

A number of applications utilizing computer-aided instruction programs have been developed in the last two decades. One such program, the computer-aided instruction program used for this study, is "Interactive Computer Aided Natural Learning," or "I CAN Learn." The system, created by JRL Enterprises, Inc., is a pre-algebra and algebra computerized curricula that is designed to improve problem-solving skills by using individualized instruction (I CAN Learn, 2010a). In literature distributed by JRL Enterprises Inc., the company purports that the program increases student achievement in in grades six through twelve. The program targets mostly districts with large concentrations of ethnically diverse, inner-city students and to districts with higher levels of poverty. JRL Enterprises, Inc. purports that lessons are designed to equip students with the mathematical skills needed to meet district, state, and national objectives (I CAN Learn, 2010a). The "I CAN Learn" pre-algebra computer program consists of 131 lessons, and the algebra computer program consists of 181 lessons. JRL Enterprises, Inc. claims the curriculum software meets the National Council of Teachers of Mathematics (NCTM) standards and can be configured to meet state and local grade-level expectations (I CAN Learn, 2010a).

Background of the Study

John Lee, founder of the "I CAN Learn" computer system, had a vision in using computers in the classroom. He was convinced computers could serve as instructional tools to provide direct instruction and guided instruction. Lee envisioned that such a system could test for measurable mastery levels instead of being used as supplemental tools. John Lee believed computers were capable of improving and contributing to growth in student achievement in mathematics (I CAN Learn, 2010a). In 1995, McDonogh No.35 Senior High in New Orleans, Louisiana, was the first school to pilot the program. Since 1995, JRL Enterprises, Inc. regularly reports in their own newsletter that the "I CAN Learn" computer system contributed to the increase in student achievement in mathematics in several schools with similar demographics as McDonogh high school in New Orleans (I CAN Learn, 2010a).

Since JRL Enterprises, Inc. developed the "I CAN Learn" computer system, disadvantaged schools and urban school districts began purchasing the program. Schools in Louisiana, Alabama, North Carolina, and California began adopting the new technology (I CAN Learn, 2010a). Disadvantaged school districts in Missouri, including Kansas City, Missouri Consolidated School District shown in Appendix A (KCMSD, personal communication, February 1, 2010), Grandview Consolidated School District shown in Appendix B (Grandview C-4, personal communication, February 15, 2011), and Hickman Mills Consolidated School District shown in Appendix C, decided to purchase the "I CAN Learn" computer system.

Hickman Mills School District was selected for this study. This district is one of several in Jackson County and is contained totally within the city limits of Kansas City. To provide the reader an understandable contextual reference of Hickman Mills School District, the researcher has included regional information. The population diversity of the region is best described by the Mid-America Regional Council. The population distribution in Jackson County shows a major concentration and growth of African-Americans in the suburbs of Kansas City including the Hickman Mills area. This is best evidenced by viewing U.S. Census data shown in Appendix I (Mid-America Regional Council, 2011).

To better understand the characteristics of Hickman Mills School District, one must understand its past. Hickman Mills served the southern portion of the city of Kansas City. In the early 1950s, when housing was sparse and businesses were small and owner-operated, business owners created the Hickman Mills Chamber of Commerce with the hope of receiving city improvements. Their goal was to improve the area with the additions of street lights, municipal offices, bus services, traffic signs, and police protection. On May 20, 1957, the entire area of Hickman Mills, Ruskin Heights, and Martin City was hit by a devastating tornado that claimed 44 lives, injured 531 people and destroyed hundreds of homes (South Kansas City Chamber of Commerce [SKCCC], 2007). Ruskin Heights residents faced the devastation head-on and were determined to rebuild. After the tornado, houses were constructed quickly and the new and cheaper housing deteriorated over time. By the time Kansas City closed its concentrated housing projects in the 1980's and 1990's, many of these deteriorated homes in Hickman Mills had become eligible for federal subsidies through Housing and Urban Development

(HUD), more commonly known as Section 8 housing. White out-migration of families progressed to newer developed areas until the overall economic level of the Hickman Mills area had dropped significantly (SKCCC, 2007). Today's Hickman Mills School District is a result of an evolution over time of the impact of natural disaster, deterioration in housing values, and "white flight" migration to suburbs.

The Hickman Mills area was considered a suburb of Kansas City. Once minorities were able to afford the cost of living and began trading urban for suburban life, white families began moving out. Over time, the population shift and decrease in housing values changed. The perception of the area gradually moved to the point that most thought of the area not as suburban but more urban (SKCCC, 2007). Table 1 shows the demographic breakdown and population diversity of the Hickman Mills area.

Table 1

Area Demographic Information

Area	Population	African-American	White	Hispanic	Average Income
Hickman Mills C-1	49,396	42.7%	51.7%	3.1%	$45,235

Note: From U.S. Census Bureau, 2010Retrieved from: http://quickfacts.census.gov/qfd/states/29/29095.html

From the table above, it can be seen that the population of Hickman Mills School District is 49,396. The ethnic diversity of the population is expressed in terms of percentages. For example, 51.7% of the population is White, 42.7% of the population is African-American, and 3.1% of the population accounts for the Hispanic population. The table also shows $45,235 as the average household income in the Hickman Mills area (U.S. Census Bureau, 2010).

Table 2 shows data from the 2007 and 2008 school years in terms of enrollment, ethnic breakdown, and percentage of students receiving free and reduced lunch. Hickman Mills School District data indicates a slight drop in the overall enrollment and a slight increase in Hispanic enrollment. African-American enrollment in the District was close to 80%, and the total number of students receiving free and reduced lunch was between 74% and 75% of the total enrollment (Missouri Department of Elementary and Secondary Education, 2008).

Table 2

Districts' Enrollment Information for the Years 2007 and 2008

School District	Year	Total District Enrollment	African American	White	Hispanic	Other	Free & Reduced Lunch
Hickman Mills C-1	2007	6,949	79.50 %	13.90%	5.20 %	1.40%	74.50 %
Hickman Mills C-1	2008	6,902	79.20 %	13.30%	5.90 %	1.60%	74.00 %

Note. From Department of Elementary and Secondary Education Retrieved from: http://dese.mo.gov/schooldata/school_data.html

Hickman Mills School District adopted the "I CAN Learn" computer system in 2003-2004 school year to improve student learning in mathematics and student achievement on the Missouri State assessment (MAP). The program was implemented at the middle school level in Smith-Hale and Ervin Middle schools. This study examined eighth grade student achievement in mathematics for the school years 2006-2007 and 2007-2008 (Hickman Mills C-1, personal communication, February 24, 2011).

Table 3 shows that the number of students who took the state assessment MAP test in the Hickman Mills School District dropped in 2008 from the previous year. The table also shows a slight decrease in the percentage of students who scored in the Below Basic category in mathematics. The data also indicates an increase in the number of students who scored in the Basic and Proficient categories in 2008. The recognizable success in moving students out of the Below Basic category into the Basic and Proficient categories was countered by a decrease in the number of students who scored in the advanced category for the same school year (MODESE, 2010a).

Table 3

Scores Reported for 8th Grade for the Years 2007 and 2008

School	Year	Reportable	Below Basic	Basic	Proficient	Advanced
Hickman Mills C-1	2007	547	47.00%	36.40%	13.30%	3.30%
Hickman Mills C-1	2008	538	46.10%	37.20%	13.80%	3.00%

Note. From Department of Elementary and Secondary Education Retrieved from: http://dese.mo.gov/planning/profile/arsd048072.html

Problem Statement

The "I CAN Learn" computer system has been purchased and implemented by school districts across the United States in an attempt to improve student achievement and close the achievement gaps in mathematics between students attending suburban and urban school districts. JRL Enterprises, Inc., the developer of the program, marketed the product by using independent research (Kerstyn, 2001; Kerstyn, 2002; Kirby, 2004a; and Kirby, 2004b) as well as their own data (I CAN Learn, 2010a) to demonstrate viability and effectiveness. JRL Enterprises, Inc. purported that the program was best used to meet the learning needs of disadvantaged students (I CAN Learn, 2010a). A 30-student single classroom setting with the “I CAN Learn” computer program costs between $100,000 and $300,000. The cost of the program depends upon whether specially adapted furniture and computers are purchased or whether the district purchases only the software. The marketing strategy of JRL for the product is directed mainly toward inner-city school districts with the majority of students classified as low SES (I CAN Learn, 2010a). The US Department of Education continues to search for data to support programs that show positive effects on student achievement in mathematics. Scrutiny applied to these searches is even greater for programs with expensive price tags such as the “I CAN Learn” computer system.

The U.S. Department of Education's Institute of Education Sciences (IES) established the What Works Clearinghouse (WWC) in 2002 in response to the No Child Left Behind legislation in 2001 (Schoenfeld, 2006). The WWC is responsible for providing stakeholders including educators, policymakers, researchers, and the public with scientific evidence of what works in education. What Works Clearinghouse collects studies on the effectiveness of educational programs, products, and practices and reports on the strengths and weaknesses of those studies measured against standards established by the WWC, which are designed to inform educators of what the WWC research evidence indicates (Northwest Educational Technology Consortium, n.d.).

What Works Clearinghouse examined Kerstyn’s (2001) research conducted on the use of the “I CAN Learn” computer system in teaching and reported their findings. The research used state standardized testing as a means to measure student achievement. The WWC reported that students who received “I CAN Learn” classroom instruction did not score significantly higher than their counterparts in traditional math classrooms (WWC, 2004). On the other hand, Kirby's (2004b) research conducted in Glimer County School District, Georgia, examined the effect "I CAN Learn" computer system had on student math achievement. Kirby's (2004b) study used data from 254 eighth grade students in which 91 students used the "I CAN Learn" computer program and the rest used traditional classroom teaching methods. The results showed students who received instruction using the computer program increased their math scores with marked improvement. The contradicting findings and reports created the need for additional examination of the effect "I CAN Learn" computer system has on student achievement. WWC also conducted a meta-analysis of studies examining the "I CAN Learn" computer system and reported the program had a positive effect on student achievement (WWC, 2009). Because of these contradictions, the researcher believes an unbiased and independent study is needed to examine the effect "I Can Learn" computer system has on student achievement in mathematics.

Purpose of the Study

The purpose of the study was to determine if the pre-algebra and algebra "I CAN Learn" computer program implemented by Hickman Mills School District had an effect on student mathematics achievement in eighth grade. The study compared average math scores as measured by MAP results in mathematics. Student data were divided into two groups. One group received instruction using the "I CAN Learn" computer system while the other group received instruction using traditional teaching methods. Student data was also divided into subgroups to determine if student math scores were greater for male students, female students, students with special educational needs, and students with low SES who received math instruction using the “I CAN Learn” computer system than similar subgroups of students who received instruction in traditional class settings.

Significance of the Study

General studies and research on incorporating technology in teaching and learning show potential in increasing student achievement on standardized tests. Kulik and Kulik (1991) wrote in their research about Computer Based Instruction (CBI):

> We conclude, therefore, that the typical student in an average CBI class would perform at the 62nd percentile on an achievement examination, whereas, the typical student in a conventionally taught class would perform at the 50th percentile on the same examination. Put in another way, the average student from the CBI class would outperform 62% of the students from the conventional classes. (p. 80)

Government oversight agencies such as What Works Clearinghouse (WWC, 2007) in particular, reported the “I CAN Learn” computer system developed by JRL Enterprises, Inc. has positive effects on student achievement in mathematics. This study is necessary and significant because additional unbiased research is needed to support or reject the impact “I CAN Learn” computer system has on student achievement in mathematics as measured by the Missouri Assessment Program. The results from this study may provide useful information regarding the effect of computer-aided instruction on student achievement in Hickman Mills School District.

Research Questions

This study focused on the following questions:

1. As determined by the Missouri Assessment Program (MAP), is student achievement greater for students using the “I CAN Learn” computer system than for students receiving traditional instruction in eighth grade math?
2. As determined by the Missouri Assessment Program (MAP), is student achievement greater for male students using the “I CAN Learn” computer system than for male students receiving traditional instruction in eighth grade math?
3. As determined by the Missouri Assessment Program (MAP), is student achievement greater for female students using the “I CAN Learn” computer system than for female students receiving traditional instruction in eighth grade math?
4. As determined by the Missouri Assessment Program (MAP), is student achievement greater for students with special needs who received math instruction using the “I CAN Learn” computer system than for students with special needs who received traditional instruction in eighth grade math?
5. As determined by the Missouri Assessment Program (MAP), is student achievement greater for students on free and reduced lunch program who used the “I CAN Learn” computer system than for students on free and reduced lunch program who attended traditional instruction classes in eighth grade math?

Delimitations

This study is delimited by the age and grade level of students. The study is also delimited to data collection during two school years, 2006-2007 and 2007-2008. Hickman Mills School District has two middle schools, and the study is delimited by using data from the two middle schools in the Hickman Mills School District. As a result of the delimitations, the results from this study potentially may not be generalizable to other grade levels and populations.

Assumptions

Certain assumptions were made for this study:

- It is assumed teacher experience in both instructional models was similar and, therefore, had no bearing on the outcome of the study.
- It is assumed that all teachers using the "I CAN Learn" computer system in their classrooms received the same training by JRL Enterprises, Inc.
- It is assumed that the "I CAN Learn" computer system is used and implemented as proposed by JRL Enterprises, Inc.
- It is assumed, in this study, that school principals and school leaders followed directives from the district office concerning random student placement in eighth grade math classes.

Definition of Terms

Adequate Yearly Progress: The NCLB Act of 2001 requires School Districts to show students are making Adequate Yearly Progress (AYP) based on proficiency, attendance/graduation rate, and participation rates. The State of Missouri's AYP targets were established by the Missouri Department of Elementary and Secondary Education based on a formula from the NCLB Act and an analysis of Missouri Assessment Program (MAP) data, attendance rate data, and graduation rate data from prior years (MODESE, 2010b).

CTB/McGraw-Hill: A leading publisher of educational assessment solutions for the early learner, K-12, and adult basic education (CTB/McGraw-Hil, 2007).

Missouri Assessment Program: A Missouri state-standardized test (MAP) designed to see if students in Missouri are meeting the state standards for communication arts, mathematics and science at grades 3-8. The test is made up of multiple-choice, mechanically-scored items, and constructed-response items. The test is also designed to compare Missouri student achievement to groups of students who take the same test in other states (MODESE, 2010c).

