Science and Mathematics Education Centre

The Effectiveness of Technology Integration in Mathematics on the Achievement and Attitudes of Fifth and Sixth Grade Limited English Proficient Students

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This thesis is presented for the Degree of

Doctor of Philosophy

of

Curtin University of Technology

February 2009

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published by any person except where due acknowledgement has been made.

Signature: Velma P. Palmer

Date: January 13, 2009

ABSTRACT

The main purpose of the research was to evaluate the effectiveness of integrating technology in the teaching of mathematics and the effect on students' attitudes towards learning mathematics and achievement in mathematics in an elementary school. The students were engaged in activities using the computer program SuccessMaker Math Skills and Concepts for 15 minutes each day of the week over nine weeks either in the classroom or the laboratory.

Quantitative and qualitative methods were used to provide responses to the research questions. The quantitative portion part of the study involved students' achievement as well as students' attitudes towards mathematics within the classroom and laboratory. A pretest and posttest design was used with student attitudes and student achievement outcomes. The sample size was 300 students who were divided into two groups of 150. Fifty students – 25 students in each group - were interviewed for the qualitative part of the study. Data generated from the interviews were used to balance information provided by the survey.

There was range of internal consistency reliability measures for the classroom and laboratory attitude scales of attitude to mathematics and enjoyment of mathematics. After nine weeks of instruction there were attitude differences in favour of the laboratory-based students. After nine weeks of implementation of the SuccessMaker mathematics program there were statistically significant differences using paired sample t-tests between the pretest and posttest FCAT scores for both groups. However, the differences in improvement in FCAT scores for students in both instructional programs were not statistically significantly different. However, the classroom-based students outperformed the laboratory-based students on the mathematics class test.

The findings from the qualitative data from interviews with 50 students (25 from the classroom group and 25 from the laboratory group) was consistent with patterns emerging from the quantitative data which involved 300 students. Overall, the SuccessMaker Math Concept and Skills program was effective in enhancing attitudes to mathematics for both classroom and laboratory groups. However, for the students in both the classroom instruction and the laboratory instruction, there were no statistically significant correlations between Interest in Mathematics lessons and Enjoyment of Mathematics lessons and the FCAT posttest score. Neither classroom nor laboratory instruction differentially contributed towards students' FCAT scores.

The study revealed that computer assisted instruction has alleviated Limited English Proficient Students' fear in doing mathematics and that has proven beneficial to their success in mathematics in the classroom and in the laboratory. Students' interview responses revealed that they enjoyed working on the computer but that additional time should be attributed to using the technology in mathematics.

DEDICATION

I wish to thank God for His loving kindness towards me during this long research journey.

I express my sincere thanks to my mentor Professor David Treagust, who worked diligently and patiently with me throughout the entire research journey. He has guided me through the most difficult times as he encouraged me to focus on the "prize', my doctoral degree. I am very appreciative for his open door policy, his prompt response, immediate feedback and his vast knowledge in the field of teaching and learning. I have developed sincere friendships with the doctoral students that I have met during my study. I extend my sincere thanks also to Professor Barry Fraser for his support during my time as a doctoral student at Curtin University. A special thank you to Petrina Beeton at the Science and Mathematics Education Centre for answering all my questions and for the final formatting of the thesis.

This work is dedicated with love and appreciation to my husband Matthew Palmer, my three children Antoinette, Ricardo, and Allison and my five grandchildren. Without their encouragement, support, understanding, and patience, writing this thesis would not have been possible. Special gratitude to my family who supported me while extending their understanding during the many months of intense study and research.

Finally, I thank the administration and staff with whom I worked for their assistance and cooperation during the research.

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CHAPTER 1

INTRODUCTION

1.1 Overview of Chapter and Introduction to the Study

This chapter provides the background upon which the present study was developed and implemented, using six sections. The rationale for the study is presented in Section 1.2, In Section 1.3 the background of the study is described and in Section 1.4 the research questions are outlined. The instruments used in the study and the limitations of the study are described in Sections 1.5 and 1.6, respectively. The overview of the thesis is presented in Section 1.7.

Over the past 15 years, schools in the United States of America have spent billions of dollars to equip their classrooms with the most modern computers and software programs. Consequently, this study investigated the effectiveness of integrating technology using computers in the teaching of mathematics to Grade 5 Limited English Proficient (LEP) students. The study examines the SuccessMaker impact on students' attitudes to mathematics and their achievement on the state assessment test called the Florida Comprehensive Assessment Test (FCAT). This chapter provides a background to the Miami-Dade Public school system as well as the Florida Sunshine State Grade 5 curriculum, which moves beyond the traditional explain and lecture by engaging students as active participants in the mathematics learning process. Furthermore, technology is an effective tool in meeting the needs of the students with disabilities, LEP students, as well as those with a variety of learning styles. LEP students often encounter difficulties in learning mathematics that have little to do with difficulties in processing mathematical ideas.

Current reform movements in mathematics education have proposed infusing the mathematics curriculum with technology and creating technology-intensive instructional environments. The National Council of Teachers of Mathematics (NCTM) Equity Principle affirms: "Mathematics instructional programs should promote the learning of mathematics by all students" (p. 23). NCTM promotes mathematics for all, challenging the notion that some students are just not proficient in mathematics. By "all" NCTM means that mathematics programs should be promoted for students who have traditionally done well in mathematics as well as those that have not done as well or have not been given the same opportunity to learn substantial mathematical concepts. Mathematics curricular programs should promote students who are seen as low performing students as well as high performing students. Note that the use of the term "performing" denotes a dynamic view of the students as active learners and that students do not exist within a set of static descriptors. Some students have been disenfranchised by the traditional mathematics curriculum. This has happened in a variety of ways that include subtle reinforcement by educational systems or more overt displays of ability tracking, a practice in which students are sorted into different instructional sequences that often results in inequitable educational opportunities and outcomes for students (NCTM, 1998). The practice of sorting, tracking, or ability grouping is another inequitable example describing and sorting students into static categories. Furthermore, NCTM emphasizes that technology be used to promote the understanding and use of mathematical concepts. NCTM also describes the technology tools that should be included in the mathematics instructional program to be calculators, computers, micro-computer/calculator based laboratories, Internet technology, and the World Wide Web. NCTM supports the implementation of technology in mathematics instructional programs but warns against the possible reliance on technology as replacements for basic understandings.

Finally, NCTM recommends preparing students to use mathematics in an increasingly technological world. In the twenty-first century the jobs that students hold will become increasingly more infused with technology, such as sophisticated computer programs and data collection devices.

The research was conducted at an elementary school in Miami-Dade County, Florida, USA. The study investigates the effectiveness of the integration of SuccessMaker Math Concept and Skill program on Grade 5 Limited English Proficient (LEP) students' attitudes and achievement in mathematics, and its impact on their FCAT scores. Students were taught mathematics either in the classroom or in the laboratory. According to Krueger (1998) technology may be exciting when it is used skillfully and with a point, and when it provides LEP students with another vehicle to construct meaning, to exercise critical thinking skills, and to learn difficult concepts.

1.2 Rationale for the Study

Former President George Bush stated in 1990 that one of the goals in the America 2000 education strategy was that US students would be the first in the world in science and mathematics. Over the years, numerous theories have been given for the poor academic performance of ethnic minority children in the United States. Most of these explanations focus on the deficiencies of these minority children rather than on the deficiencies of the education programs provided by United States' schools system. Earlier, Gould (1981) claimed that the explanations pointed to racial causes using evidence from intelligence tests. Indeed, during the 1960s, educators discussed "cultural deprivation" of minority children and the cultural "vacuum" they came from (Wax, Wax, & Dumont, 1989 [1964]). During these discussions there was a lack of consideration by educators for the cultural background of ethnic minority children. As the controversy raged, Cummins (1989) and Spindler (1987) reported that the lack of fluency in the language of instruction and cultural differences were the major reasons why these students were experiencing the difficulties in learning.

High stakes testing has had a progressively powerful impact on Florida students and schools. Students' achievements as well as schools' success are measured with the Florida Comprehensive Assessment Test (FCAT). Consequently, this study investigated how SuccessMaker software may contribute to improving students' FCAT scores of Grade 5 LEP students in addition to their attitudes to mathematics. Florida schools evaluate students in grades three through ten by using the FCAT standardized test. Students with the lowest performance on FCAT test are retained in third grade and denied graduation from high school. It is obvious that the value placed on the FCAT scores have an effect on the students' educational opportunity for advancement. Schools yearly evaluations are originated from the students' FCAT scores. The State of Florida rewards schools with bonus and positive exposure when student scores increase on the FCAT. On the other hand, constant failure to meet minimum standards results in unfavorable school evaluations and major changes in school administration.

Under the No Child Left Behind (NCLB) Act (2001), schools must demonstrate annual yearly progress in order to receive a passing grade at the Federal Level.

Treasure Island Elementary school where the study has been conducted received an "A" grade for the past six years due to extensive mathematics tutoring and the continuous work with SuccessMaker Math Concepts and Skills program. This is a computer-based interactive program designed to help students improve mathematical skills and raise FCAT scores. In an attempt to improve the school's overall grade the school has extend day and weekend classes for the students. Families participate in classes that are geared to help them understand the test so that they can assist their children at home.

Increasing FCAT mathematics scores by means of using SuccessMaker Math Concepts and Skills program is the main objective of this elementary School's Improvement Plan (2004-2005). At the end of every school year, the appointed school committee reviews the achievements as well as failures that have been made by the students and the school. Consequently, new goals and objectives are established in the major areas and it includes essential planning, effective teaching, and learning strategies. The School Improvement Plan updates are based on the need of the students in each subject area and how it will impact their learning. Since 2006 an added criterion has been measured in the School Improvement Plan; students must make yearly progress on the FCAT even if they don't pass the test. Faculty, staff, parents, students, and business partner are part of the planning as they are considered stake holders in the process. The Department of Education (2006) reported that the mission of the FCAT assessment, research, and data analysis is to establish and implement high standards and procedures for quality assessment, data collection, and data analysis to ensure the accuracy and validity of student achievement data that drive the decision making process.

One focus of this study is to evaluate the extent to which the technology used in the classroom or in the laboratory has an effect on fifth-grade FCAT scores. Consequently, the SuccessMaker program can be used to predict FCAT improvements and gains on individual test scores. The result of this study will be used by the School Improvement Plan Committee to decide the future of the computer program in fifth grade mathematics classes. The Miami- Dade School District will also benefit from this study.

1.3 Background of the Study

For decades, research has shown that Limited English Proficient (LEP) students have experienced tremendous difficulties in learning mathematics. Educational technology programs were launched in 1985 to improve the education processes and student achievement through knowledge and understanding of technology. Presently, the Miami Dade County Public School system has provided ongoing training for the teachers so that they are able to guide students in technology education. The argument was that for this training to be effective, technology and teachers must work together to provide challenging learning opportunities. Levin and Meister (1985) stated that if our goal is really to provide students with a different kind of education structured around provision of challenging tasks that can prepare them for a technology-laden world, the most relevant uses of technology are as tools and communication channels.