Missouri Department of Elementary and Secondary Education: MODESE, also referred to as Department of Elementary and Secondary Education (DESE). The department's goals are implemented statewide to: (a) prepare all Missouri students to graduate from college, (b) ensure all Missouri children will attend kindergarten, (c) support all effective educators, and (d) improve departmental efficiency and operational effectiveness (www.dese.mo.gov).

National Council of Teachers of Mathematics: (NCTM) founded in 1920, currently with approximately 100,000 members internationally. The function of the NCTM is to ensure all students have access to high quality mathematics teaching and learning. The organization's priorities are to provide guidance for developing curriculum, instruction, and assessment (National Council of Teachers of Mathematics, 2009).

No Child Left Behind Act of 2001: The most recent reauthorization of the Elementary and Secondary Education Act. The purpose and mission of the NCLB is to close and eliminate the achievement gap that exists between groups of students within American schools. The NCLB Act is research based on best practice to address accountability, parental choices, flexibility, and finding what works based on research (MODESE, 2005).

Section 8: Housing subsidies for very low income families and the elderly through the U.S. Department of Housing and Urban Development (HUD). The Federal legislation governing HUD was expanded in the 1970's and 1980's to cause local governments to disperse Section 8-eligible housing from the core of a city to areas throughout the municipality (http://portal.hud.gov/portal/page/portal/HUD).

Students with Special Needs: Students who are handicapped or gifted, and students whose mental ability, physical functioning, and emotional functioning, require special teaching approaches, equipment, or care within or outside a regular classroom. The term is also refers to students with "Individual Educational Plans" (IEP) (NICHCY, 2010).

Overview of Methodology

This quantitative study was designed to investigate and examine the effect the "I CAN Learn" computer program has on student achievement in eighth grade. Data obtained from the Missouri Department of Elementary and Secondary Education (DESE) was provided by the Hickman Mills School District Department of Curriculum and Instruction. The obtained student data was divided into two groups, one group of 589 students who used the "I CAN Learn" computer system, and the other group of 363 students who did not use the "I CAN Learn" computer program.

State assessment (MAP) scores for the 2006-2007 and 2007-2008 school years were used to measure student achievement. A statistical analysis (*t*-test for independent samples) was performed to compare the means of the two groups of students and four subgroups (male, female, special education needs, and low SES) on a given variable to determine the difference in student achievement. The instructional method served as the independent variable for this study while student MAP scores were the dependent variable.

Summary

Chapter one introduced the background of the study, the purpose of the study, the problem statement of the study, the significance of the study, overview of the methodology of the study, delimitations of the study, research questions of the study, assumptions of the study, and the definitions of key terms of the study. Chapter two explores a review of pertinent literature. Methodology is discussed in detail in Chapter three. Chapter four is organized to describe the results and findings of the study. Chapter five summarizes the research, all findings, conclusions, implications and recommendations for future research.

Chapter Two

Review of the Literature

This chapter presents a review of literature associated with developments in teaching and learning related to the use of technology in the classroom. This literature review includes the theoretical foundations for computer use in teaching and learning, the history and development of the use of technology in classrooms, selected strategies to improve student achievement, achievement in mathematics as an international issue, United States government's role in student achievement in math, examples of computer-aided instruction programs, and research regarding "I CAN Learn" computer system.

Theoretical Foundations for Computer Use in Education

All the attention to computer-aided instruction by the U.S. government pointed to the need for clear research based on a sound, documented theoretical foundation. Of the five strands of theories of education identified by Elliott Eisner and E. Vallance (1974), one stands out in its greatest support for instructional programs that involve computers. As Eisner and Vallance termed them, "Technologists" are guided by measurable learning goals and view the student in an input-output manner. The two writers further describe common vocabulary such as task analysis, management by objectives, and computer assisted learning. The five groups of educational theories described by Eisner and Vallance are noted in Appendices J. Major contributors to this strand include notable theorists such as Skinner, Thorndike, Pavlov, Hunter, Popham, and others. Costa and Garmston (2002) adopted and extended the Eisner and Vallance characterization of major educational theories in a program they termed Cognitive Coaching. Costa and Garmston wrote five statements (Appendix K), each one descriptive of one of the Eisner and

Vallance major theory categories. When a reader selects one of the five statements, the selected statement reveals the purpose of education held by that reader. In so doing, the particular belief and its underpinnings would become increasingly clear.

To explain some of these theorists' views, consider that as early as 1954, B. F. Skinner developed a teaching machine to reinforce learner behavior as a replacement for punishment. Skinner spoke only about the strengthening of responses, not the strengthening of habits. Skinner's principle could be observed when a response was followed by reinforcement. When a response was incorrect, the reinforcement provided was weaker or not provided at all (Skinner, 1960). Computer-aided instruction strategies build on Skinner's principle by providing immediate positive reinforcement to strengthen student performance.

Skinner's teaching machine extended those of Pavlov, an earlier theorist. Pavlov developed a classical conditioning theory in which a stimulus would lead to a specific response (Ormrod, 1999). Building on the work of Pavlov and Skinner, Thorndike introduced connectionism theory. This theory explains how experiences play a role in the strengthening and weakening of response connections. Thorndike's theory explains how learning is the result of associations between stimuli and responses. Such associations become strengthened or weakened by the nature and frequency of the stimuli. Thorndike theorized that responses to a situation followed by satisfaction are strengthened. Responses followed by discomfort are weakened (as cited in Ormrod, 1999). This response stimulation, when positive, reinforces learning. Computer- aided instruction programs such as the "I CAN Learn" computer system are designed to provide students with positive reinforcement and measurable goals that come from this stimulus-response relationship.

The concept of scaffolding in education is based on the social development theory of Vygotsky (as cited in Chang, Chen and Sung, 2002). To perform a new skill, teachers provide guidance and assistance to the learner during the learning process. Based on scaffolding, the "I CAN Learn" computer system provides a lesson delivery method that includes skills mastery by dividing lessons into small benchmarks. The teacher in the "I CAN Learn" computer system environment provides assistance as a facilitator to meet students' individual needs. Students who use the "I CAN Learn" computer system are required to achieve a predetermined mastery level and are able to seek the teacher's intervention when needed. ICL is an example of a scaffolded system. The learning process built into the computer program provides the student with immediate positive reinforcement once tasks are mastered. Historically, the development and implementation of computer-assisted learning programs rest squarely on these foundational theories (I CAN Learn, 2010a).

While theories contained in the "Technologist" strand shown in Appendix J may explain purported effectiveness of computer-aided instruction, a second strand, "Self Actualizers," can explain individualized instruction in learning situations. In this strand, students are guided toward self-evaluation and may demonstrate an increased sense of autonomy. Hinton (1978) noted that "individualized instruction systems work as well or better than traditional, conventional instruction.

The "Self Actualizer" strand also tends toward what has been popularized as active engagement or active participation. Students appear to be more actively engaged when computer-aided instruction is implemented. Increases in active engagement and, most likely, increased learning can be directly associated with a student's sense of commitment and belongingness (Christenson, Sinclair, Lahr, and Godber, 2001). Commitment brought about or increased through active engagement and autonomy should result in higher levels of learning.

The "Self Actualizer" strand also yields information about another theoretical construct commonly referred to as constructivist or constructivism. The work of Piaget, Dewey, and Vygotsky are often cited as those who originated the constructivist theory (Hein, 1991). As the name suggests, the learner constructs meaning through experience. When considering constructivism in relation to computer-aided instruction, an argument can be made that the learner interacts with problems, scenarios, puzzles, and other situations and, therefore, constructs knowledge through this interaction.

History of Technology in Education

As early as the 1700s, the only teaching model expected and practiced in the United States was that of teachers performing as managers in classrooms. Both the United States and the entire world have gone through many changes since then, but education still follows early teaching models, such as the "chalk and talk" teaching method (The 1900s: Education, 2001). In the early 1900s, immigrants changed the structure of American society. Americans left farming for business opportunities in the city, which, in return, impacted the national economic structure. The economy transformed from an agrarian to an industrial society. This transformation created greater ethnic and socioeconomic diversity in schools and school culture as those who populated cities mixed with those who came from rural areas (The 1900s: Education, 2001).

In addition to the socioeconomic changes in the population, invention of technology began as early as the late 1940s and 1950s when vacuum-tube-based computers were invented. Computers were introduced in vocational education; but traditional schools still used the single-classroom-teacher/manager model. Education in the United States was still not ready to change classroom structure and use new teaching methods with technology (Murdock, 2007).

Technology development increased in the 1960s. Computer languages were created that allowed computer programmers to write the codes that operated computer processes. Perhaps, the initial language was Common Business Oriented Language (COBOL) (Techopedia, 2011). In 1965, when most computer uses in schools were limited to administration, the Elementary and Secondary Education Act was passed, increasing funding support for the use of technology in schools (Murdock, 2007). In the late 1960s, the National Science Foundation (NSF) supported the development of national computing networks. By the end of 1974, the national computer networks allowed more than 2,000,000 students to use computers (Molnar, 1997).

A historical time was when Neil Armstrong landed on the moon in1969. Such a landmark in time opened the door for technological innovation and creativity. In the 1970s, mainframe computers and minicomputers were introduced and began spreading in some schools with limited use in instruction. Personal computers (PCs) were developed and introduced to the market with little involvement in education (Murdock, 2007).

The challenge facing educators was and remains how to prepare children for an unknown future, “Preparing children for the world in which they will live is becoming more difficult than ever. In retrospect, there has been a confluence of changes that have significantly impacted the direction of modern education" (Molnar, 1997, para 2). The mindset shifted within the educational system when teaching all children rather than most became the norm. Adding to the challenge is to not know what the future requires from the new generation (Molnar, 1997). The challenges presented by teaching all students calls for finding a wider variety of instructional strategies to match the diversity of learning needs. The role of computers in meeting those needs is just now beginning to be realized.

Although the use of computers in education was not accepted until the early 1980s, IBM, a mainframe company, developed the Personal Computer (PC). Computer-aided instruction began to gain acceptance in 1981 (Murdock, 2007). The increased use of technology in business, the continuous development of hardware and software, and research on the use of computers in education began the technological transformation in education. In the mid-1980s, educators began to recognize the benefit of using computers to support the single-classroom-teacher/manager model in schools (Murdock, 2007).

Technology development and uses within the society increased rapidly in the 1990s. Computer-aided instruction programs began to include CD-ROM disks for classroom instruction. Schools began providing students online information. In the mid-1990s, digital videos, virtual reality and 3-D systems ushered in a new era. Even though not all teachers had access to computers for instructional purposes, most classrooms had at least one PC available for instructional delivery (Murdock, 2007). While technology was being developed and growing, educators were still not ready for the change. As students changed their habits in terms of technology use, educators began to realize the need for newer teaching models by incorporating technology into the classroom. The creation of search engines, personal computers, and laptops forced the industry to grow faster than ever imagined. The growth met demands being made by professionals in the workplace, needs in the household, and children's dependence on technology in their daily activities (Murdock, 2007).

As America moved into the 21st Century, technology integration accelerated to improve student achievement. Children's exposure to technology led educators to become more determined to use technology in teaching and learning. The use of computers in the classroom for instructional purposes took on different names, such as Computer-Managed Instruction, Computer-Aided Instruction, and Computer-Based Instruction (Murdock, 2007).

Research exploring the effect of technology on student achievement began as early as the 1960s (Murdock, 2007). While computers were being developed and the technology was in a state of evolution, researchers were working to find the benefits produced by using computers in the classroom. Later, Kulik, Bangert, and Williams (1983) conducted a meta-analysis of 51 Computer-Based Instruction (CBI) studies with different types of computer applications. The study provided another example of the effect of technology on education and reported that half the studies examined indicated more than 90 percent of the students experienced significant increases in scores in a variety of subjects, including mathematics. Test scores raised .32 standard deviations in 48 of the 51 studies. Researchers purposefully sought advantages for using any kind of technology in education and instructional delivery methods (Murdock, 2007). Just as those who began this research focus, future researchers will continue to examine possible connections between technology and student achievement.

Strategies to Improve Student Achievement

As uses of computers continued to advance, research on strategies to increase student achievement in math became a focal point. Extensive research in learning strategies increased in the last decade of the 20th Century. In 1993, the United States Department of Education funded a study by Means, Blando, Olson, Middleton, Morocco, Remz, and Zorfass. The study, "Using Technology to Support Education Reform," examined ways the educational system can utilize technology to enhance student achievement, especially with disadvantaged students. Means et al. (1993) discovered that teachers, until the early 1990s, did not change their teaching methods and continued teaching without utilizing new technologies in lesson plans and teaching strategies. Since the early 1990s, technology in teaching and learning development has brought about educational reform through the increased use of teaching models.

Incorporating technology in teaching and learning requires financial funding. Even though legislators at all levels of government show support for educational technology by pouring billions of dollars into providing technology access in classrooms, questions are still not answered (Education Week, 2011). To continue funding, government officials must rely on research findings and gain concrete evidence that technology in education improves student achievement. One such study, funded by the Department of Education and conducted by Mathematica Policy Research, had two questions to answer; (1) Is educational technology use effective in improving student achievement? and (2) Which conditions and practices are related to the effects on student achievement? (Mathematica Policy Research, 2009). Examining the effect technology has on student achievement in mathematics, the Mathematica study was conducted for the 2004-2005 school year. The study included 132 schools in 36 districts in urban, rural, and low socioeconomic areas, and excluded schools that already used technology in teaching. Data were collected based on teacher surveys, classroom and lesson delivery observations, teacher interviews, school records, and test scores. The findings revealed confusion in the on-going debate about educational technology's effect on student achievement in mathematics when only one of the 10 products reviewed had statistically significant positive effects. To prevent bias, the products were not revealed; however, the results indicated that the positive outcome of the one product moved student achievement from the 50^{th} to the 54^{th} percentile. Overall, the examined programs did not increase nor decrease test scores by amounts that were statistically significant. The effects of math products were not affected by classroom and school characteristics (Mathematica Policy Research, 2009).

Another study, conducted in Pennsylvania, involved two groups of middle-school students (Soeder, 2001). This study examined the effect of computer-aided instruction on student achievement. The use of the computer system for the study began in fifth grade and continued through eighth grade. One group received instruction with the use of technology for the three years of the study, and the other group was taught traditionally, without the use of computers. The study showed no measurable increase in math scores by students who received instruction using technology. Independent studies found that using technology in the classroom had little or no positive effect on student achievement. The conflicting research findings created the need for the U. S. Department of Education to conduct and fund their own research. Findings from studies such as Mathematica Policy Research (2009) and Soeder (2001) show no significant increase in student achievement for students who used technology or for students who did not use computers in the classrooms. Both the Mathematica Policy Research and the Soeder findings contradict other research studies such as Kulik (1994), Kirby (2004a), and Kirby (2004b) which create the need for more research.

Contradictory findings among studies about technology's effect on student achievement brought more confusion about the subject. The findings from Kulik (1994), showed that "drill and practice" software, tutorials, and Integrated Learning Systems increase student achievement by 14 percent. The study also showed that students learn more in less time, while developing a positive attitude about their subject area. However, the use of computers did not result in an increase in achievement in all the areas in which they were used. The findings support the use of technology in education, especially in mathematics (Kulik, 1994). The success of any program, including those that are technology-oriented, depends highly on the amount of effort dedicated to the implementation stage. Effective implementation of a program was addressed by Reichstetter, et.al (2002):

> Certain design elements were observed to be crucial regarding the impact on achievement, self-concept and attitudes, and learning environment interactions for all students. These design elements include 1) offering students some control, 2) programs with feedback, 3) embedded cognitive strategies (e.g. paraphrasing, repetition of content, cognitive mapping), 4) embedded conceptual change strategies (e.g. sequences of instruction for increased understanding and

> knowledge), 5) animation and video, 6) content-related graphics, and others. Educational technology has positive effects on student achievement, attitudes and motivation toward learning, and self-concept. Introducing technology wisely into the learning environment makes learning more student-centered, encourages cooperative learning, and stimulates increased teacher-student interaction as academic achievement is addressed and impacted. (p. 5).

The discipline of mathematics benefited from studies that examined the use of technology in all subjects. A meta-analysis by Sivin-kachala's findings (1998) consisted of a review of 219 studies which were conducted as early as 1990 to determine the effect technology has on student achievement. The meta-analysis examined all ages, all subject areas, and all types of technology incorporated in education. Research results indicated that the inclusion of technology in teaching strategies and lesson delivery has positive effects on student achievement in all areas used. These findings contradict those of Kulick as cited earlier. The increase in achievement was significant for students from pre-school to high school, including special education students. Students showed positive attitudes toward their own learning. Technology use has a positive effect on student achievement, and student achievement increased the more students were exposed to the technology. Student achievement was influenced by diverse demographic student population, educator's role, the type of software being used, and the amount of time students have access to the technology (Sivin-Kachala, 1998). Similar to Sivin-Kachala's findings (1998) another study by Mann, Shakeshaft, Becker, and Kottkamp (1999) examined the effect on student achievement of West Virginia's Integrated Learning System technology, Basic Skills/Computer Education (BS/CE). The results revealed positive effects and showed that student achievement increased based on the amount of time spent participating in the program. In addition, the study of BS/CE revealed students also developed positive attitudes about learning, and teachers became more enthusiastic about technology in teaching and learning (Mann et al., 1999).

Achievement in Mathematics: An International Issue

Unlike other disciplines, mathematics and science offer opportunities for comparing American education and student achievement to other countries. The United States participates in the international comparison of student achievement, even though such comparisons are made inequitably when glaring differences exist among students in terms of instruction, testing, and many other factors. A 1995 report, "Trends in International Mathematics and Science Study" (TIMSS), showed that U.S. mathematics scores continued to lag behind other participating countries. Special attention was given to the TIMSS study in that it included 38 participating countries and focused on math and science test scores for eighth grade students. TIMSS results were reported in an article, "National Center for Education Statistics" (NCES), noting that Asian countries scored highest in math. Singapore, the Republic of Korea, and Japan had the highest averages in eighth grade mathematics (NCES, 2009). United States educators have been working diligently for years to improve student achievement in mathematics to overcome falling behind even further (NCTM, 2009). In a similar study conducted in 1999 by TIMSS, United States eighth grade students did not score any differently from the 1995 study, and American eighth grade students ranked 19th in mathematics achievement (NCES, 2009). In addition to the TIMSS reports in 1995 and 1999, another study "International Comparison of Math Skills Among 15-year Olds," revealed that the United States ranked between 25th and 28th in a study performed on 250,000 15-year-old students from 41 countries (International Comparison of Math, 2007). United States' scores continue to reflect underperformance in mathematics, especially past the fourth grade as compared to other countries (NCES, 2009). Note must be made that the goal of the U.S. is to educate all students, a goal not shared by all countries. Some positive results were noted in the 2007 TIMSS report, showing U.S. results in mathematics were better than before (NCES, 2009). U.S. eighth graders exceeded the international average in mathematics achievement. Their sixth place ranking was still below all Asian countries. Again, the TIMSS report did not consider differences in teaching strategies or any other factors that might contribute to learning, including computers and technology. Educators continue to search for knowledge about what works in the classroom (NCES, 2009).

Delaney and Smith (2000) reported on the TIMSS ranking of international student scores and international comparison of student achievement, revealing additional findings. They noted that, overall, students who scored higher in mathematics had a more positive attitude toward the subject. This particular finding encouraged researchers to conclude that positive self-confidence in being able to learn and perform mathematics is associated with higher achievement. One might also be able to conclude that American students should perform better in mathematics as a result of teacher qualifications. Delaney and Smith (2000) found that 87% of United States students were taught by teachers reported as "highly qualified" as determined by NCLB standards. Of importance, though, is that the setting of standards for "highly qualified" have been delegated as a responsibility of each state. Japanese students, on the other hand, scored higher than American students while only 18% of their students had the advantage of instruction from a teacher classified in such a way. A difference in teacher qualification exists among American school districts based on poverty rates. Teachers are more likely to be placed "out-of-field" in districts serving higher numbers of children in poverty and, therefore, less likely to be as capable of delivering instruction at its highest levels. In high poverty and high minority schools, four of ten teachers may not be certified to teach the subject (EdTrust, 2010).

United States continues to produce some of the highest level technology and software in the world. In 2004, the "Program for International Student Assessment" (PISA) reported that U. S. students ranked 24th out of the 29 countries included in the study. The study also reported that American students are lagging behind their Asian and European counterparts and the gap appears to be widening when differences in testing populations are not considered. The study revealed that, in the three years after the 2001 study, American student scores fell behind those of Poland, Hungary, and Spain (Dobbs, 2004). The international ranking of student achievement in mathematics likely gained the attention of U. S. government officials.

United States Government Role in Student Achievement in Math

United States has diligently examined problems in mathematics. Government officials depend on research and findings to decide what programs to fund. Reports from the TIMSS and PISA gained government officials' attention to seek and fund programs to improve student achievement in mathematics. The U.S. government became involved in searching for solutions for the ongoing mathematics achievement problem. Political initiatives took place aimed at improving student achievement in mathematics and science as expressed in Governors Award ESRI (2009) report. United States senators and governors took the podium supporting new technology programs. One example was Washington State Governor Gregoire's nomination of Microsoft, recognizing that company's effort to form partnerships between the state and school districts to integrate technology into public schools. Microsoft's efforts included both incorporating technology in public schools while also providing technical training to the workforce (Governors Award ESRI, 2009).

The government continued its commitment to finding solutions to the math problem with E-Rate legislation, an initiative that provides up to $2.5 billion annually to connect schools and libraries to the Internet (E-Rate, 2011). The major idea of E-Rate legislation was to use the power of technology in teaching and learning by video-streaming lessons and instructional strategies to reach learners. An independent study by Boster, Meyer, Roberto, and Inge (2002) showed an increase in student achievement in math when digital video clips were used as supplemental instruction in the classroom. The Boster et al. (2002) results were supported by Kerrey and Isakson (2003) study, which found that students who received instruction with the computer technology "Unitedstreaming" videos showed a significant increase in student achievement, including mathematics.

Funding technology does not stop at computer hardware and software. Senator Michael F. Bennet (Colorado) co-sponsored the Secondary School Innovation Fund Act, providing funding to implement innovative strategies including technology at the secondary school level to improve student achievement (S.968-111th Congress, 2009). According to Senator Bennet, "No Child Left Behind resulted in a race to the bottom, with states adopting low standards" (Bennet, n.d., para 12). He also shared an interesting point of view on finding solutions to an on-going problem: “We won’t fix schools by spending more money on the same inadequate programs. But we must commit to funding what works” (Bennet, n.d., para 16). One can conclude that supporting new technology in education requires funding, and that U.S. officials are recognizing the need to provide financial support for programs that work. Such recognition for increased funding is important as is the commitment that may follow.

U.S. Senators have worked together to provide funding for programs that will improve education and student achievement. On July 19, 2007 R. F. Actions reported in PR Newswire on the United States Senate vote to fund Enhancing Education Through Technology (EETT) with $272 million for the year 2007. Overall, several leaders from the technology industry expressed their appreciation to the Senate and their commitment and support of the education system (Actions, 2007). Such actions demonstrate understanding of the importance technology manufacturing companies play in the solution.

One must recognize that in a capitalistic society such as the United States, legislation is heavily influenced by lobbying efforts of businesses. When contracts and opportunities to sell products are impacted by actions of legislation, a relationship can be easier to trace. Low math performance also has gained the attention of a variety of support groups. Don Knezek, CEO of the International Society for Technology, thanked the Senate for its recognition of the connection between EETT and the nation’s technological competitiveness. Keith Krueger, CEO of the Consortium for School Networking, expressed his concern that “funding for the EETT program in FY07 represents a base hit for ed tech but not a home run.” (Actions, 2007, para 5). G. Thomas

Houlihan, executive director of the Council of Chief State School Officers, shared his pleasure in learning the Senate had made education technology a priority. Several companies and organizations shared their excitement and support of the funding decision made by the Senate, including Apple, Dell, Discovery Communications, Hewlett-Packard, Intel and Microsoft, to name a few. (Actions, 2007). So that business efforts based only on profit motives can be avoided, the continuous development of computer-aided instruction programs requires that educators and researchers examine the effect these programs have on student achievement.

Examples of Using Computers in Teaching and Learning

Based on educational theoretical foundations, an asset of computers in the classroom is that of specialized or personalized instruction (Jenkins & Keefe, 2001). Instruction is considered individualized once it addresses the individual's learning style, interests and talents. The idea of creating personalized instruction was originally based on students with special needs (Jenkins & Keefe, 2001). Langer (2001) demonstrated that, once instruction is customized to the student's needs at any ability level and personal background, learning may be improved. Computer-aided instruction provides relevance and creates direct connections between new skills and the student's background and understanding (Langer, 2001). In examining earlier studies (Mathematica Policy Research, 2009, Taepke, 2007, and Beck et al., 2009), researchers have examined the use of technology in education and their findings substantiate the positive effect the use of computers in the classrooms has on student achievement. An outcome of technology is that its use allows the teaching of all students, at all levels, and all types of different learning styles (Cohen, 1997).

Warschaur (2006) and Pytel (2007) examined student attitude toward mathematics once technology is incorporated in lesson delivery. They concluded that student enthusiasm and interest for learning when using computers supports teachers' reports that students are more attentive, interested, and alert in a technology-based lesson delivery than in traditional classroom teaching. Feedback is important to let students know their mistakes or if they are doing well. Computers in education provide faster and immediate feedback, while traditional teaching styles may require a longer time. Reinforcement learning, articulated by Hunter (1982) and building on early theories of Pavlov and Skinner, included factors of positive and negative reinforcement. Reinforcing learning by immediate feedback gives the learner self-confidence and a sense of self-worthiness (Marzano, 1998).

A meta-analysis study by Stratham and Torell (1996) examined the use of computers in teaching and learning. Their results considered 10 studies on the effectiveness of technology in education. Stratham and Torell (1996) concluded that the incorporation of technology in schools contributes to fewer discipline issues and a higher rate of attendance. The study also concluded that the use of technology and "computer-based teaching" is especially effective among populations of at-risk students. The results from the study revealed that when technology is implemented as intended, collaboration, stimulation, student inquiries, and problem solving become an expected behavior in the classroom.

Earlier research by DeVault (1981) still holds true to this day. He wrote about computer technology in this way:

> Computer technology used in mathematics education can be divided into two categories. The first of these is computer assisted instruction (CAI), which, in turn, can be divided into drill-and-practice programs, instruction in mathematical concepts, problem solving, and computer programming. The second use of computer technology is computer-managed (CMI) instruction. (p. 132)

The use of computers as a supplement to textbooks in education showed gains in student achievement in math according to Fengfeng (2008). Students developed positive attitudes toward math learning through computer math gaming. Short (2002) noted that middle school Math Explorer, a computer-aided instruction program designed to address specific Long Beach Unified School District math standards, achieved significant increases in student math scores between pre-test and post-test results. The study suggests that students showed noticeable gains with exposure to the Math Explorer computer program (Short, 2002).

In summary, it seems that technologies similar to the "I CAN Learn" computer system are designed to increase student achievement in mathematics. Student learning and student achievement are the basic objectives of successful programs used nationwide. Technology programs such as "Unitedstreaming," " iSucceed Math," and "Laptops in the Classroom," referred to by researchers as computer-aided instruction (CAI) or aided instruction (AI), are initiatives designed to maximize the benefits of using technology for individualized instruction by increasing active engagement and building on positive reinforcement. Such programs operationalize theories that support one-to-one and self-paced learning strategies. Such programs support theories espoused by the Self-Actualizer strand described above.

As noted earlier, educators must be aware of companies that develop educational computer programs and market products to school districts with low SES motivated by profit. As early as 1986, Wilson and Welsh (1986) warned of companies creating computer-aided instruction programs for their own business and market gains. They discussed how some companies investing in AI want to create commercial products to sell. More often, companies want to use AI to improve their own productivity and profits. Wilson and Welsh noted that AI provides potential for companies to capture market advantage within the industry. Companies developing and promoting computer programs only for their own corporate gains must be avoided. The main concern remains with companies searching for their own financial gains in developing, producing, and marketing programs simply for financial purposes, while the focus and the goal should be student achievement.