Today educators see technology as a catalyst for changing schools in ways that better support the acquisition of higher order. According to Bar and Tag (1995), ”we now see our mission is not instruction but rather that of producing learning with every student by whatever means work best” (p. 13). Indeed, the ideas expressed in the teaching of the mathematics curriculum have caused a shift in paradigm within the school district. The use of technology in Miami Dade School District has had a particular significant impact on the schooling of economically disadvantage students. Trotter (1998, p. 25) stated that computers make no personal judgments of students and can help those who are afraid of making a mistake in front of their teacher or classmates. Mergendollar (2000) believed the computer has the potential to increase students’ academic achievement but that this potential depends on how it is used. In the study reported in this thesis, the technology is integrated into activities that are a core part of the classroom curriculum.

Research has shown that students were stressed with rote and drill on lower–order skills but that the use of technology in the classroom has developed their comprehension skills, and mathematical reasoning. Eggen and Kuachak (2004) stated that maximizing instruction time and engaging learners raises students' achievement; when making as much use of the allotted time as possible is when learning increases. These comprehension skills have supported students in higher education and in effective functioning in the real world. According to Lawrence (2000), technology has stimulated students' thinking by fostering number and spatial sense, preparing them to solve problems in a flexible manner and carrying out tasks encountered in daily life, and also developing positive attitudes towards mathematics because students enjoy the subject. Nevertheless, Cohen (1999) has argued that technology has been, and is likely to remain, regulated to the margin of American education. If viewed only as a mechanism for enrichment or remediation, technology will not move forward the agenda of systematic curriculum reform.

One of the purposes of teaching mathematics using computer-based technology is to encourage teachers at all levels to enhance mathematical skills by supporting effective teaching and learning. In a study by Valdez (2005) teachers were trained during professional development workshops to use the different computer stands in addressing student's individual needs in mathematics. This method has been shown to be very effective in helping students who fail to grasp specific mathematical concepts. Although mathematics and science education are vital aspects of nation's productivity, students' mathematics competencies fall below what is required for an increasingly technological world. At the same time, recent reports have indicated that changes are necessary in the way mathematics is taught (Baker & O'Niel, 1994). The National Education Association reported statistics (released by the United States Department of Education in April 2000) found that less than thirty-five percent of teachers felt that they were well prepared to use technology effectively. Although fewer schools categorized a majority (50 percent or more) of their teachers as beginners than in previous years, few schools report a majority of their teachers as being advanced or innovative technology users (*Technology Counts*, 2001).

The Educational Department responded to these findings by improving professional development for teachers in using technology as a national goal. Nevertheless, research has shown that there are also the inequalities in access to technology resulting in digital divide. According to Chubb and Loveless (2002) there are many barriers for students in mathematics especially due to poverty. Research shows that the damaging effects of poverty have prevented large number of students being successful in schools, "resulting in a disparity between the performance of low income and those from high income families” (LeTendre, Wurtzel, & Bouckris, 1999, p. 270). About sixty percent of low-income communities were connected to the internet in 2001-2002 as opposed to eighty two percent of the more affluent communities. The disadvantages of inequitable access to technology in schools and classrooms are compounded by the fact that students with limited access to technology in school are also less likely to have access to computers and the internet at home.

1.4 Research Questions

Three research questions guided this study.

1. How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students’ attitudes towards mathematics?
2. How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students’ achievement in mathematics?
3. Are there any interactions between attitudes and achievement in mathematics for students taught mathematics using technology in different ways?

1.5 Instruments Used in the Study

The initial goal of the study was to validate the use of the adapted version of the Test of Science Related Attitudes (TOSRA) to the Test of Mathematics Related Attitudes (TOMRA) attitude survey that was used in the research. The TOMRA was administered to a sample size of 300 English Language Proficient students in ten 5th Grade classes. Reliability analysis was performed for two scales with the class mean as a unit for analyses. In addition 20 questions were asked of individual students. For the achievement portion of the test a pretest and a posttest was used. The 300 students were administered the FCAT test and this was used as one measure of academic achievement.

Both quantitative portion and qualitative methods were used to generate responses to the research questions as recommended by Tobin and Fraser (1998). The use of mix-methodologies in the research and the establishment between students' attitude and achievement outcomes reflects an important aspect of understanding students’ learning. According to Erickson (1998, p. 1155), qualitative information is particularly appropriate when researchers require "detailed information about implementation ... [or] to identify and understand change over time". It was considered appropriate, therefore, to collect qualitative data using a variety of sources. It was with this in mind that data collection for the present study involved different kinds of information (as recommended by Erickson, 1998) to triangulate the data gathered.

1.6 Limitations

This study was limited to fifth-grade students at Treasure Island Elementary School because it was the only grade level that investigated SuccessMaker program and its effect on the LEP students FCAT scores.

The major issues of the mixed methodology approach in the context of this research was the lack of control of the many different variables that may affect the outcome of the variables (Anderson 1998). Also some of the teachers had limited professional development with the SuccessMaker Program and therefore they may have had limited capabilities for student support or had difficulties understanding how to generate reports and analyze data from the program. Another significant limitation was scheduling in collecting and analyzing data and interpreting the results of the study in a timely manner. Difficulties associated with reading and comprehending are common-place among LEP students. Therefore, the survey questions may have created some constraints for them. In addition, this researcher’s major concern was the high mobility rate within the school and our complex timetable scheduling. There may be constrains with the on-going testing and teachers reluctance to follow the computer schedule daily.

1.7 Research Overview

This research study was designed to review and examine and compare the effectiveness of teaching mathematics with the integration of technology in the classroom and in the laboratory on Grade 5 students’ learning in Miami-Dade County Public Schools. The SuccessMaker program was utilized by students to reinforce their mathematics skills. Students engaged in activities that gathered and analyzed data derived from mathematics computer sessions, as well as the FCAT pretests and posttests. However, the FCAT tests were not done on the computer, but were hand-written (or bubble in answers) with a pencil. All aspects of the examination were strictly monitored by the Department of Education. Instructional staff and assistants were trained as proctors to handle the FCAT examination and were bounded by law to follow all procedure verbatim.

This research described the impact of technology when integrated in the curriculum to achieve measurable objectives for LEP students who are working below grade level struggle to keep up with their peers academically. It was the expectation that SuccessMaker could help improve these students skill level and standardized scores as well as improve their attitudes towards mathematics. The sample consisted of 300 Limited Proficient English (LEP) students in 10 classes. Some classes formed a group that used computers as part of their classroom activities and a comparison group worked in the laboratory during the teaching and learning of mathematics. A measure of the effectiveness of the integration includes students' attitude towards mathematics, and students' mathematics achievement on statewide tests.

The learning goals of the SuccessMaker activity promoted the vision by the Miami-Dade County Schools System and the students National Standards in Mathematics Education. Treasure Island Elementary school makes the SuccessMaker software a priority in the laboratory and the mathematics classroom. The school's educational goals and objectives are driven by the Florida Comprehensive Test (FCAT). Hence the study examined the impact of the SuccessMaker program on the fifth-grade learners' mathematical abilities, their attitudes and the association between their attitude and achievement as measured by the FCAT.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of the Chapter

This chapter presents the literature review relevant to the study. The literature is situated in Section 2.2 and an overview of Education in the United States is provided in Section 2.3. Mathematics Education Reform in the United States and a brief review on Limited English Proficient Students are described in Sections 2.4 and 2.5, respectively. Section 2.6 focuses on Technology in Mathematics Education. The Florida Comprehensive Assessment Test and reviews on Students' Attitudes to Mathematics are discussed in Sections 2.7 and 2.8, respectively. Finally, a summary of the chapter is presented in Section 2.9.

2.2 Introduction

Computers are everywhere – in classrooms, offices, laboratories, libraries as well as homes. Even the less educated people use computers for communications, record keeping, as well as banking. In education, computers are being used progressively to facilitate students' learning at all levels. This literature review explores how the use of computer technology can improve Florida Comprehensive Assessment Test mathematics scores.

A historical evaluation of K-12 mathematics education discloses the dominance of testing and technology in the mathematics classroom. According to Lambert and Lenthall (1988), traditionally, mathematical achievement was compared to the student's computational skills and abilities to quickly calculate the correct solution speedily.

The Florida Comprehensive Assessment Test (FCAT) standardized testing dictates procedures in the mathematics classroom including the use of technology. An enormous emphasis is placed on improving standardized test scores for all students in the State of Florida and the Miami-Dade County Public

Schools (MDCPS) District. Eisenberg and Berkowitz (2000) argued that standardized assessment is used to measure students' achievements**.** Also, teachers use standardized test results constantly to make judgments about students' learning (Kallick, 1997). This aspect is extremely important because inadequate achievement in mathematics can hinder a third grade student from promoting to fourth grade and a high school student from obtaining a diploma in the state of Florida (National Center for Education Statistics, 2003).

During the past 20 years, theories, learners and learning have undergone major change. Numerous researchers have provided knowledge about the factors related to students' success in mathematics. While evidence revealed that computers can help students improve their achievement on the tests of basic skills, many researchers found that technology is most prominent when used as a device for problem solving, critical thinking, and theoretical development (Culp, Hawkins, & Honey, 1999). Researchers believed that although technology can support educational change, there will be very little impact without accompanying reform in the classroom and school district. Therefore, a significant amount of time and money is invested in technology each year in classrooms throughout the United States in hopes of improving educational achievement. New legislation such as the "No Child Left Behind (NCLB)" initiative raises the stakes as schools scramble to provide individualized education experiences designed to meet the needs of each student. The lack of basic mathematics skills exhibited by many elementary students is a problem that grows exponentially as students advance through the education system. Tyler (1999) believed that basic mathematic skills and abilities is a requirement to function in society, perform one's work and achieve one's goals.

Policymakers and the public often pose questions concerning the effectiveness and cost of technology in education, implying that technology is, in itself, an educational activity. The computer serves as a freestanding or networked workstation that provides tutoring to students and can be structured to adapt to students' responses. The growth in use of technology by schools is enormous; schools are adding equipment and developing connections to the national information infrastructure at an increasing rate. Despite this rapid growth, surveys suggest that the average school still makes limited use of computers and substantial numbers of schools have very limited access to technology of any kind. Instances of deep, school-wide use, championed by advocates of technology-supported instruction, are somewhat rare.

Moursund (1999) questioned the huge investment in technology and why it has not produced major improvements in education. Indeed, the use of educational technologies in schools has grown tremendously and has permeated all areas of our lives. Technology has been proven to accommodate different learning styles, effectively motivating students with specific learning needs. Papert (1980) mentioned that children can learn to use computers in a masterful way and learning to use computers can change the way they learn everything else. The guarantees of technology in the classroom go beyond tutorial knowledge and are described by some researchers as having perfect images for improving success in mathematics (Papert, 1980). However, barriers to educational improvements include lack of time for preparing Information and Communication Technology (ICT) resources for lessons (Preston, Cox, & Cox, 2000) as well as lack of ongoing support, fragmented knowledge, ignorance of school needs, and poor leadership knowledge and support (Hardy, 1998). Also affecting the use of technology in schools is the availability of guidance from specialist mentors and online resources (Sherry, Billig, Tavalin, & Gibson, 2000); compatibility of technology-related innovation with the school's philosophy, and finally, the changing nature of technology itself (Zhao & Frank, 2003). Therefore, changes in teaching are required when using computer programs (Meyen et al., 1993; Fuchs, 1989). The teacher's role in the equipped computer classroom can transform the teacher from lecturer and distributor of knowledge to an individualized tutor for the students (Kerr, 1991; Linn, 1992; Office of Technology Assessment, 1996; Schofield, 1995).