Research continues to study the effect of computer-aided instruction programs on student achievement in mathematics. Findings from research on the use of three computer programs similar to the “I CAN Learn” computer system follow. “Unitedstreaming” is a video-on-demand technology designed to improve lesson plans by incorporating technology in lesson delivery methods for grades K-12. “Unitedstreaming” is produced by Discovery Education, a division of Discovery Communications Inc. Discovery Education is a leading global, real-world and knowledge-based media company. The developers of the program are committed to create standards-based digital resources for learning with the focus on improving student achievement (Henry, 2007). Data from Boster, Meyer, Roberto, Lindsey, Smith, Strom, and Inge (2004), a study conducted on the use of the “Unitedstreaming” program in math classes, indicated enhanced student performance and increased student scores in mathematics. The study was an extension of Boster et al.'s 2002 research that examined math scores for sixth and eighth grade students in four different schools with two schools of four being assigned randomly to the experimental condition. The control group received instruction in a traditional setting and the experimental group received instruction using "Unitedstreaming" computer program. The study found the group of sixth grade and eighth grade students who received instruction using the computer program achieved higher average score than the group who received traditional instruction (Boster et al., 2004).

Another example of incorporating technology in teaching mathematics is the "iSucceed Math" program, a data-driven solution for students who have not mastered basic fundamentals of math at earlier grade levels. This program specializes in providing individualized instruction to address conceptual learning in mathematics. The program's curriculum is aligned with both the National Council of Teachers of Mathematics (NCTM) standards and each individual state's standards (Blumenfeld, 2009).

The "iSucceed Math" computer program was designed with a focus on Response to Intervention methodology (RtI). RtI is a multi-system of support recently applied in schools to address educational needs of students by providing individualized instruction, problem solving skills, and step-by-step guided practice. The program also addresses tutoring, group instruction, collaboration, and assessing student mastery levels. The RtI model is closely aligned with the "iSucceed Math" model which has a five-step teaching cycle, and includes diagnostics of individual needs, appropriate lesson allocation, direct practice, recapitulation opportunities, and assessing student mastery level (Beck, Conner, Cruse & Fernandez, 2009).

Beck, Conner, Cruse, and Fernandez (2009) examined the effect "iSucceed Math" computer program on student achievement. The study focused on grades five through eight. Students who scored too low on a pre-test were placed in an "iSucceed Math" class, and students who received higher scores were placed in a traditional classroom without technology. Students who passed were not included in the study. Students who received instruction using "iSucceed Math" computer program showed a significant increase in math scores on a post-test, surpassing their counterparts who had received higher scores on the initial screening test.

Another initiative that includes the use of computers in teaching and learning, "Laptops in the Classroom," was recognized and supported by the Department of Education. An article, "Research Finds Laptop Learning Yields Better Students and Better Teachers Through Anytime, Anywhere Access" (2000), revealed that students seemed to perform better in writing, were more involved in class work, and worked more collaboratively. Teachers also showed positive attitudes toward using technology in teaching (Research Finds Laptop Learning, 2000). The computer program and the technological initiative showed positive gains in student achievement in math. The "Laptops in the Classroom" program provided hope for new programs to meet and exceed expectations of success. Similar to "Laptops in the Classroom" program, JRL Enterprises, Inc. promise that the "I CAN Learn" computer system delivers similar success.

The use of technology in the classroom positively influences the way students feel about their subject and learning in general (Pytel, 2007). Pytel's findings concluded that students had a high level of enthusiasm for learning and showed an increased level of self-confidence in classrooms in which computers are being used. Such findings support a major emphasis of the JRL Enterprises Inc. program. Also, Warschaur (2006) found similar results when studying a group of students who used laptops in their daily learning process. At the same time, he found students who use laptops daily have higher test scores. Middleton and Murray (1999) showed a direct correlation between student achievement and the amount of time spent using computers for class work and learning. The study on the Laptops program showed students who spent more time with laptops scored significantly higher than students with no laptops or limited time with the technology (Lowther, Ross, Morrison, 2003).

A study conducted by Ash (2005) found significant increases in student test scores in middle school math when computers were used as teaching tools for one hour a week. JRL Enterprises, Inc. designed its program to be used throughout the entire class period. JRL Enterprises, Inc. marketed the "I CAN Learn" computer system with promises to increase student achievement in math supported by the research findings of Kirby (2004), Barrow, Markman, and Rouse (2007), and WWC (2007). The "I CAN Learn" computer program gives students control and autonomy over lessons and tests. Student engagement with computer-based instruction using the "I CAN Learn" computer system appears to be similar to that found in the Laptops in the Classroom program, which provided self-paced, one-on-one, and higher mastery level in learning.

Research Regarding the "I CAN Learn" Computer System

Similar to computer-aided instruction programs explored earlier, the "I CAN Learn" computer system is marketed as a tool to increase student achievement in math. As stated earlier, the program name, "I CAN Learn," is an acronym for "Interactive Computer Aided Natural Learning" and is also referred to as "ICL." The system is a pre-algebra and algebra computerized curricula designed to improve problem-solving skills with students in grades six through twelve (I CAN Learn, 2010a).

JRL Enterprises, Inc. promotes their "I CAN Learn" computer system as a problem solver that improves student achievement in pre-algebra and algebra classes. A 30-student single classroom setting with the "I CAN Learn" computer program costs between $100,000 and $300,000, depending on whether tables, wiring, and computer hardware are purchased. JRL Enterprises, Inc. markets their product to inner city school districts as the need to raise student achievement levels is generally perceived to be greater (I CAN Learn, 2010a).

The "I CAN Learn" computer system is designed to pre-test students individually. Based on pre-test results, students are allowed to move to the next lesson. They also may choose to review previous lessons to reinforce understanding before moving on. "I CAN Learn" appears to follow what Bloom (1971) advocated, that mastery learning techniques help reduce the amount of time spent achieving mastery on a particular skill. Bloom also claimed that mastery learning increases positive attitude and the interest of students (Bloom, 1971). Based on Bloom's mastery learning, the "I CAN Learn" computer system provides students who need to learn a lesson with a warm-up session, a lesson presentation including several videos with step-by-step problem solving, individualized instruction, guided practice, and finally a quiz. When a student's score falls below the threshold level of 70%, the student may ask for teacher's assistance. Students have the freedom to maneuver around within each lesson, using the computer software as needed to find examples of problems that aid the student's understanding (I CAN Learn, 2010a).

The "I CAN Learn" computer-aided instruction program allows each student to interact with each lesson through stages. The first stage is a pre-test to examine each student's mastery level before taking the lesson. The pre-test stage helps students who pass to move to the next lesson and eliminate boredom. The program allows each student to learn and move at his/her own pace. A student has the choice of taking the lesson or moving on once they pass the pre-test. Each lesson is divided into segments: warm-up, lecture, note taking, independent practice and step-by-step examples. Students maintain autonomy in that they may retake a test. This assists in the growth of self-confidence and development of one's ownership of the learning process (I CAN Learn, 2007).

The demonstration that all learners can benefit from the use of computers has been noted (Middleton and Murray, 1999; Beck et al., 2009; and Boster et al., 2004). In 1981, DeVault discussed the importance of Computer-Aided Instruction (CAI) in teaching and learning:

> Mathematics learning by disadvantaged youth can be improved by certain computer applications of CAI. Studies that investigated the impact of CAI on Native Americans, the deaf, inner city African-Americans, and bilingual Hispanic-American youth have shown that mathematics achievement can substantially exceed expectations based on previous experience. (p.143)

If DeVault is correct that CAI can increase student achievement among disadvantaged

youth, other factors may be present. These may include a culture of low expectations of educators,
parents, and even students themselves. In such an environment, little exists to motivate a student to complete lessons and, therefore, to achieve mastery. DeVault and others may well recognize that CAI can instill intrinsic motivation within the learner that can overcome other factors. Since the ICL program allows that student to move at his or her own pace and positive reinforcement adds to the motivation to move forward, boredom can be reduced.

Several research studies were conducted on the “I CAN Learn” computer system. Some studies reviewed in this chapter either created confusion or created additional questions about the reliability of the data and the findings. Barrow, Markman, and Rouse (2007), for example, examined the “I CAN Learn” computer program. Their findings showed that the use of the computer-based program had a positive effect on student math scores and increased student achievement in the examined districts. The study considered three school districts and used a pre-test and post-test to measure student achievement. Data used by Barrow, et. al raised confusion concerning the reliability of the data because the pre-tests were specifically created for the study and the post-test was re-created to match a post-test already in place at one of the other districts.

Kirby (2004b) conducted a similar study in 2003-2004 on the “I CAN Learn” computer system. Her research showed significant improvement in student achievement in math as it was measured by the Georgia Criterion-Referenced Competency Tests (CRCT). The students were randomly placed in “I CAN Learn” classes for the Kirby study; however, it was revealed that teachers had divided students into three groups based on their performance in seventh grade math – low, average, and high – before placing them in eighth grade math classes. This grouping may cause results to be questioned until the composition of ICL classes can be determined. In addition to sub-grouping students before placing them in eighth grade math classes, special education students and all high achievers were excluded from the study.

What Works Clearinghouse was established by the U.S. Department of Education's Institute of Education Science to provide the public, educators, policy makers, and researchers with valid information on what works in teaching and learning based on research. WWC examines the validity of research and excludes studies that do not meet validity standards set by the organization (Schoenfeld, 2006). The following studies and reports on the "I CAN Learn" computer system create the need for more research on the program. For example, Kerstyn's (2001) quasi-experimental design met WWC standards "with reservations." The study used state standardized testing as a means to measure student achievement. The WWC report agreed with Kerstyn's findings that students who received "I CAN Learn" classroom instruction did not score significantly higher than their counterparts in traditional math classrooms (WWC, 2004). Later, WWC (2007) published a report confirming the "I CAN Learn" computer program was found to have positive effects on student math achievement. This report was published after WWC claimed to have updated their evidence standards and adjusted their methodological process (Schoenfeld, 2006). Out of twelve studies, the following studies were the ones considered for the WWC report: Kerstyn, 2001; Kerstyn, 2002; Kirby, 2004a; Kirby, 2004b; Kirby, 2005; and Kirby, 2006 (WWC, 2007). Confusing reports by the WWC caused questioning of the new positive findings after the latest adjustments WWC altered in its methodology.

Schoenfeld (2006), senior content advisor at WWC, explained in his report in the Educational Researcher about the WWC (2004) report,

> The Institute of Education Sciences (IES), which funds WWC, instructed WWC not to publish it. An expanded version, written at WWC's invitation for a special issue of an independent electronic journal and a book to be published by WWC, argued that methodological problems rendered some WWC mathematics reports potentially misleading and/or uninterpretable. IES instructed WWC staff not to publish their chapters—thus canceling the publication of the special issue and the book. Those actions, chronicled here, raise important issues concerning the role of federal agencies and their contracting organizations in suppressing scientific research that casts doubt on current or intended federal policy (p. 13).

If research is to be neutral and free from political, social, or philosophical bias, it is essential that results be published without regard to any constraints. Government officials, in general, and educators, in particular, rely on government funded agencies to provide data driven information to assist in making educated decisions on programs that work in schools. Because WWC is controlled directly or indirectly by a political process that often changes with succeeding presidential administrations, research results may become tainted.

In 2009, What Works Clearinghouse reported that the "I CAN Learn" system had a positive effect on student math scores and achievement. WWC initially reviewed 27 studies for the report and accepted only five of the studies, concluding that there was evidence that the “I CAN Learn” computer-aided instruction system demonstrates a medium to large increase in student achievement (WWC, 2009). WWC eliminated 22 studies for not meeting the WWC standards, and the following studies were considered for the WWC (2009) report: Kerstyn, 2001; Kerstyn, 2002; Kirby, 2004a; Kirby, 2004b; and Kirby, 2006 (WWC, 2009).

JRL Enterprises, Inc., developer and marketer of the “I CAN Learn” Education Systems, shared its own on-going improvements and continuous success in their own newsletter: “What Works Clearinghouse has just awarded its highest rating to the ‘I CAN Learn’ Algebra and Pre-Algebra programs for their ‘positive effects’ in raising student test scores on NCLB-required high-stakes testing” (I CAN Learn, 2007). On May 4, 2009, Sandy Garrett, state superintendent of public instruction for the State of Oklahoma, issued a letter sharing the success in student achievement resulting from the use of the “I CAN Learn” computer system statewide. Garrett’s letter is part of the “I CAN Learn” newsletter and can be accessed from their website (I CAN Learn, 2010a) and included in Appendix D in this study. Garrett explained that Oklahoma public schools received a three year commitment for professional development and technical support in addition to the hardware and software of the system to ensure the program’s success. The information provided in Garrett’s letter displays an average increase of 20% in the median number of students scoring proficient or higher on the Oklahoma Core Curriculum Test (OCCT) for the years 2006, 2007, and 2009.

JRL Enterprises, Inc. assessed student achievement in Oklahoma in mathematics on the Oklahoma Core Curriculum Test (OCCT) before and after implementing the “I CAN Learn” computer system in the public schools. The information shared by JRL

Enterprises Inc. included a chart of student scores on the OCCT from 2005 to 2008 and can be viewed in Appendix E. The information from the chart reveals the average growth in student achievement to be "from 46.4% in 2006 to 74% in 2008 in 10 schools." The information included the use of the program in 50 public schools; however, the chart shared by JRL Enterprises, Inc. displays only 36 of the 50 schools (Oklahoma Schools See, 2009).

JRL Enterprises Inc. reported the following information in their July, 2010 newsletter celebrating their success, recognition and accomplishments. The newsletter stated, "In boosting student performance, the program makes all teachers 'highly effective teachers,' especially those in the lowest-achieving school, a hallmark priority of the federal government" (I CAN Learn, 2010d, para 8). In the January, 2010 newsletter, JRL stated, "School officials are turning to the I CAN Learn Instructional Improvement System as a key component in their plans to compete for $4.35 billion in federal Race to the Top grants" (I CAN Learn, 2010b, para 1). Noting the self-reporting nature of the information, JRL Enterprises, Inc. reported in April, 2010 newsletter "U.S. Department of Education to award Tennessee and Delaware Race to the Top grants further affirms a national commitment to data tracking systems like the one included in the I CAN Learn Instructional Improvement System" (I CAN Learn, 2010c, para 3). In the July, 2010 newsletter, JRL Enterprises, Inc. shared the following:

> School CIO Strategies for K-12 Technology Leaders featured the I CAN Learn Instructional Improvement System (IIS) on its front page, highlighting its status as the only middle school math program to earn the U.S. Department of Education's What Works Clearinghouse's highest rating of "Positive Effects." Ratings for

other math intervention programs range from no effects to potentially positive effects (I Can Learn, 2010d, para 1).