The Third International Mathematics and Science Study [TIMSS] (1994-95) revealed the State of Florida's low achievement results in mathematics and science and prompted action by the state legislators. Evidence from the TIMSS indicated that countless students are not adequately prepared with mathematics skills needed in this changing economic atmosphere; middle school curricula were not developmentally appropriate and students were working one year below other students of the same age in other countries (Schmidt, 1997). The report has prompted actions throughout the country. Consequently, the state of Florida in 1996 developed the Florida Comprehensive Assessment Test (FCAT), a performance-based assessment designed to measure student achievement of higher order cognitive skills contained in the Sunshine State Standards (SSS). The Florida Comprehensive Assessment Test (FCAT) is a component of Florida's effort to improve the teaching and learning of higher educational standards. In the northern spring of each year, the FCAT test in reading, mathematics, and science is administered to students in Grades 3 through 10.

According to Stage (2005) greater emphasis on high stakes testing has prompted greater scrutiny on what's being tested and how it relates to what students need to know to succeed in society. This is fueled in part by the poor performance of United States students on the international assessments. Major concerns have arise and Government leaders ranging from former Education Secretary Margaret Spellings to former Secretary of State Colin Powell have signaled that today's students are not prepared to compete internationally (Kagan and Stewart, 2004). As a result, numerous business leaders and educators have also questioned whether current assessments focus too much on measuring students' ability to recall unrelated facts that does not adequately measure students' ability to think critically and solve problems (Partnership for 21st Century Skills, 2005). Ridgeway, McCusker, and Pead, (2004) argued that some researchers assert that this form of assessment produce, at best, only illusory student gains.

2.3 Education in the United States of America

The American education system is very complex. Ninety percent of American students below the college level attend public elementary and secondary schools, which do not charge tuition but rely on local and state taxes for funding. The remaining ten percent of American students' education are funding by parents or through private funding. Elementary school traditionally includes kindergarten through the sixth grade while middle school is from grades seven through nine and high school comprises grades 9 through 12. In 1867, President Andrew

Johnson signed legislation to establish The Department of Education, which supports elementary and secondary education for all students, whose main purpose was to collect information and statistics on schools and teaching that would help the States establish effective school systems. Since that time, years of discontent with public education has resulted in national demands for school reform in successive waves. Murphy and Hallinger (1997) claimed that the restructuring of schools to meet the needs of a postindustrial society has been on federal, state, and local agendas since the Nation at Risk report in 1983. The report known as The Imperative for Educational Re-form of 1983 called for widespread, systemic reform, including stronger graduation requirements, more rigorous and measurable standards, more time in school, and significantly improved teaching.

The 1950s brought about political and social changes which resulted in extended federal funding for education. The successful launch of the Soviet Union's spaceship Sputnik in 1957 impelled nationwide concern that led to an increase in aid for science education and mathematics education programs. The 1960's and 1970's saw greater increase in federal aid to education with national efforts to help racial minorities, women, and people with disabilities, while non-English-speaking students gained equal access to education.

Millions of American students are known to have one or more physical or mental disabilities and the numbers are increasing; these individuals include one of the most disadvantaged groups in society. To address these concerns, the Rehabilitation Act of 1973 that prohibited discrimination based on race, sex, and disability was instituted to improve occupation as well ad educational accessibility. In addition, the Elementary and Secondary Education Act of 1995 launched a comprehensive set of programs, including the Title I program of Federal aid to disadvantaged children to address the problems. Glod (2008) claimed that under the law, public schools are mandated to raise the achievement of special-needs students … a broad spectrum that includes children with learning disabilities, autism, and the most severe cognitive impairments. However, after the establishment of this federal law the public school systems continue to systematically separate students with disabilities in schools and discriminating against them by placing them in separate classrooms outside of their neighborhood schools. The students with disabilities who gain equitable opportunities are the ones whose parents fight relentless for their children's legal rights. It appears almost impossible to attain what has been secure by law for these children. Some educators complained that the law is too rigid and that schools with dedicated teachers can be unfairly punished when even a handful of students with disabilities fall short on tests. Additionally, other parents worry that LEP students and children with significant disabilities are ill-served if they are pushed into grade-level classes above their comprehension.

The purpose of Title 1 is to ensure that all children have a fair, equal, and significant opportunity to obtain a quality education and reach a minimum proficiency on challenging state academic achievement standards and state academic assessments. Brown (2002) stated that Title I funds from the No Child Left Behind Act of 2001 (NCLB), provided the money for the technological advancement in schools. Schools in low income areas benefited largely through Title I federal funds because the federal government makes available significant learning opportunities for every student. To develop mathematical literacy, there is a need to examine how young children learn arithmetic and simple mathematical concepts, as well as how older children learn more rigorous mathematics (National Council of Teachers of Mathematics [NCTM], 2003). In 1980, Congress established the Department of Education as a Cabinet level agency that now administers programs and is concerned with every area or level of education. During its history the major goal of the agency was to ensure equal educational opportunity for all. The department improved the quality of education through federal support, research programs, as well as information sharing, while providing support to states and local school districts.

However, in the United States education is primarily a State and County government responsibility. States, communities, as well as public and private organizations establish schools and colleges, develop curricula, and determine requirements for enrollment and graduation. This structure of educational finance in America reflects the predominant State and local role. It is evident that there is a great disparity gap between rich and poor due to school funding. Half of the school funding comes from local taxes; hence the district in which a person resides determines the quality of public school education. According to Cortes and Miller (2000), the unequal distribution of wealth is directly related to inequality in education beginning at early education. These disparities have created a type of class system. There are high minority populations with high poverty areas and high unemployment rates. chools are unable to procure qualified teachers, provide updated materials, and consequently there are low performances on students' tests scores. According to Bennett and LeCompte (1990), education achievement is found to be associated with poverty and minority status. This also includes various other factors affecting mathematical ability, namely, mathematics anxiety, significance of learning, self-efficacy, as well as the learning environment (Berndt & Miller, 1990; Kloosterman, 1988),.

Slow learners as well as students with disabilities are often neglected, especially in poorly resourced schools, and students as well as their parents are dependent on the available resources in their school district. Kozol (1991) stated that the American public education system is one in which the amount of wealth in a school district shapes the quality of its schools. Consequently, the wealthiest districts spend as much as three times per student compare to the most economically disadvantaged districts.

For decades the debate over whether educational spending shapes achievement has persisted, mainly because of methodological and analytical limitations associated with the use of district-level data. *The Chicago Reporter* stated that there are calls for reform from districts serving the poor, blacks and Latinos as well as those serving mostly white and middle class Chicago urban districts. Variations in unique spending and achievement were analyzed within-district among 89 public elementary schools. The analyses revealed substantial disparities in spending within the district, related to local patterns of racial and class stratifications and concentration. The study showed how these locally driven inequalities and their association to specific school resources have consequences for achievement in five distinct subject areas. The researchers discussed the allegations of their findings as a way for understanding the construction of class and racial educational inequality and the recent moves toward resegregation that are apparent in most American cities. Meyers reported that Bowles and Gintis (2008) stated that the purpose of education is to preserve the existing class structure. Therefore, the amount of racial isolation has increased over the last several years, as minority students are systematically placed into lower tracks, and schools where minorities represent the majority of the student body receive less state money. This placement is generally based on a standardized test given at an early point in the student's education.

However, during the 2004-2005 school years, an estimated $909 billion was spent nationwide on education at all levels; the expenditure was intended to address some of these existing disparities as well as other existing problems. Indeed, the average spending per head on students' educational needs in the United States of America is much greater than France, Italy, Japan, United Kingdom and Germany (Sherman, 2000).

The enactment of the No Child Left Behind Act (NCLB) of 2001 by President George W. Bush is a landmark in education reform designed to improve student achievement and change the culture of America's schools**.** The law clearly sets a goal for Limited Proficient Students (LEP) to meet the same challenging state academic achievement standards and state academic content standards expected of all students. The law also states that every student should be technologically literate by the eighth grade, regardless of student background or family socioeconomic status. The NCLB together with the revised Elementary and Secondary Education Act are a blend of new requirements, incentives and resources, and it poses significant challenges for states. The law sets deadlines for states to expand the scope and frequency of student testing, revamp their accountability systems and guarantee that all teachers are qualified in their subject area. The NCLB requires each state to demonstrate annual progress in raising the percentage of students who are proficient in reading and mathematics, and in narrowing the test-score gap between advantaged and disadvantaged students. At the same time, the revised law increases funding in several areas, as well as before- and after-school programs, and provides states with greater flexibility to use federal funds as they see fit. NCLB is an ambitious law and forces states to move faster and further to improve the achievement of every student.

Each state is mandated to measure every public school student's progress in reading and mathematics in grades 3 through 8 and at least once during grades 10 through 12. The new law represents a sweeping overhaul of federal efforts to support elementary and secondary education in the United States. It is built on four common-sense pillars: accountability for results; an emphasis on doing what works based on scientific research; expanded parental options; and expanded local control and flexibility. The law supports learning in the early years, thereby intending to prevent many learning difficulties that may arise later. Most reading problems faced by adolescents and adults are the result of problems that could have been prevented through positive instruction in their early childhood years (Snow, Burns & Griffin, 1998). States and local school districts are now receiving more federal funding than ever before for all programs under the NCLB Act. The stated goal is an emphasis on implementing educational programs and practices that have been clearly demonstrated to be effective through rigorous scientific research.

According to Neal and Poole (2004), The NCLB Act has drawn major criticism throughout the United States of America. Ten Senators declared their support for significantly overhauling of NCLB Act. Their criticisms mandate the tests and other changes as Congress prepares to tackle the reauthorization of this massive federal education law. The senators have written letters to Congress stating that they have concluded that the testing mandates of NCLB in their current form are unsustainable and must be overhauled significantly during the reauthorization process beginning in 2006. Communities in conjunction with State Officials have banded together voicing their concerns about the assessment of students being tested. Based on to their arguments, the final assessment does not fully assess the students' abilities and therefore hinders educators in meeting the demands of educating students. While the ten senators agreed that states and districts should be held accountable for academic outcomes and continue working toward closing the achievement gap among their students, they stated that federal education law should not take the form of a "one-size-fits-all cookie-cutter approach" (National

Education Association [NEA] 2007). Among the criticisms of NCLB in Florida, opponents say that it de-emphasizes important subjects such as social studies and it is an unfunded federal mandate. While some debated that the high stake testing is a deep threat to critical thinking and imaginative thinking, others argued that this is a destruction of public education and a promotion for privatization of schools. Rogers (2004) commented that when it comes to education and the NCLB Act debate presents misleading rhetoric that does a disservice to the public and does nothing to address the fundamental problems of students lack the knowledge and skills to succeed in school and those left behind in school will likely remain behind as adults.

The Sentinel (2008) newspaper reported that after much debate and controversy Governor Charlie Crist, a former education commissioner, has promoted a de-emphasis of the FCAT in school grades, but he has not yet indicated whether he will sign the package of education bills into law. Educators across the state hailed the changes approved by the Legislature. Although the FCAT is now administered in February and March, the bill gives state Education Commissioner Eric Smith the power to schedule it for the latest possible date in the school year. It also attempts to diminish some of the FCAT frenzy surrounding the test. Schools were told that during classroom time they could no longer conduct rallies to boost student enthusiasm towards completing the FCAT test.

2.4 Mathematics Education Reform in the United States of America

In the United States, alternative teaching approaches such as individualized technology programs attempt to make mathematics more appealing and meaningful for the Limited English Proficient Students (LEP). Current reform issues in mathematics education place great emphasis on raising the achievement level of all students, particularly the low performance of minority students. Numerous changes have taken place which have profoundly affected the teaching of mathematics at the elementary school level. Five changes which are still having considerable influence are the increase in the number of Limited English Proficient Students (LEP) who are now attending public school; major curriculum changes; the increasing differences regarding the purposes, goals, teaching approaches and methods; the rapid development and integration of technology within the curriculum; and the demands for schools and teachers to be held publicly accountable for the students' success or failure. Each of the states is extremely apprehensive about meeting the Adequate Yearly Progress (AYP) guidelines to avoid being recognized as a failing school in need of improvement (Olson, 2003). Consequently, schools are challenged with the massive task of improving all students' performance on the standardized tests. Gratz's (2003) philosophy for progress is that if teachers raise expectations then students will improve achievement on the standardized tests. Therefore, teachers should present all students with specific mathematical standards covered on the standardized tests to ensure minimum proficiency.

The National Council of Teachers of Mathematics (NCTM) noted that today's society has moved from an industrial to an information-based society that relies on a far greater use and application of technological understanding and has goals that promote equal opportunity for mathematics learning for all its citizens. Consequently, mathematics itself is no longer seen as hierarchical and discrete with the consequent belief that this is the way it is learn. Instead, influential reports on the mathematics education show a vision of mathematical knowledge that is different to many preconceived beliefs about the subject. NCTM's accepted view of mathematics as basic arithmetic skills has given way to a broader view that emphasizes mathematics as general processes, or ways of thinking and reasoning, as well as an important form of communication (NCTM, 2000). Current theories of learning mathematics suggest that students are not passive receivers' of knowledge but actively construct knowledge consensual with social and cultural settings (von Glasersfeld, 1991). These changing views of mathematics and the way students learn have broadened the ways in which mathematics is taught. Instead of a view of teaching that relies on teacher exposition followed by student practice, modern teaching practices involve strategies such as problem solving, investigations, and practical activity (NCTM, 1995).

It can be argued that these changes in teaching and learning have had a greater influence on mathematics than perhaps on any other discipline. Burz (1996) recognized that in a performance-based curriculum mathematics education goes beyond factual knowledge. Curriculum-based reform mathematics education has been devised to advance understanding of mathematics, to improve intrinsic interest and positive reception of mathematics in daily living, as well as to develop self-assurance in students such that they become self-sufficient and eager to accept demanding task in mathematics. Part of children's difficulty in learning school mathematics lies in their failure to reconcile the rules of school-mathematics with their own independently developed mathematical intuition (Freudenthal, 1983; Resnick, 1987). Too often, ingrained assumptions, like standard grammar applied in contexts where irregularity rules, can impede learning. Consequently, a considerable number of children find school mathematics opaque.

The Third International Mathematics and Science Study (1996) offered methodical information on the status of mathematics and science in the United States compared to other countries. It showed that approximately 40 percent of the variance in achievement is related to factors outside of school. High-achieving schools across this international study have higher levels of parental education, homes with more books, and more study aids. In addition, the high-achieving schools have parents and students who value immediate and long-term student achievement. Schools have limited control of these factors and some educators become discouraged about educating Limited English Proficient (LEP) students. However, the curriculum is a vital factor and it is the blueprint for how schools have provided learning opportunities for these students. The degree of curricular modifications required for LEP students can only be determined by closely looking at both student academic achievement and student experience with formal and informal education. Indeed, both curriculum and methodology in mathematics classrooms have shifted from the behaviorist approach using rote learning and practices to the direction of an interactive problem-solving approach in certain contents. The United States has been developing curricula and professional standards for education practices since the 1980’s based on the result of the national reports on educational achievements such as A Nation at Risk (1983). The National Council of Teachers of Mathematics (1999) reported that higher expectations of students' capability and knowledge, and new methods of invention have surpassed traditional ideas about basic mathematics skills.

The State of Florida was sued by a coalition of eight minority groups during the 1990s because the state failed to establish standards and guidelines for provisions of services for LEP students. All students should have equal access to comprehensible instruction by appropriately certificated personnel with such instruction validated by defensible assessment practices (Multicultural Education Training and Advocacy [META], 1990). META filed a class action suit against the Florida Department of Education on behalf of LEP students who did not speak English as a first language. The action taken by META was intended to force Florida Department of Education to make provisions for the LEP students' needs. A settlement was made out of court in 1990. A judge of the United States District Court signed a decree giving the court the power to enforce the agreement between the Florida State Board of Education and the Multicultural Education Training and Advocacy. Subsequently, all 67 school districts in Florida must abide by the agreements set forth in the League of United Latin American Citizens (LULAC) et al. vs. Florida Department of Education Consent Decree. The purpose of the consent decree is to ensure that LEP students have equal access to intensive English language instructional programs and services. The META agreement was designed to provide the means whereby LEP students are provided with access to a full range of educational programs. The spirit of the META agreement is that LEP students will be given adequate and appropriate instruction to enable them to pass the required graduation examination and meet other requirements for a high school diploma.

The Department of Education Consent Decree also mandated teachers to take certification courses as a requirement for teaching LEP students. However, a lack of qualified teachers can limit the effectiveness of federal funding for the program. Districts and schools are responsible for properly identifying LEP students and providing accurate academic assessment information**.** According to the Department of Education (2005), each LEP student must have equal access to appropriate programming that must include intensive training and instruction in basic subject areas such as mathematics. Each student determined to be LEP must be further assessed in the basic subject areas in order to aid the students' teachers in developing an appropriate instructional program.

Curriculum changes have led to new developments in the Florida education system. The Sunshine State Standards were adopted by the Department of Education (DOE) in 1994 to measure the level at which all students are functioning. This also gives parents, students, and teachers and school administrators a clear understanding of what mathematical skills and competencies Florida students should acquire at the time of high school graduation. The Standards were written in seven subject areas, each divided into four separate grade clusters (PreK-2, 3-5, 6-8, and 9-12). The format was chosen to provide flexibility to school districts in designing curricula based on local needs. Consequently, mathematics classes are organized in six strands; number concepts, measurement, geometry, spatial sense, algebra and data analysis, and all the strands are assessed based on the Sunshine State Standards. Students' achievement on the mathematics test is reported by achievement level as well as by scale scores.

The Florida Department of Education (2004) reported that there are high levels of expectations for student achievement in Florida public schools. Florida legislatures, parents, teachers, and school administrators have contributed to development of a system of high standards. An important part of teaching high standards is to establish a transparent picture of what students are expected to know and to assess student progress. The Sunshine State Standards (SSS) is a foundation that monitors the system of high standards and levels of achievement.

The Sunshine State Standards identify the essential knowledge and skills that students should learn and for which the state holds schools accountable. These Standards are established at four combined grade levels so that students can be monitored academically as they develop. The Sunshine State Standards affect many aspects of schooling in Florida such as the curriculum, instruction, what and how teachers teach. Classroom tests are geared to the standards after they have been implemented. The Sunshine State Standards is a common thread in both the FCAT test and the SuccessMaker mathematics program. Proponents claimed that scores increase when students use computer preparation; there is also an increase in academic interest and motivation (Kozma, 1991; Sivin-Kachala, 1998). The SuccessMaker program and the test are designed to meet the Sunshine State Standards' objectives. The state yearly assessment in mathematics is based on the Sunshine State Standards and schools are expected to show progress.

The underlying philosophy is that if teachers and students are held accountable for students' scores on standardized tests, then academic standards will rise (Rothberg, 2001). Student progress is reported in a clear relationship to the standards. The standards are the starting point for most of what is done within Florida's educational system. The standards and benchmarks are organized within a specific curriculum, how they are taught within learning activities, and what instructional strategies and materials are used to teach them.

Accountability has become the focus of education reform in the United States of America. Linn (1998) affirms that assessment and accountability play a major important role in American schools. Armstrong and Casement (2001) noted that the foundation of standardized testing goes way back to Sir Francis Galton, a cousin of Charles Darwin, the inventor of the well-known bell curve; therefore it is not new. The demands for greater test scores force teachers to present enormous amount of information quickly to their students (Middlebrooks, 2003). However, these LEP students are still behind other students in mathematics (Stevenson, Chen, & Lee, 1993; National Center for Education Statistics, 1999). Mathematics education reform has emphasized a need for increased experience with technology and critical thinking skills in order to better prepare students for a modern society that is dependent on access to and use of information. The NCLB Act (2002) sets a goal for the LEP students to meet the same challenging state academic achievement standards expected of all students. The law also affirmed that every child should be technological literate by the eighth grade, regardless of the student background or family socioeconomic status. The complexity and diversity of these skills leaves some uncertainty about their successful implementation in the mathematics classroom. Presently educational reform efforts emphasize the development of higher-order reasoning and problem solving skills. The National Council of Teachers of Mathematics has emphasized the process standards of problem solving, and reasoning and the role of technology in achieving the goals.

President George W. Bush presented education reform as the cornerstone of his administration**.** Therefore, educators are constantly seeking ways to advance the quality of education due to the high-stakes testing that is playing a key role in today's education system. Accountability continues to be an important part of public education and the government continues to stress the importance of students meeting the necessary standard and mathematics achievement has been predominantly targeted. Large-scale evaluations are a major part of the American education system.

2.5 Limited English Proficient Students

Since 1992, Limited-English Proficient (LEP) student enrollment has nearly doubled in the United States of America. Most recent data from the National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs (NCELA) indicates that there are close to five million students identified as LEP (NCELA, 2002). These skyrocketing numbers of LEP students emphasize the importance of ensuring that student academic success becomes a reality and that teachers provide them with the opportunity to succeed. Minicucci and Olsen (1992) contend that the challenge of educating LEP students arises from the growth and diversity of these students and their diverse academic and social needs. The revised Elementary and Secondary Education Act, the NCLB Law, is a powerful blend of new requirements, incentives and resources, and it poses significant challenges for states. All parents want their children to graduate with the basic tools needed to work and succeed in today's global marketplace (Bush, 2007). One of America's greatest attributes is its diversity ensuring that all children, regardless of background, have the chance to succeed is a central purpose of the federal role in education. The changes that schools in the United States of America have witnessed over the last decade have created new challenges to teaching and learning. Numerous studies indicate that using educational technology as a learning tool can increase opportunities for LEP students. School reformers, such as Mehlinger (1995), believe that technology can support learner-centered instruction as practice. Developing multiple, effective, adequate strategies to integrate technology in LEP students' learning is critical. Secada (1998) explored the challenges that LEP students face while developing both oral communication skills and academic skills in mathematics. The study confirmed that the development of communication skills is necessary, but it is not enough to ensure academic achievement. For example, learning to interpret bar graphs requires both communication skills and problem-solving skills. To succeed in the mainstream classroom, LEP students must learn both academic and communication skills. Along with practitioners, researchers such as Johns and Tórrez (2001) support the fact that "the new technologies offer many possibilities to the second language learner (LEP)".