Summary

Chapter two provided a review of the literature on the use of computers in teaching and learning. This chapter demonstrates the need to recognize that technology development, growth, and social dependency extend to schools and education. The literature also demonstrates the need for educators to stay abreast of research concerning the use of technology. The rapid increase continues in dependence on technology in the education system for teaching strategies, lesson delivery methods, and student achievement. Raising student achievement in mathematics is not a new challenge. The reviewed literature demonstrates the continuous struggle to compete internationally in mathematics and the need for improvements in student achievement.

Searching for new ways to improve student achievement in mathematics was never confined to schools. Government officials share in trying to figure out what works best for our children, and depend on reliable research to determine what helps our education system.

This chapter reviewed computer-aided instruction programs and the literature related to the topic. The programs were: “Unitedstreaming,” a video-on-demand technology, “iSucceed Math” program, a data driven program, and Laptops in the classroom, a “one-on-one” and self-paced initiative to help improve student achievement in math.

In Chapter three, research methodology will be explained. The chapter will address the research design, the population and sample, the instrumentation, validity, data collection procedure, data analysis, and limitations.

Chapter Three

Research Methodology

The purpose of the study was to determine if the “I CAN Learn” computer system implemented by Hickman Mills School District in eighth grade had an effect on student achievement and math scores. The study compared average Missouri Assessment Program (MAP) math scores to determine if eighth grade student scores were greater for those who received instruction using the “I CAN Learn” computer system than for those who received traditional instruction. Students were divided into male, female, special education, and low SES subgroups. This chapter describes the methodology used to conduct the study including the research design, population and sample, instrumentation, validity, data collection, data analysis, and limitations.

Research Design

This quasi-experimental study used MAP achievement scores from eighth grade students in the Hickman Mills School District. The independent variable was the instructional method used in the classroom for the 2006-2007 and 2007-2008 school years. Students who received instruction using the “I CAN Learn” computer system were the treatment group. Students in the control group received “Chalk and Talk” math instruction. Data obtained were used to determine if student achievement was greater for students in eighth grade math classes who received instruction using the “I CAN Learn” computer system instruction than for those students who received traditional math instruction.

Population and Sample

The population for this study included eighth grade students attending Smith-Hale and Ervin middle schools at Hickman Mills School District in 2006-2007 and 2007-2008 school years. The participants for this study were students identified to receive instruction using the "I CAN Learn" computer program in the eighth grade and students who received traditional math instruction. A random selection process was used to place students in all math classes, including the "I CAN Learn" computer classrooms. School administrators divided students by marking student rosters, following a random procedure without regard to any characterizing factor. "We use a highlighter and randomly mark student names to be placed in all math classes" (J. Davis, personal communication, September 20, 2009).

Students who did not attend seventh grade in the district, students who attended the Management school, students who were homebound, and students with invalid MAP scores were excluded from this study to reduce the possibility that differences in instruction and other such factors would affect results. The sample for this study included a total of 589 students who received mathematics instruction using the "I CAN Learn" computer system and 363 eighth grade students who received traditional mathematics instruction for the 2006-2007 and 2007-2008 school years.

Instrumentation

Hickman Mills School District uses the Missouri Assessment Program (MAP) to measure student achievement. MAP testing is required and administered every year to all students in the eighth grade in Missouri. MAP tests are aligned with the Missouri math standards and require approximately three hours for completing all sessions in the mathematics portion of the test (Missouri Department of Elementary and Secondary Education, 2010e).

The MAP testing for eighth grade includes Communication Arts, Mathematics, and Science. These assessments are designed to determine if students are meeting grade level standards (Missouri Department of Elementary and Secondary Education, 2010e). The Mathematics score portion from the MAP test data was used for this study. The MAP tests assess mathematics during three sessions. MAP mathematics tests for eighth grade are constructed to assess:

- Number and Operations
- Algebraic Relationships
- Geometric and Spatial Relationships
- Measurement
- Data and Probability

The MAP test is divided into three sessions, two that are untimed and one that is strictly timed. All three sessions contain multiple choice and constructed response questions. In all, the eighth grade MAP test is comprised of 64 questions and problems. Students are allowed to use calculators in the untimed sessions.

The MAP test is a high stakes, secured state testing program that includes Communication Arts, Mathematics, and Science in grades 3-11. To provide examples of MAP questions for this study, only released items from the MAP test are available to the public. Currently, questions from session one are released. Examples of test items may be found in Appendix H.

Validity

Construct validity of the MAP test is established by demonstrating the test's ability to measure the constructs the test claims to measure. A CTB/McGraw-Hill report (2007) provides evidence of validity by the minimization of construct irrelevant variance, by focusing the questions on the skill being tested, and under representation, by probing questions targeting the tested skill in the development process of the MAP test. Continuous review of the items representing that content are first steps in minimizing construct irrelevant variance. CTB shares the steps taken to minimize construct irrelevant variance and construct under representation, including: specification, item writing, review, field testing, and test construction (CTB/McGraw-Hill, 2007).

Schools in Missouri experienced an evolution of testing that began with the passing of legislation in 1984 intended to focus on the improvement of student achievement. Prior to the 1984 legislations, Missouri students in eighth grade completed the BEST Test as well as other standardized achievement tests selected individually by each district (K. Whited, personal communication, 2011). Once the 1984 legislation was in place, the state department developed the Missouri Mastery Achievement Test (MMAT) which was later replaced by the Missouri Assessment Program (MAP). This set of tests was developed by CTB/McGraw-Hill. Districts were given the option of using the MAP test or developing their own as long as the test met certain criteria. Given that many Missouri school districts lack the staff resources necessary to develop their own tests, all districts adopted the MAP and since 1999, have continued to refine processes with the intent of improving the overall process (Missouri Department of Elementary and Secondary Education, 2007).

In 1999, validity of the MAP study was evaluated by the Department of Education and Counseling Psychology College of Education, University of Missouri-Columbia. The study, designed to examine the meaningfulness of the MAP test results, focused specifically on changes in instructional practices in mathematics. The research also reported that teachers were becoming more adaptive and data-driven based on MAP test results. Educators began revising grading practices as a result of the MAP. Increased uses of performance event testing methods have been noted (Short et al., 1999).

DESE developed the MAP assessments using rigorous test development procedures. The tests were developed and aligned to specific Missouri State standards being measured at a specific grade level. Missouri teachers took part in writing constructed response questions and performance events that matched the measured standards. Each question was reviewed by a group of educators to ensure the alignment of each item to the specific standard. The alignment of questions produced by the reviewers was used to provide evidence for the meaningfulness of the MAP scores (MODESE, 2010c).

Data Collection Procedure

Hickman Mills School District required a copy of the researcher's Institutional Review Board (IRB) request, in which the researcher provided detailed information about the study, its purpose, subjects to be included, and steps taken to ensure data confidentiality. The IRB also required details of any observations, questionnaires, and any conditions or manipulation that are part of the study. The researcher's IRB is attached as Appendix F.

Hickman Mills School District required submission of a letter from Baker University indicating that this study was approved. This letter is attached as Appendix G. A letter of approval for data release from the director of curriculum and instruction at Hickman Mills School District was also obtained and attached as Appendix C. Hickman Mills School District required that student identities were confidential and not revealed in this study. Student names and identification numbers for the school years 2005-2006 and 2006-2007 for seventh grade student rosters were provided by the District to allow the researcher to determine and exclude transferred students into the eighth grade from the study. A list of all students who attended eighth grade during the school years 2006-2007 and 2007-2008 was provided. Prior to any uses of data, student information that identified individuals was deleted to eliminate questions of bias based on familiarity by the researcher. Data provided to the researcher for this study included all student information essential to the study, such as gender, MAP score, Special Education with an Individual Education Plan (IEP), and if a student received free or reduced lunches, and if the student attended the "I CAN Learn" computer system classroom or traditional classroom.

Data Analysis

Independent samples *t*-tests were performed to determine the significant difference in student achievement between the two means of (MAP) scores of students who used the "I CAN Learn" computer system and students who did not use the "I CAN Learn" computer program for the 2006-2007 and 2007-2008 school years. The following research questions and corresponding null hypotheses (H_0) were the focus of this study.

SPSS computer software was used to perform the statistical analysis needed for this study.

Data analysis was performed to address the following research questions and the corresponding null hypothesis:

1. As determined by the Missouri Assessment Program (MAP) is student achievement greater for students who used the "I CAN Learn" computer system than for students who received traditional instruction in eighth grade math? The following null hypothesis, "The mean of MAP scores for students who received math instruction using the 'I CAN Learn' computer program is no different from the mean of MAP scores for students who received traditional math instruction at the 0.05 level of significance" (H_0: μ group1 = μ group2), was examined using SPSS computer software.
2. As determined by the Missouri Assessment Program (MAP), is student achievement greater for male students who used the "I CAN Learn" computer system than for male students who received traditional instruction in eighth grade math? The following null hypothesis, "The mean of MAP scores for male students who received math instruction using the 'I CAN Learn' computer program is no different from the mean of MAP scores for male students who received traditional math instruction at the 0.05 level of significance" (H_0: μ male (group1) = μ male (group2)), was examined using SPSS computer software.

3. As determined by the Missouri Assessment Program (MAP), is student achievement greater for female students who used the "I CAN Learn" computer system than for female students who received traditional instruction in eighth grade math? The following null hypothesis, "The mean of MAP scores for female students who received math instruction using the 'I CAN Learn' computer program is no different from the mean of MAP scores for female students who received traditional math instruction at the 0.05 level of significance" (H_0: μ female (group1) = μ female (group2)), was examined using SPSS computer software.
4. As determined by the Missouri Assessment Program (MAP), is student achievement greater for students with special needs who received math instruction using the "I CAN Learn" computer system than for students with special needs who received traditional instruction in eighth math? The following null hypothesis, "The mean of MAP scores for students with special education needs who received math instruction using the 'I CAN Learn' computer program is no different from the mean of MAP scores for students with special education needs who received traditional math instruction at the 0.05 level of significance" (H_0: μ SpEd (group1) = μ SpEd (group2)), was examined using SPSS computer software.
5. As determined by the Missouri Assessment Program (MAP), is student achievement greater for students receiving free/reduced lunch who used the "I CAN Learn" computer system than for students receiving free/reduced lunch who attended traditional instruction classes in eighth

grade math? The following null hypothesis, "The mean of MAP scores for students on free and reduced lunch program who received math instruction using the 'I CAN Learn' computer program is no different from the mean of MAP scores for students on free and reduced lunch program who received traditional math instruction at the 0.05 level of significance" (H_0: μ Free &Reduced lunch (group1) = μ Free &Reduced lunch (group2)), was examined using SPSS.

Limitations

This study was limited by factors such as students attitudes toward computers and student pre-knowledge of computer usage. The study was also limited by teachers' educational level in mathematics and teachers' level of confidence in using computers. The MAP test scores were the only standardized test results available from Hickman Mills School District for 2006-2007 and 2007-2008 school years. The research was limited by the accuracy, dependability, and reliability of the MAP test.

The study was also limited by the impact teachers have on students during instruction in terms of effective modeling. The limitations in this study included student absenteeism and the natural effect computers have on students.

Summary

The purpose of the study was to determine if the pre-algebra and algebra "I CAN Learn" computer program implemented by Hickman Mills School District had an effect on student achievement in eighth grade math classes. This study examined student math scores from the MAP test for 2006-2007 and 2007-2008 school years. Students who were transferred into the district for the examined school years were excluded from the study. Student data used for this study were divided into two groups. The experimental group was comprised of students who used the "I CAN Learn" and the controlled group was comprised of students who did not use the computer program. SPSS computer software was used in this study to perform all the statistical analysis needed for the study. Independent samples *t*-tests were conducted to determine the effect "I CAN Learn" computer system on student achievement. Chapter four describes the results of the statistical analyses of the data.

Chapter Four

Results

The purpose of the study was to determine if student achievement, measured by the Missouri Assessment Program (MAP), was greater in eighth grade mathematics classes for students who received instruction using the "I CAN Learn" computer system than for students who received traditional "Chalk-and-Talk" instruction. The study focused on Hickman Mills School District. A total of 589 students who received instruction using the "I CAN Learn" computer system and 363 students who received traditional instructions from all eighth grade students at Hickman Mills School District for 2006-2007 and 2007-2008 school years were part of this study.

A statistical computer software (SPSS) was used for the analysis portion of the research. A *t*-test for independent samples was conducted to determine if student achievement is greater for students who received math instruction using the "I CAN Learn" computer system than student achievement for students who received math instruction in a traditional class setting in eighth grade math. The obtained *t* value was compared to the critical value to determine if there was a significant difference in student achievement between both groups of students. The null hypothesis (H_0) will be rejected once the *t* value is greater than the critical value. In case the *t* value was less than or equal to the critical value, then the null hypothesis will be accepted. In this study, the critical value was 1.96 (infinity) due to the large sample size for each group tested (Salkind, 2004). The critical value was determined by finding the degrees of freedom for each group and subgroup tested. The null hypotheses were tested as two-tailed, non-directional at the 0.05 Level of significance (Salkind, 2004).

Hypothesis Testing Results

The first research question was addressed by using an independent samples *t* test for the following null hypothesis: The mean MAP score for students who received math instruction using the “I CAN Learn” computer program is no different than the mean MAP score for students who received traditional math instruction at the 0.05 level of significance (H_0: μ group1 = μ group2). A *t*-test for independent samples was used to compare MAP scores of students who received instruction using the “I CAN Learn” computer system (experimental group) with the MAP scores of students who did not receive instruction using the computer program (control group). The mean MAP score for the experimental group was compared to the mean MAP score for the control group. Table 4 shows the results of the statistical test.

Table 4

“I CAN Learn” and Traditional Groups

	N	Mean score	St. Deviation	*t*-value	*df*	Cr. value
“ICL”	589	678.3243	37.78945	4.955	950	1.96
Traditional	363	665.2865	41.97165			

The mean was (M = 678.3243) for students who received instruction using the “I CAN Learn” computer program (n = 589) with a standard deviation of (sd = 37.78945). Students who did not receive instruction using the “ I CAN Learn” computer system (n = 363) had a mean of (M = 665.2865) and a standard deviation of (sd = 41.97165). The *t*-test obtained the value (t = 4.955), the critical value was determined to be 1.96 based on a degree of freedom (*df* = 950) and a 0.05 level of significance. The obtained value (t = 4.955) was greater than the critical value of 1.96 and led to the rejection of the null hypothesis, showing there is a significant difference between the means of MAP scores of the two groups. The results show the MAP math score average for students who received math instruction using the "I CAN Learn" computer system was higher than for students who received math instruction using the "Chalk and Talk" method.