According to the Office of Civil Rights U.S. Department of Education (1999), concerns have grown about providing fair and accurate assessments for LEP students during the past decades. LEP students are often considered low achieving students; they are often been deprived of the opportunity to learn higher-level thinking skills because it has been believed that they must demonstrate the ability to learn the basic or lower levels of knowledge before they can be taught higher-level skills (Foster, 1989). There is an emphasis on remediation for low achievers, which has resulted in teachers' lower expectations for these students and an overemphasis on repetition of content through drill-and-practice (Knapp & Shields, 1990; Lehr and Harris, 1988; Levin, 1987). Research implies that expectations set for students are very important in determining students' achievement. On the contrary, Secada and Carey (1990) stated that developing mathematical understanding does not mean displaying immediate knowledge, but it rather manifests itself in students' ability to link what they are learning to previous knowledge that they already obtained**.** Wood (1999) found that teaching mathematics with a focus on number sense encouraged students to become problem solvers in a wide variety of situations and to view mathematics as a discipline in which thinking is important. Findings from a number of studies show that when students ascertain mathematical ideas and construct mathematical procedures, they have a stronger conceptual understanding of connections between mathematical ideas. Student achievement and understanding are significantly improved when teachers are aware of how students construct knowledge, are familiar with the intuitive solution methods that students use when they solve problems, and employ this knowledge when planning and conducting instruction in mathematics

Mathematical problem solving has been the focus of concern for many years (National Council of Teachers of Mathematics Standards 1989, 2000). In order to develop LEP students' problem-solving achievement, teachers need to be sensitive of student behaviors, and identify which instructional strategies help develop their problem-solving abilities. John-Steiner, Mahn and Holbrook (1996) claimed that word problems embedded in culturally and linguistically familiar situations allow young children to use what they know about the world to make sense of mathematics and learn with understanding. Problem solving, which involves the application of previously acquired knowledge to new unfamiliar situations, was emphasized by the National Research Council (1990) as the main reason for studying mathematics. Trueba (1999) affirmed that LEP students in the United States deals with issue of culture, class, and language that affect their opportunities for full participation in problem solving activities. Consequently, LEP students need multiple opportunities, to demonstrate their thinking in order to uncover the depth of their understanding. For example use students' pictorial representations of problems solutions that will show both insights and gaps in their skills. When students recognize patterns and trends they become better problem- solvers and are better able to apply the concept that they have learned (Kallick, 1997).

Numerous published research studies investigate and recommend cooperative learning activities in elementary schools, and these studies are centered on mathematics classes. Secretary's Commission on Achieving Necessary Skills (SCANS 1991) presented arguments favoring cooperative learning and teamwork, which stated that the education world, viewed these activities primarily as effective strategies for learning mathematical reasoning as well as from the business world who view cooperative activities as essential for productive employees. Cooperative Learning is an instructional strategy that employs a variety of motivational techniques that makes instruction more relevant and students more responsible. Students are more positive about each other when they learn mathematics cooperatively than when they learn alone, competitively, or individualistically - regardless of differences in ability, ethnic background, or being handicapped (Johnson & Johnson 1997).

Small-group learning activities seem to benefit LEP students in many different ways including problem–solving. Johnson, Johnson, and Holubec (1999) debated that small groups can function effectively as they promote each other's learning by helping, sharing, and encouraging efforts to learn. Garfield (2007) also claimed that the use of small group learning activities leads to improved group production, positive student attitudes, as well as greater achievement. Other researchers' logic is that cooperative learning groups relates to the constructivist theory of learning on which a great deal of the current mathematics and science reform in education is being established. This theory depicts learning as actively constructing one's own knowledge. Based on the constructivist view, students bring their own ideas, experiences, and beliefs to the classroom, which influence how they comprehend and learn new materials.

Learning mathematics through technology activities as part of the group work transforms the learning process itself. For example, when students work out problems in groups that require research on the internet, it allows greater interaction among them and a sense of responsibility for the group. A class where students interact fosters an environment conducive to high student motivation and participation and student attendance (Treisman (1992). Numerous research studies have concluded that small groups create a positive cycle of good performance building higher self-esteem which in turn leads to more interest in the subject and fosters higher levels of performance**.** According to Hanson-Smith (1997), the old model of instruction places the student alone at a desk with a book, while collaboration in groups allow learners to take an active role in helping each other to accomplish a task that is a vehicle for using authentic communication.

Most mathematics educators agree that there is more need for posing and solving problems and less need for drill exercises (National Research Council, 1989). Learning the language of mathematics starts prior to formal education. Linking

Sent Limited English Proficient (LEP) students often experience difficulties in learning mathematics that have little to do with processing mathematical ideas. Davison and Schindler's (1998) cultural investigation of Native Americans identified three areas in which LEP students have difficulties in learning mathematics, namely, language, culture, and learning modality. Culture can obstruct the learning of mathematical concepts in the classroom. For example, one Native American culture does not have a concept for line (Lovett, 1980), and one South American culture does not have a concept for some numbers. Instead they have conceptualized numbers 1, 2, and many; the Hmong culture in Cambodia does not have a concept for fractions (Kimball, 1990). These instances demonstrate how culture can interfere with the learning of mathematical concepts. Indeed, Secada (1983) and Norman (1988) have revealed that numerals are not universally the same. So in an American Indian community, for example, it would be more meaningful to reorganize the problem as the addition of 12 horses to 32 horses where horses are an important part of lives. In the past, mathematicians have recognized similarities and differences in the mathematics of different cultures and have traced the influence of cultures on one another in the evolution of mathematics (Joseph, 1992). Therefore there are indisputable cultural differences in mathematics.

It is crucial for students to understand the main components of language and its relationship to mathematics in the classroom. These components include vocabulary, syntax, semantic properties, and discourse (Dale & Cuevas, 1987). D'Ambrosio (1995) recommends an ethnomathematics approach to the curriculum that draws on traditional culture while focusing on mathematics integration. LEP students are from different cultures, speak different languages (other than English as their primary language), and have preferred differences in cognitive processing. A number of researchers have investigated the influence of language and culture on a bilingual student's learning of mathematics and observed that there are different culture errors in mathematics problem solving (Leap et al., 1982). A review of studies of mathematics learning among a variety of non-Western cultures indicated that indigenous peoples are often unable to solve mathematical problems that are not perceived as culturally relevant (Saxe, 1982).

According to statistics from the United States Census Bureau, Hispanics comprise 11.2 percent of the U.S. population; it is the largest and fastest growing minority. The few studies that have investigated mathematical difficulties among Hispanic students (LEP) show that their error patterns are nearly always the result of differences in language or culture. Problems related to syntax, for example, sentence structure and semantic components of language in the mathematics class present difficulties for Hispanics students in two areas. The first, relates to the lack of a one-to-one correspondence between mathematical symbols and secondly, the words they represent (Kessler, Quinn & Hayes, 1985). Hispanics students are more likely to be enrolled below grade level and be retained one or more times, be enrolled in remedial classes that do not prepare them for college, and they have the highest drop out rate throughout the United States. Gomez and Rodriquez (2005) stated that Hispanic children enter school already behind. Some research stated that there are many misconceptions in elementary mathematics among Hispanic students but the number of unique errors among Hispanics resulting from linguistic difficulties is, however, small. In general, these linguistic difficulties cause Hispanics to commit the same types of errors as Anglos but with a higher frequency. Students do not come to the classroom as blank slates, instead, they come with theories constructed from their everyday experiences (Resnick, 1983). They have actively constructed these theories, an activity crucial to all successful learning. Some of the theories that students use to make sense of the world are, however, incomplete half-truths.

Schindler and Davison (1985) found from that dominant Crow language speakers viewed Crow as the language of the home and English as the language of the school. Such a dichotomy makes it very hard for educators to accomplish the objectives of bilingual education and to reduce cultural discontinuity between home and school. Consequently, mastery of mathematical concepts in the Crow language would have to be developed more in the school before they could be used to facilitate the learning of the same concepts in English. The problem was made worse by the students seeing little or no use for the textbook-dominated mathematics they learned in school. In addition, confusion occurs when certain terms such as "factor" and "product" have specialized meanings in the mathematics classroom different from their regular English language meanings.

Based on Garbe's (1985) work with Navajo Indians, he noted that the students were not receiving enough instruction in technical mathematics vocabulary. His recommendation was that the vocabulary to be mastered should be clearly identified and that student performance in vocabulary be passed on to the next grade teacher.

One of the most widely accepted goals of the mathematics community is that students should understand the mathematics they perform. For centuries educators have known that understanding grows only with active learning. This has led mathematics educators to believe that students construct their own understanding (Hiebert & Carpenter, 1992). In this view, understanding cannot be delivered by instructors, no matter how skillful, but must be created by learners in their own minds.

The constructivist posits that children learn as they attempt to solve meaningful problems. In this view, understanding emerges from reflection following questions (Campbell & Johnson, 1995). The teachers' primary role is not to instruct but to pose problems and ask questions that provoke students to reflect on their work and justify their reasoning. In this way, activities such as explaining, justifying, and exemplifying not only demonstrate understanding but also help create it. According to supporters, constructivism focuses education on the learner (what happens in students' minds); on inquiry (seeking the right questions, not just the right answers); on relevance (questions of natural interest to children); and on activity (learning with both hand and mind) (Brooks & Brooks, 1993). Yet critics (Anderson et al., 1997) contend that constructivist methods too easily slight the importance both of didactics (systematic instruction) and drill (systematic practice). There is abundant evidence that young children, on their own, develop simple mathematical rules that they use to solve problems in their environment (Resnick, 1987).

LEP students' difficulties in learning mathematics cannot be attributed to any one factor**.** Research confirms that standardized tests place a great emphasis on language skills. Subsequently, LEP students are at a serious disadvantage and will automatically score low on mathematics standardized tests because they do not understand mathematical processes; this understanding frequently comes through the use of manipulatives and visuals. In competing with mainstream students on standardized tests, LEP students are often disadvantaged through an interchange of English language deficiency, cultural dissonance between home and school, and often excessively abstract instruction. Dawes' (1983) research results illustrate that the understanding of logical connectors was the one factor that distinguished the students who could successfully reason mathematically from those who could not.

Research confirms that a variety of techniques and special teaching strategies should be implemented when teaching mathematics to LEP students. Thornburg and Karp (1992, p. 176) put forward "cognitive apprenticeship" for mathematics instruction that includes modeling, scaffolding, evaluating, and peer collaborative strategies. Modeling is a strategy that involves demonstrating the steps to accomplish a task while scaffolding is being used to describe the support offered by the teacher on aspects of the task the student cannot independently accomplish. Scaffolding also involves students linking new materials to their prior knowledge. “Evaluation is part of the learning process where the learner reviews the strategies used in the attempt to master presented tasks, facilitating the learner's awareness and control of what is learned" (Thornburg & Karp, 1992, p. 167). This evaluation is best done as a student-teacher dialogue rather than as a paper and pencil test.

Considering the recommendations of the National Council of Teachers of Mathematics (NCTM) standards for stressing understanding rather than rote computations (NCTM, 2000) and considering the proven relationship between language skills and mathematics (Dale, & Cuevas, 1987), it seems evident that the belief that inability or limited ability to speak English has a minimal effect on the learning of mathematics is actually a myth.

The National Council of Teachers of Mathematics (1991) acknowledges the potential for language ability to create barriers to learning mathematics and the need for teachers to attend to the role language plays in students' understanding of mathematics. The Council goes on to state, "Teachers' knowledge of their students' cultural backgrounds and the implications of this knowledge for their teaching are crucial in recognizing the impact of language on learning" (p. 146). Current theories of learning mathematics suggest that students are not passive receivers' knowledge but actively construct knowledge consensual with social and cultural settings (von Glasersfeld, 1991). These changing views of mathematics and the way students learn have broadened the ways in which mathematics is being taught. instead of a view of teaching that relies on teacher exposition followed by student practice, modern teaching practices involve strategies such as problem solving, investigations, practical activity, group work, projects and applications of relevant technologies (NCTM, 1989).

Moschkovich (2000) suggested that classroom instruction should support bilingual students' engagement in conversations about mathematics that go beyond the translation of vocabulary and involve students in communicating about mathematical concepts. Various activities, providing cooperative learning opportunities, and the use of audio-visual aids as a means of drawing from the student's past experiences is an excellent strategy to help students to succeed. For example, in mathematics study LEP students used the computer for exploring and analyzing sequences, used algebraic thinking to determine a rule for generating patterns and speculated their relationships; used critical thinking to analyze the sequences generated, and then analyzed each numerically and graphically. Students investigated, collected, organized and analyzed temperature data from the website of the National Climatic Data Center; and then created colored data graph to show their findings. Similarly, Radomski's (2001) investigation revealed academic performance and behavior can also influence how much access LEP students have to technology and how they use it.

Success or failure of Limited English Proficient students in mathematics depends to a large extent on the teachers' awareness of their unique learning problems. Assessments of how well LEP students communicate mathematically need to consider more than their use of vocabulary but how they make comparisons, explain conclusions, specify claims, and use mathematical representations. Alternative assessment is recommended by the Office of Technology Assessment (1992) as well as by several researchers. Alternative assessment tasks generally involve a demonstration or product which is to be observed and rated by the teacher. Alternative assessment approaches generally involve more extended tasks, i.e., tasks that require more time to complete or that involve a series of multiple tasks (Baker, 1992). Alternative assessment can also include student-constructed products that demonstrate the student's knowledge or proficiency. Such demonstrations might be a specific performance or product (e.g., an oral presentation, mathematical representations of the problem) or, the product could be a longer-term demonstration such as a portfolio that represents examples of student work over time (e.g., writing samples, examples of problem-solving in mathematics).

2.6 Technology in Mathematics Education

Technology has often been viewed as a useful advantage to education. Over the past several years rigorous efforts have been undertaken to mandate the inclusion of technology within the educational settings. Research confirmed that technology used in modern-day education can support global thinking and provide information to adopt new teaching and learning developments. Greene (1998) maintained that the internet contains rich sources of information, engages the user in imaginative ways and is therefore changing the face of instruction. Much progress has been made in integrating technology into mathematics instruction. Educational technology is now widely valued for its ability to enhance one of the most significant intellectual developments for students, namely their emerging ability to think abstractly (Jarrett, 1998, p. 4). As noted in NCTM (Suydam, 1990, as cited in Jarrett, 1998), today's technology can offer adolescents a bridge from concrete to abstract thinking, enabling them to observe and create multiple representations of mathematical ideas: numerically, graphically, and symbolically. For example, students can use geometric construction software to investigate the relationship between the circumference and diameter of a circle. They can measure several round objects and record the circumference and diameter (numerical representation). They can plot the values and estimate a "best fit" (graphical representation). Students can then determine the best fit equation (symbolic representation). Technology can also help teachers respond to students' diverse learning styles by creating rich environments that engage students' tactile, visual, and auditory senses.

Technology activities shift the learning process itself and transform the way that information is viewed. Researchers found that technology can impact learning only under specific conditions. Some of the conditions included students having access to computers, ongoing teacher education, ongoing monitoring of technology in the classrooms, and guaranteeing that the software was appropriate for the child’s needs and the objectives of the instruction (Branett, & Butzin, 2001). However, other researchers claimed that technology has not significantly changed the quality of instruction over the past 20 years despite subjective promise of advancement (Martorella, 1997). Szabo (2002) took a different, more general view, asserting that the main consideration when introducing an innovation is not the actual technology but ensuring that the social context, people, technology, and purposive action involved are compatible with the proposed introduction of technology.

Modern technological advancements have dramatically changed the way we conceptualize teaching and learning. From the word processor to the internet, students and teachers have been prompted to take advantage of new technological tools almost as fast as they have been developed. It has been suggested that these new technologies have transform everything from telecommunications, to commerce, to education. The introduction of these technologies into the classroom has resulted in remarkable changes in the way mathematics teachers can teach their classes and students the way students learn. Educational technology can have a significant positive impact on learning in most subject areas, and for students with special learning needs.

Supported by the NCLB Act, training teachers how to use technology remains one of the highest prioritized goals and concerns. According to The National Center for Education Statistics (1999), federal funds provide training for teachers, classroom materials, and new technology designed to improve mathematics education in the schools. The use of instructional technology offers great promise but also lends itself to significant challenges for teachers. These challenges include keeping up with advancement in technology and being able to assess technology for indicators of student progress. Teachers are required to become competent enough to integrate technology proficiently, innovatively, and assertively into their daily lessons. Ramirez (2001) claimed that LEP students need teachers who are trained both to help them learn English and to use computers effectively in instruction. Hence, teachers are faced with a predicament of fulfilling curriculum requirements, especially in states with high-stake tests, while trying to choose appropriate software programs that align the state curriculum standards (Moursund, 1999). Kilpatrick, Swafford, and Findell (2001) argued that the qualities of the curriculum, instruction, and assessment, as well as the vital component of teacher preparation and attitude, are the key components that can result in LEP students' academic success in mathematics.

Research has highlighted many benefits of using instructional technology with LEP students. Murray and Kouritzin (1997) affirmed that competent use of computers prevents LEP learners from academic and social marginalization**.** Almost three decades ago, Papert (1980) explained that learning mathematics through technology is more than just fun; children are learning to speak mathematics and acquiring a new image of themselves as mathematicians. He maintained that technology creates flexible learning environments in which students easily construct and learn new information. Technological developments permit teachers and students to obtain advance knowledge and support critical thinking. Productivity in mathematical activities has increased significantly in terms of learning and effective teaching, offering the possibility to solve problems and enhance the stability and quality of learning in a coherent manner (Isman, 2003). Consequently, technology allows students to have the most control over the direction of their learning by controlling their time, speed of learning, autonomy, choice of topics or even their own uniqueness (Hoven, 1992). In addition, technology provides students with punctual feedback, tailors the instructional sequence, and individualizes their learning. Burgess and Trinidad's (1997) investigation found that technology can meet LEP student specific needs and increase their autonomy, permit more responsibility, promote equal opportunity in an early nonsexist environment, encourage student teamwork with peers, and encourage decision making. The opportunities that

LEP students find through technology has greatly helped in building on their confidence and they are not embarrassed for not knowing answers (Lee, 2000; Padrón & Waxman, 1996).

Recent research has supported the use of technology in teaching mathematics because it helped students to communicate and deal with genuine life situations, comprehend and understand mathematics representations, work together willingly on solving problems, talk about mathematical concepts and ideas, communicate their mathematics thinking, and solve problems on their own. According to Glaser (1992), deep understanding must be well connected; in contrast, superficial understanding is inert, useful primarily in carefully prescribed contexts such as those found in typical mathematics classroom. Moreover, students with different levels of skills may be equally able to address tasks requiring more sophisticated mathematical reasoning (Cai & Fink, 1996). However, technology is not only electronic instruments; it includes new teaching-learning methods that can be used in a beneficial way in education (Isman, 2003**).** Evolving from traditional teaching methods is mass instruction (i.e., conventional lectures, film and video presentations, educational broadcasts, mass practical and studio work) in which the role of teacher is traditional because they are in control of the educational process and students are dependent on the instruction and media used by teachers. Other methods are Individualized learning and group learning. Individualized learning consists of directed study of text, study of open-learning materials, mediated self-instruction. In Computer Base Learning (CBL), as well as the use of multimedia, the role of the teacher moves from controller to tutor and guide. They manage the learning resources and provide support to students as needed (The Robert Gordon University, 1996). In group learning (i.e., buzz sessions, class discussions, seminars, group tutorials, games, simulations, and group projects), the role of the teacher becomes a facilitator of learning experiences as well as the organizer of group activity; students become largely responsible for their own learning and dependent on each others' preparation and interaction (The Robert Gordon University 1996). Mehlinger (1995), along with other school reformers, believes that technology can support learner-centered instruction enhamcing the relationship between students and teachers. Previously, schools were places with the power to decide what and when subject matter was covered; presently new technology provides students access to information that was once under the control of teachers. Smith (1995) calls technology a great equalizer because technology has been increasingly easing the process of LEP student integration into the mathematics classroom.

According to Duebel (2002), many parents and educators admitted that they believe that computers were in the schools to improve achievement test scores. Presently, this is the case in Miami Public schools where FCAT dictates technology procedures in the mathematics classroom and laboratory. Consequently, technology is used to improve selected skills tests that are intended to measure. The use of computer for improving FCAT mathematics scores lends to individual pace and the ability to reach students success level. Therefore, individualized computer instruction is considered appropriate for improving student progress on the FCAT mathematics test.

2.6.1 Visualization

In American schools today there is a multiplicity of traditional and reformed teaching and learning methodologies. To possess the quality of instruction and learning in a linguistically diverse classroom, schools must be receptive to the theory of teaching and learning that can have an effective impact on learners for the twenty-first century. In order to develop the quality of instruction and learning that can educate students in the context of culturally and linguistically diverse classrooms, teachers must believe that students can improve over time. Skinner's behaviorism, Piaget's cognitive, developments, and Vygotsky's social cognition, and Gardner's Multiple Intelligences theory (1983) have impacted on curriculum, instruction and assessment which led to new developments, using technology visualization in teaching and learning. Students of all ages construct meaning about themselves and their world out of personal experiences, including the influences of culture (Beane, 1995; Caine & Caine, 1991). Learning is enhanced when curriculum and instruction integrate student experiences with the development of meaning. Iran-Nejad, McKeachie, and Berliner (1990) claimed that the more meaningful, the more deeply or elaborately processed, the more situated in context, and the more rooted in cultural, background, cognitive, and personal knowledge an event is, the more readily understood, learned, and remembered. Students using the internet within the inquiry-based curriculum gain access to visualizations and animations that allow them to become active researchers and knowledge-generating participants who are able to understand many abstract concepts.