The second research question was addressed by using an independent samples *t* test for the following null hypothesis: The mean MAP score for male students who received math instruction using the "I CAN Learn" computer program is no different than the mean MAP score for male students who received traditional math instruction at the 0.05 level of significance (H_0: μ male (group1) = μ male (group2)). A *t*-test for independent samples was used to compare the MAP math scores of male students who received instruction using the "I CAN Learn" computer system with male students who did not receive instruction using the computer program. The mean MAP score for experimental group was compared to the mean MAP score for the control group. Table 5 shows the results for the statistical test.

Table 5

Male with "I CAN Learn" and Male with Traditional instruction

	N	Mean score	St. Deviation	*t*-value	*df*	Cr. value
Male "ICL"	263	674.5399	42.76071	2.234	479	1.96
Male "Trad."	218	665.7202	43.49161			

The mean was (*M* = 674.5399) for male students who received instruction using the "I CAN Learn" computer program (n = 263) with a standard deviation of (*sd* = 42.76071). Male students who did not receive instruction using the "I CAN Learn" computer system (n = 218) had a mean of (*M* = 665.7202) and a standard deviation of (*sd* = 43.49161). The *t*-test obtained value was (*t* = 2.234), the critical value was determined to be 1.96 based on a degree of freedom (*df* = 479) and a 0.05 level of significance. The obtained value (*t* = 2.234) was greater than the critical value of 1.96 and led to the rejection of the null hypothesis showing there is significant difference between the means of MAP scores of the two groups. The results show math score average for male students who received instruction using the "I CAN Learn" computer system was higher than male students who received instruction using the "Chalk and Talk" method.

The third research question was addressed by using an independent samples *t* test for the following null hypothesis: The mean MAP score for female students who received math instruction using the "I CAN Learn" computer program is no different than the mean MAP score for female students who received traditional math instruction at the 0.05 level of significance (H_0: μ female (group1) = μ female (group2)). A *t*-test for independent samples was used to compare math MAP scores of female students who received instruction using the "I CAN Learn" computer system with female students who did not receive instruction using the computer program. The mean MAP score for the experimental group was compared to the mean MAP score for the control group. Table 6 shows the results for the statistical test.

Table 6

Female with "I CAN Learn" and Female with Traditional instruction

	N	Mean score	St. Deviation	*t*-value	*df*	Cr. value
Fem. "ICL"	326	681.3773	32.99523	4.766	469	1.96
Fem. "Trad."	145	664.6345	39.71632			

The mean was (M = 681.3773) for female students who received instruction using the "I CAN Learn" computer program (n = 326) with a standard deviation of (sd = 32.99523). Female students who did not receive instruction using the "I CAN Learn" computer system (n = 145) had a mean of (M = 664.6345) and a standard deviation of (sd = 39.71632). The t-test obtained value was (t = 4.766), the critical value was determined to be 1.96 based on a degree of freedom (df = 469) and a 0.05 level of significance. The obtained value (t = 4.766) was greater than the critical value of 1.96 and led to the rejection of the null hypothesis, showing there is a significant difference between the means of MAP scores of the two groups. The results show math score average for female students who received math instruction using the "I CAN Learn" computer system was higher than female students who received math instruction using the "Chalk and Talk" method.

The fourth research question was addressed by using an independent samples t test for the following null hypothesis: The mean MAP score for students with special education needs who received math instruction using the "I CAN Learn" computer program is no different than the mean MAP score for students with special education needs who received traditional math instruction at the 0.05 level of significance (H_0: μ

SpEd (group1) = µ SpEd (group2)). A *t*-test for independent samples was used to compare MAP scores of students with special education needs who received instruction using the "I CAN Learn" computer system with students with special education needs who did not receive instruction using the computer program. The mean MAP score for the experimental group was compared to the mean MAP score for the control group. Table 7 shows the results for the statistical test.

Table 7

Special Education with "I CAN Learn" and Special Education with Traditional instruction

	N	Mean score	St. Deviation	*t*-value	*df*	Cr. value
SpEd "ICL"	34	654.4118	30.90074	2.448	115	1.96
SpEd "Trad."	83	635.1446	41.36811			

The mean was (*M* = 654.4118) for students with special education needs who received instruction using the "I CAN Learn" computer program (n = 34) with a standard deviation of (*sd* = 30.90074). Students with special education needs who did not receive instruction using the "I CAN Learn" computer system (n = 83) had a mean of (*M* = 635.1446) and a standard deviation of (sd = 41.36811). The *t*-test obtained value was (*t* = 2.448), the critical value was determined to be 1.96 based on a degree of freedom (*df* = 115) and a 0.05 level of significance. The obtained value (*t* = 2.448) was greater than the critical value of 1.96 and led to the rejection of the null hypothesis, showing there is significant difference between the means of MAP scores of the two groups. The results show math score average for students with special educational needs who received math instruction using the "I CAN Learn" computer system was higher than students with special educational needs who received math instruction using the "Chalk and Talk" method.

The fifth research question was addressed by using an independent samples *t* test for the following null hypothesis: The mean MAP score for students on the free & reduced lunch program who received math instruction using the "I CAN Learn" computer program is no different than the mean MAP score for students on the free & reduced lunch program who received traditional math instruction at the 0.05 level of significance (H_0: µ Free & Reduced lunch (group1) = µ Free & Reduced lunch (group2)). A *t*-test for independent samples was used to compare the MAP math scores of students on the free and reduced lunch program who received instruction using the "I CAN Learn" computer system with students on the free and reduced lunch program who did not receive instruction using the computer program. The mean MAP score for the experimental group was compared to the mean MAP score for the control group. Table 8 shows the results for the statistical test.

Table 8

Free and Reduced Lunch with "I CAN Learn" and Free & Reduced Lunch with Traditional Instruction

	N	Mean score	St. Deviation	*t*-value	*df*	Cr. value
Low SES "ICL"	429	674.4149	34.37208	4.235	688	1.96
Low SES "Trad."	261	661.9847	41.88675			

The mean was (*M* = 674.4149) for students on the free or reduced lunch program who received instruction using the "I CAN Learn" computer program (n = 429) with a standard deviation of (*sd* = 34.37208). Students on the free or reduced lunch program who did not receive instruction using the "I CAN Learn" computer system (n = 261) had a mean of (*M* = 661.9847) and a standard deviation of (*sd* = 41.88675). The *t*-test obtained value was (*t* = 4.235), the critical value was determined to be 1.96 based on a degree of freedom (*df* = 688) and a 0.05 level of significance. The obtained value (*t* = 4.235) was greater than the critical value of 1.96 and led to the rejection of the null hypothesis, showing there is significant difference between the means of MAP scores of the two groups. The results show math score average for students on the free & reduced lunch program who received math instruction using the "I CAN Learn" computer system was higher than students on the free or reduced lunch program who received math instruction using the "Chalk and Talk" method.

Summary

This study utilized an SPSS computer program to conduct independent samples *t*-tests to compare scores of students who used " I CAN Learn" computer system using the entire sample, males only, females only, students with special education needs only, and students who were on the free and reduced lunch program only. The experimental group was students who received math instruction using the "I CAN Learn" computer system and the control group was students who received traditional math instruction method. The comparison performed examined five research questions and five corresponding null hypotheses. The results of the comparison rejected each null hypothesis and showed students who used "I CAN Learn" computer system had higher average score on the

MAP test than students who received traditional math instruction. The results in chapter four show math average score for male students, female students, students with special educational needs and students on free or reduced lunch program who received math instruction using the "I CAN Learn" computer program was higher than similar student subgroups who received math instruction using the traditional "Chalk and Talk" method. Chapter five presents an overview of the research problem, purpose of the research, review of the methodology, findings related to the literature, implications for action, and recommendations for future research.

Chapter Five

Interpretation and Recommendations

Hickman Mills School District adopted the “I CAN Learn” computer program in 2003 to help students with math skills. The goal was to increase student achievement in math and increase student scores on the Missouri Assessment Program (MAP). The “I CAN Learn” computer system, created by JRL Enterprises, Inc., was designed to help students learn algebra, pre-algebra concepts, and basic math skills (JRL Enterprises Inc., 2010). This study examined the effect “I CAN Learn” computer system had on student achievement in eighth grade math by comparing average MAP scores between students who used the “I CAN Learn” computer program and students who did not use the computer system in eighth grade. Average MAP scores of subgroups of the population were also analyzed to explore trends with respect to gender, special education students and students on free and reduced lunch program. This chapter presents an overview of the problem, purpose of the research, review of the methodology, findings related to the literature, and findings. This chapter also includes implications for action, and recommendations for future research.

Summary of Findings

In this section, the overview of the problem is reviewed as well as the purpose of the study and the methodology used.

Overview of the Problem.

Missouri Department of Elementary and Secondary Education is holding school districts accountable for their performance. The No Child Left Behind 2001 Act held schools accountable to increase student achievement in reading, science, and mathematics. Student subgroups including low SES, and students with special educational needs are expected to perform at or above grade level by the year 2014. Facing the challenge, school districts are searching for instructional methods that will improve student achievement including technology in the classrooms. JRL Enterprises, Inc. developed and marketed the “I CAN Learn” computer program. The company purports the program increases student achievement in middle and high school pre-algebra and algebra in districts with large concentrations of ethnically diverse, inner-city students as well as in districts with low socioeconomic demographics (JRL Enterprises Inc., 2010). Hickman Mills secured funding and purchased the computer program in 2003 to increase student achievement on the MAP test.

Purpose of the Study.

A lack of research exists in Missouri about the “I CAN Learn” computer program created by JRL Enterprises, Inc. The purpose of the study was to determine if the “I CAN Learn” computer program implemented by Hickman Mills School District had an effect on student achievement and math test scores in eighth grade when compared to similar students who received math instruction in a traditional classroom setting, as measured by the Missouri Assessment Program. The study included 589 students who received math instruction using the “I CAN Learn” computer system and 363 students who received math instruction using “Chalk and Talk” instructional method.

Review of Methodology.

The study compared student achievement and average math scores in terms of (MAP) test scores in mathematics to determine if student math scores are greater for male students, female students, students with special educational needs, and students with low

SES who received math instruction using the "I CAN Learn" computer system than similar subgroups of students who received math instruction in a traditional class setting in eighth grade math. The independent variable for this study was the instructional method. Students in the experimental group received math instruction using the "I CAN Learn" computer system. The control group received traditional math instruction. The Missouri state assessment MAP scores were used to compare the average scores between the two groups and served as the dependent variable. Hickman Mills School District provided seventh and eighth grade MAP math scores for 2006-2007 and 2007-2008 school years for students who attended Smith-Hale and Ervin Middle Schools. All information regarding individual students was initially available to the researcher; however, this information was deleted prior to any analysis. Data included the type of math class the student attended as well as student gender, if the student had special educational needs, and if the student was enrolled in the free and reduced lunch program. The Missouri Assessment Program is aligned with the Missouri State Mathematics Standards. JRL Enterprises, Inc. claim the curriculum software meets the National Council of Teachers of Mathematics (NCTM) standards and can be configured to meet state and local grade-level expectations.

Findings

Five different *t*-tests for independent samples were conducted to determine if student achievement was greater for students who received math instruction using the "I CAN Learn" computer system than for students who received math instruction in a traditional classroom setting in eighth grade. In this study, the obtained *t* value was greater than the critical value of 1.96 for all the of the research questions set by the researcher. The five null hypotheses were rejected based on the sample evidence. Results revealed higher math achievement for students who received instruction using the "I CAN Learn" computer system than students who received traditional math instruction, referred in this study as "Chalk and Talk." Results were disaggregated for gender, special needs, and SES status.

The mean was higher for the group of students who received instruction using the "I CAN Learn" computer program than the group of students who received traditional math instruction. The obtained value was greater than the critical value, once compared, which led to the rejection of the null hypothesis. The results show a statistically significant increase in math scores in students who received instruction using the "I CAN Learn" computer program from their counterparts who received math instruction in a traditional class setting.

A statistically significant difference was also found in male students who received instruction using the "I CAN Learn" computer program than the subgroup of male students who received traditional math instruction. The obtained value was also greater than the critical value, once compared, which led to the rejection of the null hypothesis.

A statistically significant difference was also found in female students who received instruction using the "I CAN Learn" computer program than the subgroup of female students who received traditional math instruction. The obtained value was greater than the critical value, once compared, which led to the rejection of the null hypothesis.

The mean was higher in math scores of students with special educational needs who received instruction using the "I CAN Learn" computer program than the subgroup of students with special educational needs who received traditional math instruction. The obtained value was greater than the critical value, once compared, which led to the rejection of the null hypothesis.

Finally, a statistically significant difference in math scores was also found for students on free and reduced lunch program who received instruction using the "I CAN Learn" computer program than the subgroup of students on free and reduced lunch program who received traditional math instruction. The obtained value was greater than the critical value, once compared, which led to the rejection of the null hypothesis.

Findings Related to the Literature

As expressed in the Stratham and Torell (1996) study in Chapter two, incorporating technology in teaching reduced discipline issues and student drop-out rates. While not all students included in this study may be categorized as "at-risk," students may gain, in terms of learning, from the benefits of having access to technology in classrooms. Student benefits include collaboration, student inquiries, and problem solving resulting in higher achievement and test scores as shown in Appendix J (Costa and Garmston, 2002).

According to Kirby's (2004b) study that was discussed in the literature review, students who used the "I CAN Learn" computer program showed significant increases in math scores when the Georgia Assessment System test scores were used to measure student achievement. What Works Clearinghouse examined several studies conducted on the "I CAN Learn" computer program including Kirby (2004b) and concluded the program has positive impact on student achievement. WWC considered different studies for their 2007 and 2009 reports and both reports agreed that students who used the "I

CAN Learn" computer system showed statistically significant increases in achievement in math. JRL Enterprises, Inc. shared "What Works Clearinghouse has just awarded its highest rating to the 'I CAN Learn' Algebra and Pre-Algebra programs for their 'positive effects' in raising student test scores on NCLB-required high-stakes testing" (I CAN Learn, 2007). In addition to WWC examining studies and providing reports to government officials and stakeholders, Sandy Garrett, state superintendent of public instruction for the State of Oklahoma, expressed her appreciation for the success of 50 public schools showed resulting from using the "I CAN Learn" computer program in her state.