In this way, technology can provide LEP students a visual picture of the concept, allowing them to understand the lesson. Visual additions help students to learn a concept and expand important related vocabulary. Additionally, curriculum supported through a multi-sensory approach of text, graphics, speech, and sounds are best suited for LEP students. García's (1999) investigation on the effects of visuals on LEP children's learning processes resulted in his claim that the use of animation software develop on LEP students' skills in learning.

2.6.2 Motivation

Educational technology has been found to have positive effects on student attitudes toward learning and on student self-concepts. Students felt more successful in school, were more motivated to learn, and had increased self-confidence and self-esteem when using computer-based instruction. This was particularly true when the technology allowed learners to control their own learning. "Computers make no personal judgments, a fact that can help children who are afraid of making a mistake in from of their teachers or classmates. Proponents of education technology also say it can motivate students, encourage them to work in teams, and take them a step beyond the lessons and materials they get in class" (Trotter, 1998). Researchers have also found that teachers report the use of computer software in the classroom often positively influences student behavior (Miller, 2002).

Technology can be motivational and nonjudgmental to most LEP students, building their self -confidence by allowing them to believe in themselves and have a positive attitude towards life. Students are driven to be excellent at completing their mathematics assignments, allowing them to perform high quality work. Dweck (1986) suggested that motivation plays a central role in any learning activity. Although there has been a great deal of research on motivation, there is "little scientific knowledge ... about the factors that underlie motivation, enjoyment, and satisfaction. …..To assist children to learn mathematics, we can provide them with cognitive artifacts, for example, artifacts that extend and improve their cognitive capabilities (Norman, 1993, p. 23). Fox (1998) stated that the heightened motivation is attributed to the new medium and the constructive effects of technology and this will subside as the students become accustomed to it. On the contrary, Relan (1997) credited the improved motivation to instant feedback and individualized tutoring of the students.

Kinzie (1990) suggested that intrinsic and continuing motivations are important for students in order for them to stay involved with computer-based instruction. Intrinsic motivation allows the student to participate in an activity and receive satisfaction from completing the activity. When a student chooses to return to an activity or lesson without being told by the teacher, the student demonstrates continuing motivation. Simulations and games seem to heighten both types of motivation. Computer games can give the opportunity to learners to explore their imagination comfortably. According to Vockel (2004), using fantasies mental images and non-real situations in computer games can stimulate learners' behavior and increase motivation. Educational technology impacts on other aspects of student learning beyond cognitive curriculum outcomes, such as student attitudes, self-esteem and the development of social competencies. The use of computers in classrooms increases student motivation, increases enjoyment of learning, and increases student control over their learning and access to information.

2.6.3 SuccessMaker

Presently, numerous standards exist in mathematics education. As a result of the development of the Curriculum and Evaluation Standards for Mathematics (National Council of Teachers of Mathematics [NCTM], 1989), schools have a new opportunity to ensure that students are engaged in full and coherent mathematical development. Educators are empowered, so they can use the NCTM *Standards* as a framework to articulate mathematics experiences from kindergarten through high school. For example, a growing research base supports the idea that students learn mathematical concepts best when the concepts are presented gradually over time. Educators must be sure to provide the conceptual base and experiences needed so that students will be able to understand new and more difficult concepts. Research also has verified the importance of building on students' prior knowledge when helping them learn new concepts. Prior knowledge acts as a lens through which to view and grasp new information; it is a mixture of what has been learned from both our academic and everyday encounters (Kujawa & Huske, 1995). Consequently, students learn and retain new information best when it is associated with pertinent prior knowledge. Beyer (1991) indicated that teachers who link classroom activities and instruction to prior knowledge expand on their students' knowledge, enabling students to relate the subject matter to their own background and experience. When teachers link new information to the student's prior knowledge, they activate the student's interest and curiosity, and infuse instruction with a sense of purpose. One method to align the curriculum to standards is the use of computer–based instructional management systems (Elias et al., 2000). SuccessMaker is an example of these systems.

SuccessMaker computer-based instructional software was designed to assist students with improving mastery of basic mathematical skills. SuccessMaker has a prolonged history of proven success in schools and districts across the United States and around the world. The Education Commission, (1999) found that the main features of the SuccessMaker include standards-based content and instructional design, individualized instruction, continuous progress assessment, resources and tools for students to utilize, and flexibility. The SuccessMaker program provides individualized, self-paced instruction for each student in reading and mathematics. SuccessMaker mathematics meets the student where he or she is and moves each student forward at their own pace into higher levels of mathematics (Pearson Digital Learning, 2003). Success Maker mathematics also presents individualized interactive lessons that are adjustable so that each student can strengthen weak areas and comprehend basic mathematical concepts. Recent findings indicated that students learn from SuccessMaker. There is evidence that the use of SuccessMaker impacts more significantly on higher- order thinking than on lower-order cognitive processing and rote learning (Educational Testing Service, 2001).

The program places the student at the appropriate grade equivalent based on the data gathered. After this initial placement, the management system tracks each student's progress and automatically provides the level of instruction appropriate to each student's needs. Additionally, SuccessMaker mixes the content, skills, and strategies taught and provides additional practice in areas in which performance is academically weak. Students proceed at their own pace and this permits them to take on greater academic challenges while acquiring new skills, knowledge and strategies. The constructivist approach to education is also applied when students use the SuccessMaker program; it guides the students to create their own understanding of concepts and manipulates objects on the computer screen. SuccessMaker has proven to be extremely effective in motivating students' progress. Another innovative tool employed by SuccessMaker is the multiple means of assessment. Teachers have access to numerous reports which provide immediate and precise information detailing student performance. For examples, reports including the number of correct problems out of the total number attempted and the length of the each session. Educators observed that the benefits of utilizing SuccessMaker in the classroom can not always be measured in statistical terms. For example, increases in self-confidence, motivation, and student collaboration have been contributed to students' use of SuccessMaker software.

The goal of this type of instruction management system is to monitor student's progress, provide immediate feedback to students, and adopt instructions to meet individual needs, and to improve achievement in all functional areas (Black & Wiliam, 1989). Evidence Math Concepts and Skills provided by the SuccessMaker program are designed to inspire students' interest in mathematics while developing process abilities in complex multi-step problem solving.

Learning mathematics through high-levels technology activities shifts the learning process itself so that students can meet mathematics expectations. SuccessMaker as a tool to enhance teaching, learning, and multisensory experiences provides a variety of pathways for students at different levels (Ficklen & Muscara, 2001). Most researchers also agree that technology has been proven to accommodate various learning styles; it is considered a useful motivator for LEP students as well as offering other distinct learning needs such as increased motivation, increased student-controlled participation, and extended exposure to language which promotes faster learning. Furthermore, technology has the potential for enhancing cultural interactions.

2.6.4 Increased Achievement

In 1998 and 1999 Highland Elementary School in Palm Beach County Schools District was rated as a "D" school by the state of Florida. The school adopted SuccessMaker in an effort to meet the major challenges (Pearson Education, Inc 1999). The school received a rating of "A in 2000 and a rating of "B" in 2002. A vast number of students are low socio-economic status; 90 percent are classified as Limited English Proficient (LEP). The SuccessMaker program helped the students to achieve at higher levels in mathematics, reading and writing (Pearson Education, Inc., Highland, 2006). Similarly, the Andrew Jackson School in Brooklyn, New York, also had outstanding success with this same program, by meeting state and city standards in mathematics each year (Pearson Education, Inc., Andrew Jackson, 2006).

Rapid technological developments have impacted education and can help teachers to solve problems such as low motivation to learn mathematics, the transfer of problem solving skills to real life situations, and applying mathematics standards in the curriculum**.** Studies showed that students who participated in the mathematics computer program scored much higher than those who were not in the program. Clements, Nastasi, and Swaminathan (1993) revealed significant evidence of computer-aided mathematics achievement for primary age children. AppleWorks (1998) reported on 27 studies that they conducted on the academic achievement of 6th through 12th grade students who had either received traditional classroom instruction or traditional classroom instruction supplemented with computer-assisted instruction. On an average, 58.2% of the students receiving instruction involving computers achieved higher academic achievement in mathematics than those in traditional-instruction-only classrooms.

The teaching and learning approaches using computers helped the teachers to diagnose various learning problems so that they can plan effectively to help these students. Common learning problems identified were that low achievers are unable to read and comprehend correctly. These students experience difficulties with mathematics reasoning, syntax, visual, and audio lessons. They often have trouble spelling correctly and have frequent grammatical errors which have resulted in poor sentence structure. They often misunderstand mathematics symbols, as well as having difficulties with the concepts of money and time. Some students recognized their lack of ability and this resulted in low self-esteem which greatly effected their social skills. However, students with these learning problems can be taught effective learning strategies that can help them to approach tasks more effectively (Lombard, 2005).

The following strategies are considered useful in teaching low achievers:

- Encourage students to verbalize the steps involved in solving a mathematical problem as they work through it.
- Use manipulatives to help students visualize the mathematical concepts.
- Allow students to use computational charts and aids such as calculator, number lines, abacus, and counters.
- Teach mathematical concepts and computation procedures through games and kinesthetic activities.
- Give practice in reading word problems by identifying the key words to determine the operation needed to solve the problem.
- Utilize whenever possible good audiovisual programs for presentation of new concepts and assignments.
- Begin with the easiest word problem adding the harder problems in a progressive order.
- Group problems initially by the operational procedure to be used.
- Teach through modeling rather than giving directions.

Lawrence (2000) reported that a media-enhanced mathematical curriculum actively engaged students and capitalized on natural learning patterns, building on children's life experiences and encouraging corporative learning.

A meta-analysis undertaken by Burns and Bowman (2002) revealed that computer-assisted instruction resulted in significant increases in mathematics achievement of primary age students. A large meta-analysis study that involved five counties in New York State concluded that "increasing the technology available to students encourages, facilitates, and supports student achievement-at the elementary levels; the most overwhelming effects were found in the area of mathematics, where sixth-grade mathematics scores on the state's Comprehensive Assessment Report were strongly related to increases in technological use. (Page, 2002, p. 34).

Page (2002) conducted an additional study at five elementary schools to determine if students in technology-enriched classrooms showed higher levels of achievement, greater self-esteem and increased classroom interaction than students in traditional classrooms. Participants in the technology-enriched classrooms appeared to score significantly higher in mathematics achievement than their peers in the non technology-enriched classrooms. The results of this study in terms of mathematics achievement were consistent with the meta-analyses reported earlier (Page, 2002).

Furner, Yahya and Duffy (2005) investigated a limited number of strategies that are successful in teaching mathematics to all students, including Limited English Proficient students. One strategy they recommended as the best practice was the use of computers to accomplish mathematics goals. They reported research that computer-based instruction students scored at the 64th percentile on achievement tests while students without computers scored at the 50th percentile; students learned more in less time and had more positive attitudes when they used computer-based instruction Students identified with a learning disability increased their achievement in mathematics in technology-rich environments (Schacter, 1999). The greatest student achievement was seen among students when they had consistent access to technology, when both teachers and students had a positive attitude towards technology, and when teachers were completely trained in using the technology (Schacter, 1999). In the study on the Teachers' View on Enhancing ICT Use, the results showed that teachers' views towards using technology in the classroom were more positive. Specifically, during their years of integrating technology-rich tasks in a technology-rich environment, the teachers' views on factors affecting their technology integration shifted away from factors reflecting a need for external legitimacy, reinforcement, encouragement, power, and emotional support from authority figures such as superintendents and principals.