Based on the researcher's direct experience with the "I CAN Learn" computer system, the theories discussed in chapter two were utilized in the design of the "I CAN Learn" program. Using the computer program provides students with individualized instruction, motivation, student engagement, self-paced learning and classroom management. The researcher also credits the success of the "I CAN Learn" computer program found in this study involving eighth grade students from Hickman Mills School District to two components. One is the nature of the program and its intervention strategies such as:

- Individualized instruction.
- Student freedom to maneuver around a given lesson.
- Student freedom over quizzes and test taking.
- Student freedom to skip a mastered skill.
- Elimination of boredom and including rigor with high achieving students.
- Minimization and/or elimination of classroom disruptions.

- Immediate response/feedback and personalized intervention.

The second factor that contributed to the success of the program are the resources JRL Enterprises, Inc. provides to school districts. JRL Enterprises, Inc. provides essential services to their customers such as:

- Hands-on teacher training.
- Continuous software maintenance and updates.
- In-school technical support on teacher demand.
- Continuous data monitoring system.

Conclusions

Uses of technology in education continue to increase as the 21st Century advances and improvements in hardware and software applications improve. What was considered futuristic only a few decades ago is often taken for granted today. Continued growth in the uses of technology may well change the shape of education even more dramatically in the next decade and beyond.

Implications for Action.

Continued monitoring and further testing of student achievement of students who receive “I CAN Learn” computer system instruction in high school and college levels may provide a long term effect of the program. Differences in student achievement between students who used “I CAN Learn” and students who did not use the computer system may provide needed evidence or answer questions about such programs.

Recommendations.

Considering the findings of this study, recommendations for further study are needed. In the State of Missouri, Kansas City Missouri School District and Grandview

School District are similar in demographics and diversity to Hickman Mills School District. Further research is needed to support such findings with additional schools and neighboring school districts to Hickman Mills C-1. Additional study is also needed to determine the effects on additional subgroups such as African-American, Hispanic, low SES, and English as second language students.

Algebra students in the Missouri are required to take an End Of Course Exam (EOC) in mathematics. In addition to MAP scores, further study is needed utilizing EOC algebra scores to examine the effect “I CAN Learn” has on student achievement. Students in middle schools in Missouri take the TerraNova test as well. Data from the TerraNova test can also be used in addition to the MAP test scores to determine the effect “I CAN Learn” computer system might have on student achievement.

Recently, JRL Enterprises, Inc. expanded their program to include high school and college levels. New services include online distance learning as well (I CAN Learn, 2010a). Further study is needed to include higher grade levels and college students to measure the effect “I CAN Learn” have on student math test scores.

Further, research is needed that tracks student success in high school and college for those who received computer-aided math instruction in earlier school years. JRL Enterprises, Inc. and participating school districts could utilize ACT test scores to measure student achievement.

Several uncontrolled variables may have contributed to the success of the “I CAN Learn” computer system in improving student achievement in mathematics. These variables deserve an in-depth investigation. Variables include teacher quality, including years of experience, advanced degrees, and degrees specifically in mathematics. The availability, delivery, and quality of professional development for teachers should also be considered. The presence of resources for both teachers and students that support the teaching and learning process are worth investigation as are student absenteeism, teacher absenteeism, and student attitudes.

Concluding Remarks

In closing, it is the belief of this researcher that student achievement is the main goal of any successful education system. School districts must adopt sound program evaluation processes prior to purchasing new programs and at intervals following implementation. Educators must realize that adopting untried and untested products can only result in wasted time and resources. Such actions can only end in ineffective learning for our children. Educators, government officials, and stakeholders need to put their differences aside, collaborate, come to consensus, and support innovations that work. Supporting expensive programs that work is nothing but an investment in our most valuable asset, our children.

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Appendix A:

Electronic communication with Kansas City Missouri School District concerning "I CAN Learn" computer system

---------- Forwarded message ----------
From: **Mary Esselman** <messelma@kcmsd.net>
Date: Mon, Feb 1, 2010 at 10:35 AM
Subject: RE: Student Data
To: mofeed aql <mofeedaql@gmail.com>

I will need a copy of your research proposal to begin the approval process. Thanks, Mary

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From: mofeed aql [mailto:mofeedaql@gmail.com]
Sent: Monday, February 01, 2010 10:31 AM
To: Mary Esselman
Subject: Re: Student Data

Hello Ms. Esselman,

You probably see several e-mails included on this one. the emails show that i am looking for the one that can hep, I hope it is you.

I understand student information and confidentiality is an important issue. I do not need students names, or any referebced numbers. I am trying to find out through my dissertation if the **"I Can Learn"** Program has a positive effect on student achievement in mathematics. I only need MAP scores from 2007 and 2008 for 8th grade only. I need to know if the student was enrolled in a traditional Math class or the **"I Can Learn"** program.

I hope you can help, or please allow me to visit with you personally to explain what I need for the study. I think my study will provide your district with valuable information as well.

Thank you

On Mon, Feb 1, 2010 at 9:58 AM, Anthony Moore <amoore1@kcmsd.net> wrote:

Mofeed Aql,

Although I am the executive director for elementary and early childhood education, I will not be able to help you with your request. I am not sure we will be able to share any student data with you, however, Dr. Mary Esselman, executive director of research, assessment and professional development, will be the person you need to speak with. I have cc her in this email for you to contact her. If you have a problem reaching her, please get back in touch with me.

Thanks,

Tony

Appendix B:

Electronic communication with Grandview School District concerning

"I CAN Learn" computer system

Gmail by Google mofeed aql <mofeedaql@gmail.com>

RE: Doctoral Thesis

2 messages

Evans, Bruce <bruce.evans@csd4.k12.mo.us> **Tue, Feb 15, 2011 at 3:32 PM**
To: Corse Ralph <ralphc@hickmanmills.org>
Cc: mofeedaql@gmail.com, "Tate, Barbara" <barbara.tate@csd4.k12.mo.us>

Hi Ralph,

I spoke with Mofeed yesterday. An issue I have is that we do not already have the information that is needed at the Central Office ready to create the reports requested. Since we do not already create reports for the schools that contain this data, there is a time factor (about a day) of searching, disaggregating and report creation associated with the request. We just don't have that kind of time to devote to this request right now, although it is an interesting endeavor and would be valuable information to have and use. Perhaps we will address this topic in the future and when we do will be willing to share our findings.

Bruce

From: Corse Ralph [mailto:ralphc@hickmanmills.org]
Sent: Tuesday, February 15, 2011 2:28 PM
To: Evans, Bruce
Cc: PiA; Aql Mofeed
Subject: Doctoral Thesis

Bruce,
Mofeed Agl is a teacher in the Hickman Mills School District. He is needing some data for his doctoral study. He has talked with Barbara Tate. Mofeed will email you and let you know what he needs. Thanks.
Ralph

Ralph W. Corse
Director of Curriculum and Instruction
10530 Greenwood
Kansas City, MO 64134
Phone (816) 316-7585
Cell (816) 935-5958

mofeed aql <mofeedaql@gmail.com> **Wed, Feb 16, 2011 at 8:23 AM**
To: "Evans, Bruce" <bruce.evans@csd4.k12.mo.us>
Cc: Corse Ralph <ralphc@hickmanmills.org>, "Tate, Barbara" <barbara.tate@csd4.k12.mo.us>

Good morning Mr. Evans,
Thank you for your immediate response.

I was hopping I can get data without taking too much of your time.

All I need is 7th and 8th Grade student's MAP scores (Student Scale Score Report) and a classroom roster from the years 2006, 2007, and 2008

Appendix C:

Hickman Mills School District approval of the study

February 24, 2011

To Whom It May Concern:

Mofeed Aql is hereby given permission to use student data from MAP scores in academic years 2006-07 and 2007-08. The scores are from 8^{th} grade mathematics and will only be released to his use with the understanding that any uses will assure anonymity of all students, teachers, or other information that would identify individuals in any way.

Sincerely,

Dr. Greg Rich, Director
Curriculum and Instruction

Appendix D:

Letter From the State of Oklahoma Superintendent of Public Instruction Appreciating the "I CAN Learn" Computer System

SANDY GARRETT
STATE SUPERINTENDENT OF PUBLIC INSTRUCTION
STATE OF OKLAHOMA

May 4, 2009

To Whom It May Concern:

Since the passage of the Achieving Classroom Excellence Act of 2005, the Oklahoma State Department of Education has awarded Middle School Mathematics Labs each school year. These I CAN Learn® Math Labs are awarded to schools that have less than 50% of their eighth graders proficient or better on the Oklahoma Core Curriculum Tests (OCCT) in Mathematics. Schools receive the hardware and software necessary to fully implement the lab as well as three years of professional development and technical assistance from I CAN Learn®. Since 2005, over fifty school sites have been awarded a Middle School Mathematics Lab. According to the data collected, the school sites implementing, with fidelity, the I CAN Learn® Mathematics Lab have seen successes in their eighth grade OCCT results.

- During the 2005-2006 school year, ten school sites received an I CAN Learn® Mathematics Lab. Before receiving the I CAN Learn®, Mathematics Lab, the median percent of eighth graders in these schools who achieved proficient or better in 2005 was 45%. After implementing the program, the median score rose 20.4% to a median of 66.75% of eighth graders scoring proficient or better on the OCCT Mathematics in 2006. The percent of eighth graders scoring proficient or better has remained fairly consistent at a median percent of 62 in both the 2007 and 2008 school years.

- During the 2006-2007 school year, an additional ten sites in Oklahoma received an I CAN Learn® Mathematics Lab. The median percent of eighth graders in these schools who achieved proficient or better prior to implementation in 2006 was 46.4%. The median score of eighth graders scoring proficient or better on the OCCT Mathematics in 2007 rose 19.1% to a median of 65.5%. The median percent of eighth graders scoring proficient or better in these ten schools rose another 8.5% to 74% in 2008.

- During the 2007-2008 school year, an additional sixteen sites in Oklahoma received an I CAN Learn® Mathematics Lab. The median percent of eighth graders in these schools who achieved proficient or better prior to implementation in 2007 was 38.5%. The median score rose 21% to a median of 59.5% of eighth graders proficient or better on the OCCT Mathematics in 2008.

Sincerely,

Sandy Garrett

Sandy Garrett
State Superintendent

SG:ns

OKLAHOMA STATE DEPARTMENT OF EDUCATION
2500 NORTH LINCOLN BOULEVARD, OKLAHOMA CITY, OK 73105-4599
(405) 521-3301, FAX: (405) 521-6205
http://sde.state.ok.us
FIRST IN THE TWENTY-FIRST

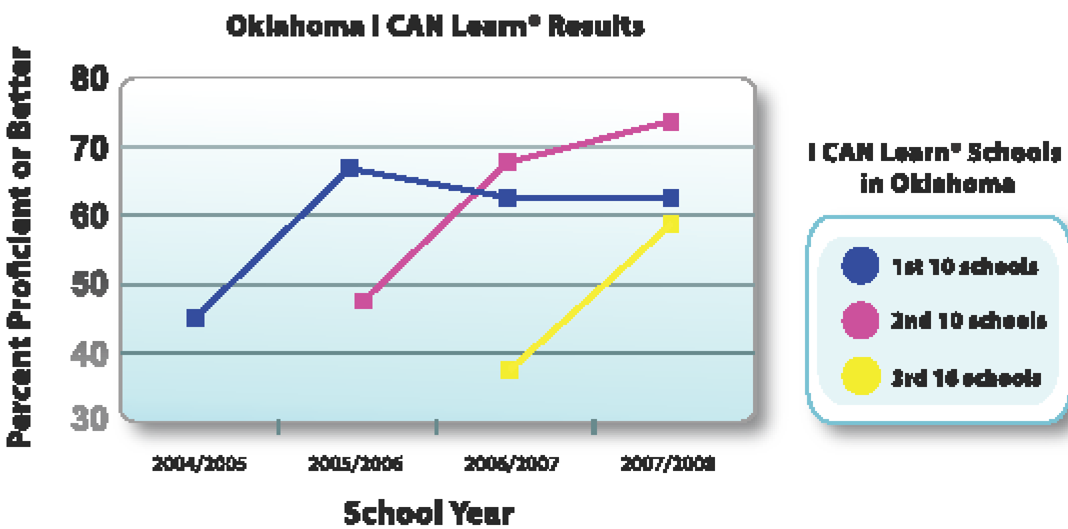
Appendix E:

JRL Enterprises, Inc. Graph of Student's Achievement of the Oklahoma Public Schools

after Incorporating the "I CAN Learn" Computer System in Their Schools

Oklahoma Schools See Big Gains on OCCT Scores using the I CAN Learn® Program

Since the 2004/2005 school year, over 50 schools statewide have put the I CAN Learn® Program to use with great success. The chart below tracks the rapid progress OK students made on OCCT scores following the implementation of this program. As you can see, students swiftly experienced real results in test gains. For example, eighth grade students scoring proficient or better on the OCCT rose from **46.4%** in **2006** to **74%** in **2008** in ten schools using this mathematics program. With results like this, it is no wonder that educators around the nation are turning to the I CAN Learn® Program to bring their students up to proficiency, fast.



JRL Enterprises, Inc.
912 Constantinople St.
New Orleans, Louisiana 70115
Toll Free: 888.263.1390
Email: info@icanlearn.com
www.icanlearn.com

I CAN Learn® EDUCATION SYSTEMS

Appendix F:

Institutional Review Board (IRB) Request

IRB Request

Date __April 26, 2011_______________

IRB Protocol Number_________________
(IRB use only)

I. Research Investigator(s) (students must list faculty sponsor first)

Department(s) ___EDUCATION____

Name Signature

1. ___Mofeed Aql______________________________ Principal Investigator

2. ___Dr. Harold Frye___________________________ __X_ Check if faculty sponsor

3. ___Peg Waterman____________________________

Principal investigator or faculty sponsor contact information:

Phone __816-853-3030___________

email mofeedaql@gmail.com______

Mailing address of Principal Investigator:

12805 Oakland Ave.
Grandview, MO. 64030

Expected Category of Review: _X_ Exempt __ Expedited __ Full __ Renewal

II: Protocol Title

THE EFFECT OF COMPUTER INTEGRATED INSTRUCTION USING "I CAN LEARN" COMPUTER SYSTEM CREATED BY JRL ENTERPRISES, INC. ON STUDENT ACHIEVEMENT IN EIGHTH-GRADE MATH

III. Summary:

The following summary must accompany the proposal. Be specific about exactly what participants will experience, and about the protections that have been included to safeguard participants from harm. Careful attention to the following may help facilitate the review process:

In a sentence or two, please describe the background and purpose of the research.

The purpose of the study is to determine if there is a difference in student achievement in 8th grade mathematics in classes receiving instruction using the "ICL" system compared to similar 8th grade students receiving traditional "Chalk-and-Talk" instruction as measured by the Missouri assessment Program (MAP).

Briefly describe each condition or manipulation to be included within the study.

No manipulation will be required as the data already exist.

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.

There will be no subject observation included in this study. There will be no questionnaire or any instruments used in this study.

Will the subjects encounter the risk of psychological, social, physical or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

There will no direct contact with subjects for this study.

Will any stress to subjects be involved? If so, please describe.

There will be no direct contact with subjects for this study.

Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

The subject's MAP test scores for the years 2007 and 2008 will be used for this study. The data will include student demographics information as well.

Will there be a request for information which subjects might consider to be personal or sensitive? If so, please include a description.

Hickman Mill school district will provide their student data based on a protocol for data sharing, collection and retrieval which will be followed in this study.

Will the subjects be presented with materials which might be considered to be offensive, threatening, or degrading? If so, please describe.

No, there will be no direct contact with subjects for this study.

Approximately how much time will be demanded of each subject?

No time will be needed for contact with subjects in this study.

Who will be the subjects in this study?

8th Grade math students for school years 2007 and 2008 will be the subjects for this study. Hickman Mills school district will participate in data collection and data sharing for this study.

How will they be solicited or contacted?

The subjects will not be contacted for this study. The subject's data will be collected from the school district included in this study following their protocol for data collection.

Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate.

There will be no volunteering on subject's part. The data that will be requested and collected from the district office will include the student name and/or reference number, if they were enrolled at the same school the previous year, if they were enrolled in a math class that is traditional or an "ICL" computer system, if they received special education assistance and if they received free or reduced lunch.

Include a copy of any written solicitation as well as an outline of any oral solicitation.
The request will be made directly to the responsible officers at Hickman Mills school district. This form will be included and part of the data collection request.
What steps will be taken to insure that each subject's participation is voluntary?
Hickman Mills school district have agreed to sharing student data as expected.
What if any inducements will be offered to the subjects for their participation?
There will be no direct contact or communication with the subjects in this study.
How will you insure that the subjects give their consent prior to participating?
Hickman Mills school district has agreed to sharing student data. Student names and reference numbers will not be used or be part of the study.
Will a written consent form be used? If so, include the form. If not, explain why not.
No, there will not be a consent form used for this study. The communication is direct with the officers at Hickman Mills school district which is involved in the study.
Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.
The study will not include student name or any student reference number.
Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher or employer? If so, explain.
No, there will be nothing included in any permanent record and, therefore, nothing that supervisors, teachers or employers will be able to access or observe about any student or teacher. The data used in the study will be shared directly by the school district and will be rendered completely anonymous of any names, student numbers, or any other references.
What steps will be taken to insure the confidentiality of the data?
As explained above, the study will not include student names or any student reference numbers. All personal information for all students, teachers, administrators and schools will be eliminated prior to any analysis of the data.
If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?
There will be no risk to subjects or districts in this study.
Will any data from files or archival data be used? If so, please describe.
Yes, Hickman Mills school district will have to provide MAP scores for the school years 2007 and 2008 including student information for the same years.

Appendix G:

Baker University Approval of the Study

School of Education – Graduate Department
8001 College Blvd., Overland Park, KS 66210
913-491-4432

January 25, 2011

Hickman Mills School District
Kansas City School District
Grandview School District

To Whom It May Concern:

This letter is written in support of Mofeed Aql, a candidate for the degree Doctor of Education in Educational Leadership. He has completed all course requirements and portfolio development and presentation and is currently completing requirements for the dissertation. His study proposal has been approved by the faculty and submitted as an "exempted" study to the Baker University Institutional Review Board. The study intends to investigate the impact of "I Can Learn" mathematics curriculum on student learning. As an "exempted" study, he will analyze MAP test scores for the 2007-08 school year. All aspects of the study will in no way identify individuals, schools, or School Districts.

In addition to serving as department chair, I serve as Mr. Aql's major advisor and am thoroughly familiar with the study and its intent. We are anxious to see the results of his research as we know that information helpful to today's educational delivery models will become clearer.

If there are questions that would need further follow-up, I would be most pleased to respond.

Sincerely,

Harold B. Frye

Harold B. Frye, Ed.D., Chair
Graduate Education Programs

BAKER
UNIVERSITY
Own Confidence

June 1, 2011

Mofeed Aql
12805 Oakland Ave
Grandview, MO 64030

Dear Mr. Aql:

The Baker University IRB has reviewed your research project application (M-0116-0426-0601-G) and approved this project under Exempt Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

The Baker University IRB requires that your consent form must include the date of approval and expiration date (one year from today). Please be aware of the following:

1. At designated intervals (usually annually) until the project is completed, a Project Status Report must be returned to the IRB.
2. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
3. Notify the OIR about any new investigators not named in original application.
4. Any injury to a subject because of the research procedure must be reported to the IRB Chair or representative immediately.
5. When signed consent documents are required, the primary investigator must retain the signed consent documents for at least three years past completion of the research activity. If you use a signed consent form, provide a copy of the consent form to subjects at the time of consent.
6. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.

Please inform Office of Institutional Research (OIR) or myself when this project is terminated. As noted above, you must also provide OIR with an annual status report and receive approval for maintaining your status. If your project receives funding which requests an annual update approval, you must request this from the IRB one month prior to the annual update. Thanks for your cooperation. If you have any questions, please contact me.

Sincerely,

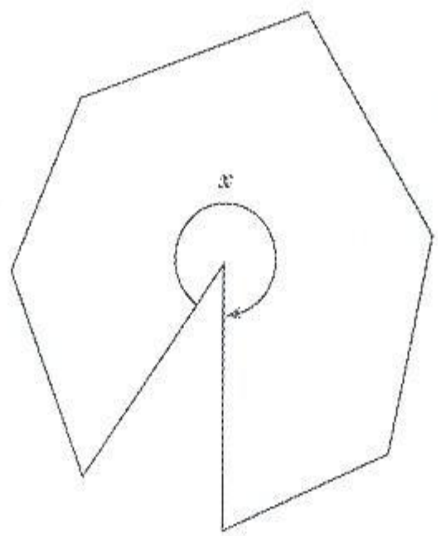
Carolyn Doolittle, EdD
Chair, Baker University IRB

Appendix H:

Examples of MAP Test Released Items

5 Use your protractor to help you solve this problem.

Look at the figure below.



What is the measure of angle *x* in the figure?

- ○ 37°
- ○ 120°
- ○ 240°
- ○ 323°

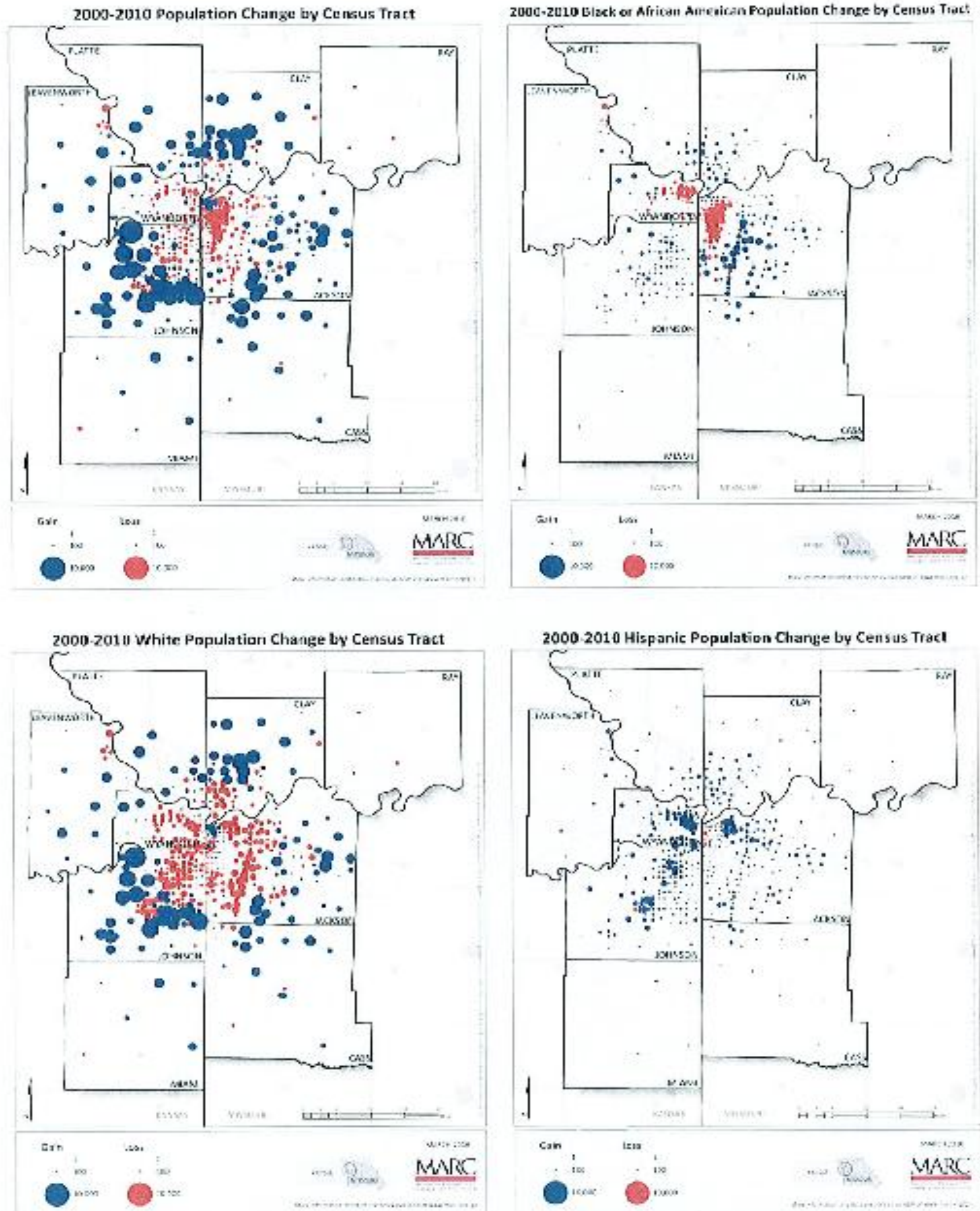
6 Melissa uses 9 cups of milk to make pancakes. How many ***quarts*** of milk will Melissa use to make the pancakes?

- ○ 1.1 quarts
- ○ 2.25 quarts
- ○ 3.0 quarts
- ○ 4.5 quarts

DO NOT WRITE HERE * DO NOT WRITE HERE * DO NOT WRITE HERE * DO NOT WRITE HERE *

Appendix I:

2000-2010 Population Change by Census Tract



Source: (Mid America Regional Council Website) http://www.marc.org/

Appendix J:

Cognitive Coaching Chart:

Theories of Education Belief System

Theories of Education
Belief Systems

Attributes	1. Cognitive Processors	2. Self Actualizers	3. Technologists	4. Academic Rationalists	5. Social Reconstructionists
Sources of Goals	Scientific method, problem solving, thinking as basic	Individual needs, interests, abilities	Measurable learning, task analysis	Truths, classics, structure of disciplines, traditional values	Problems of society now and in the future
View of the Learner	Problem solver, mind over matter, all learning in the brain	Within each individual are potentials to be nourished	Information processor, Input-Throughput-Output	Container/vessel to be filled/sponge to absorb	Social being – member of the group
Educational Psychology	Cognitive	Humanistic, Holistic, Gestalt	Stimulus/Response, Skinnerian/behavioral conditioning	Imitative	Molding
Organization of Materials	Problem focuses, data sources, discrepant events	Multiple, varied, student created, individualized	Learning activity packages, modules, systems computers	Basic tests, classical literature	Newspapers, current events, school problems
Teaching Strategies	Inquiry, critical thinking, problem solving	Self-directed learning centers, individualized	Diagnosis/prescription management systems, task analysis, 5 steps	Lecture, notetaking, memorization, drill	Simulations, role playing, values awareness
Methods of Evaluation	Observations of performance in problem situations	Self-evaluation, demonstration of increased autonomy	Entry level/mastery level, pre- post-testing, gain scores	Content master, achievement testing, summative	Social concern and cooperation, empathy
Leaders in the field	Suchman, Montessori, Piaget, Bruner, Fuerstein, Bloom, deBono, Sternberg	Maslow, Combs, Rogers, Buzan, Leonard, Simon, Edwards	Skinner, Pavlov, Hull, Thorndike, Mager, Popham, Hunter	Bestor, Adler, Hirsch, Bennett, Ravich, Finn	Ferguson, Cremin, Tofler, Hutchins, Shane, Friere, Whitehead, Houston, Illich
Vocabulary	Cognitive processes, cognition, thinking skills, intellectual development	Right brain	Task analysis, management by objectives, computer-assisted learning, teacher-proof, competences, accountability	Conceptual themes, traditional values, classics, rigor, humanities, basics, 3R's, scholarly	21st Century, student rights, consumer education, peace, environment

Costa, Arthur and Robert Garmston,Cognitive Coaching: a Foundation for Renaissance Schools. (2nd Edition). Norwood, MA: Christopher-Gordon, 2002.

Appendix K:

Cognitive Coaching:

Belief Statements

Theories of Education
Belief Systems

Cognitive Coaching (Arthur Costa and Robert Garmston)

5 Statements of Belief

1. To develop students' ability to think clearly, to use intellectual reasoning to solve problems, and to make rational decisions.
2. To nurture the individual child's unique potential to allow full development of his/her creativity and sensitivity, and to encourage personal integrity, love of learning, and self-fulfillment.
3. To diagnose the learner's needs and abilities, to design instructional strategies which develop skills and competencies, and to produce trained people who are able to function efficiently in our changing, complex, technological world.
4. To transmit to young people the basic knowledge, skills, traditions, academic concepts, and values necessary to interpret, participate in, and further the heritage and traditions of our country.
5. To create an intense awareness of the critical social and environmental issues, and develop a consciousness of responsibility and reform to ensure the survival of society.

Costa, Arthur and Robert Garmston,*Cognitive Coaching: a Foundation for Renaissance Schools*. (2nd Edition). Norwood, MA: Christopher-Gordon, 2002.