The Apple Classrooms of Tomorrow (ACOT) project provided some valid conclusions that showed that students in computer-enriched classrooms increased their performance, had a more positive attitude towards school, had higher self-esteem and their writing improved dramatically. This argument was accepted by the federal government resulting in an enormous investment being directed to training, hardware, software, and funding from the 1980s until 2000. However, other researchers are concerned that during these three decades the education system has failed to implement and utilize these advanced technology innovations in a way that would increase student learning (Page, 2002).

Contrary to numerous reports in which regular students have used computers with mixed results, students with special needs have experienced increased levels of achievement while engaging in instruction involving computers. A comprehensive study involving computer-based instruction, established that computers were particularly effective with low-achieving students (Parry, Thorkildsen, Biery, Macfarlane, 1986). Additionally, students with learning disabilities who used computers performed logical-thinking tasks considerably better in problem-solving activities (Grossen & Carnine, 1990), and students vulnerable to failure were found to increase their chance for success when using computer–based instruction (Waxman & Padron, 1995).

2.7 The Florida Comprehensive Assessment Test

In Florida, standardized testing, namely the Florida Comprehensive Assessment Test (FCAT), dictates the modus operandi in the mathematics classroom plus the use of technology. The Florida Comprehensive Assessment Test (FCAT) was created in 1998 to measure a portion of the Sunshine State Standards (SSS). The test results form the basis for the school accountability program, and the grade 10 FCAT has now become the high school graduation test. The FCAT is a component of Florida's effort to improve the teaching and learning in order to meet higher educational standards. The primary purpose of the FCAT is to assess student achievement of the high-order thinking skills represented in the Sunshine State Standards (SSS) for Reading, Writing, Mathematics, and Science. The SSS portion of the FCAT is a criterion-referenced test. The secondary purpose is to compare the performance of Florida students to the performance of students across the nation. Student achievement and schools' success are both measured with the Florida Comprehensive Assessment Test (FCAT).

The Florida Comprehensive Assessment Test (FCAT) uses standard-referenced assessment to provide a snapshot of where students stand academically not in relation to each other, but in relation to their ability to reach educational standards set by the legislators. These expectations are outlined in the Sunshine State Standards. FCAT is included in the School Accountability Report that is used to identify critically low performing schools as well as high performing schools. FCAT is used for promotion and graduation purposes at the elementary, middle, and high school levels and to identify students in need of remediation in reading and mathematics to obtain feedback on curriculum and teaching strategies, and to gauge student progress. According to the Department of Education (2006) FCAT accesses high-level, challenging standards appropriate to the grade level assessed.

The Sunshine State Standards have been created through a school improvement and accountability initiative to reform education in Florida's public schools. The goal of this initiative is to raise student achievement to world-class levels. FCAT is designed specifically for Florida. It is based on the Sunshine State Standards, and measures how well students are progressing toward those academic standards at varying developmental levels. A set of written criteria known as rubrics is established for scoring students' responses. The FCAT Reading and FCAT Mathematics assessment are administered annually, in late February and early March, to all public school students in grades three through ten. Students' FCAT results are compiled to generate a rank for each public school under the Governor's A Plan. Under this plan, public schools receive a grade from A to F, depending on student performance and the degree to which the bottom 25% of the school has improved compared to its past performances. The higher a public school scores, the more funding it receives.

The system is designed to reward public schools for excellence in teaching; however, some educators and community members, claim that the program takes funding from schools that need it most. Many students, parents, and teachers criticized the Florida Comprehensive Assessment Test as a controversial standardized testing because it does not prepare students for the real world. Instead, teachers should be encouraged to teach students the essential material in the core subjects of English, rather than teaching students to pass a test. There is an ongoing debate among parents, teachers, administrators, politicians and the public in general about FCAT and the negative effects it has on Florida education system. FCAT is generally viewed as political and will result in destroying the public school system.

Recently *Florida Today News* (2005) reported in their opinion section that there is an urgent call from the public to Governor Charlie Christ requesting fundamental change to the FCAT. The article criticized an assessment method that uses one, imperfect test to determine who gets promoted, who graduates and which schools or teachers get bonus dollars in a state where education is chronically cash-poor. The claim is that this system is extremely unfair, if not unethical. Linking scores to cash cheapens the educational process, turning teachers into potential teach-to-the-test mercenaries, and children into pawns in a game to win dollars. Furthermore, the extreme pressures to boost FCAT scores are robbing students of time for non-test subjects, such as history, geography, arts electives as well as much-needed physical education classes. Despite the governor's insistence, the public believes that a standardized test is not the best way to assess teachers' performance or determine students' advancement.

2.8 Students' Attitudes to Mathematics

Students' attitude toward mathematics has been deemed an important factor in influencing participation and success in mathematics. It is commonly stated that LEP students show signs of anxiety when learning mathematics and this impacts upon their attitude**.** Poor attitude towards mathematics has been quoted as a factor that has contributed to student reluctance to participate in mathematics and have less success. Aiken (2000) claims that attitudes influence people in everything they do, being the determining factor of people's behavior. Students' positive attitude toward mathematics is critical for them to succeed in education.

If students are to make sense of what they learn, they need to participate in the classroom and the teacher should provide support for learning (Tobin & Fraser, 1998). However many studies have confirmed that attitude is the major stumbling block for progress and learning mathematics though technological aids such as computers have improved students' attitudes toward mathematics (Aiken, 2000). Consequently, students with positive attitudes towards mathematics are inclined to perform well while students with negative attitudes toward mathematics are likely to perform poorly.

Other studies have indicated that the use of computers in education is likely to change student attitudes positively towards mathematics and computers (Funkhouser, 1993; Ganguli, 1992) and that affective behaviors undergo far more sudden transformations than cognitive behaviors (Popham, 1994). It could be assumed that if students have a tendency to act positively toward a subject, for example, technology, then they will have more of an interest in that subject (Krathwohl et al., 1964). The effectiveness of computer-assisted instruction varies with different types of students and classrooms. Roach (2005) claims that technology in classrooms increases self-esteem and confidence, motivates students to learn, improves student attitudes, enhances social skills as students become more self-directed about their learning.

Baker, Gearhart, and Herman (1994) evaluated The Apple Classrooms of Tomorrow (ACOT) program and they also found evidence of positive student attitudes, and higher self-esteem among the users. Educators and researchers such as Robertson et al. (1987) witness the benefits of this positive attitude claiming that a reduction in negative reinforcement allows the student to learn through trial and error at his or her own pace; therefore, positive attitudes can be protected and enhanced.

Teachers in metropolitan schools such as Miami-Dade County constantly find themselves guiding students who are from diverse backgrounds. Research on teacher attitudes, student attitudes, and student content knowledge is essential for evaluating the effects of the SuccessMaker "Math Concepts and Skills" programs. Students' socioeconomic status in schools has long been regarded as an attribute that has impacted upon teachers' attitude towards students. Race or ethnicity along with poverty becomes one more aspect, to be associated with a low-status background. These factors sometimes influence teachers' expectations of LEP students who are encumbered by social and legal discrimination. Cotton and Wikeland (1997) alleged that educators differentiate among these students based on, race/ethnicity, socioeconomic status, gender, tracking, language, and negative comments about students. Many teachers who exhibit such disparity may not even be aware of their attitudes.

Numerous studies have indicated that the personality and behavior of the teacher is important in the formation of students' attitudes (Fennema 1995). Anderson (1991) found that teachers who are well-organized, achievement-oriented, and enthusiastic tended to have more positive mathematics attitudes (Fennema & Sherman, 1995). Tracz and Gibson (1986) argued that teachers with high levels of efficacy are more likely to expect that all students can learn, they feel responsible for that learning, than are teachers with low efficacy levels.

2.9 Summary

This chapter reviewed literature that focused on technology in mathematics education and its impact on the Florida Comprehensive Assessment Test (FCAT) test. The primary question in the research literature was to examine wheter or not SuccessMaker computer-based instruction had an effect on students' learning mathematics and their attitudes towards mathematics. Researcher studies supported the use of SuccessMaker as a means of increasing student's achievement. A considerable amount of research has been conducted in the area of mathematics achievement, computer–assisted instruction, and curriculum management. A summary of the findings of the literature includes:

- Political and social changes have brought about higher expectation in students' achievement in the United States at all levels.
- Reform in mathematics education places emphasis on raising academic levels of all students.
- The No Child Left Behind (NCLB) Act set goals for LEP students to meet challenging state academic achievement standards.
- Greater emphasis on high stakes testing has prompted greater scrutiny on what is being tested and how it relates to what students need to know to succeed in society.
- Significant investments in technology for schools to improve learning generally have been made.
- Presently, FCAT dictates technology usage and teaching for the test techniques in the mathematics classroom and laboratory within the Miami-Dade Public School System.
- Technology is used to improve selected mathematics skills that are designed to be measured, used as a tool, provides unlimited resources for students and teachers as well as provide a means of engagement for higher-order thinking skills.
- Widespread efforts are being made to provide the means to educate LEP students.
- Various learning problems are diagnosed due to the teaching and learning approaches using SuccessmMaker computer program.
- Evidence that technology supports improvements in student performance, student motivation, teacher satisfaction, and other important educational outcomes have been obtained through numerous credible research.

- Numerous studies support higher student achievement on the FCAT while using the SuccessMaker computer program.
- Numerous researchers support the notion that the integration of technology in mathematics has created confidence among LEP students and they are less fearful of the challenges in mathematics.
- Technology allows LEP students to explore and exchange ideas with a global audience and provides LEP students visualization for making learning connections.

The multiple Sunshine States Standards is one aspect of the ongoing reform that has impacted the education system in Florida. The use of computers for improving mathematics FCAT scores leads to individual pacing and the ability to reach students' success level. Consequently, individualized computer instruction is appropriate for improving student advancement on the FCAT mathematics test.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research questions, research methods, research design, and procedure for collecting data, survey instruments, as well as how the data was analyzed. This chapter is divided along ten broad sections starting with the following sections:

Section 3.1 presents the Introduction of the chapter, Section 3.2 outlines the research questions and Section 3.3 describes the Research Design. Section 3.4 outlines the Student Sample and Section 3.5 explains the Quantitative Data Collection Procedures. Section 3.6 explains the Qualitative Data Collection Procedures. Section 3.7 describes the nature of Triangulation and sections 3.8 and 3.9 describe the Quantitative Data Analysis and Qualitative Data Analysis, respectively. Section 3.10 explains the relationship between the research questions, data collection and analyses. Section 3.11 gives a summary of the chapter.

This study was designed to investigate how technology influences students' academic performance in mathematics and their attitudes towards mathematics. Bain and Ross (1999) state that the integration of technology within the curriculum and teachers' professional development increases students' achievement significantly. The study proposed to contribute information about student attitude and achievement in mathematics. The study examined the effectiveness of the implementation of a computer-assisted instruction program called SuccessMaker on student achievement on the Florida Comprehensive Examination (FCAT). Additionally, this study examined the relationship between the students' attitude towards and achievement in mathematics. Statistical analyses were conducted on variables such as computer scores, FCAT pre and post-test scores for Limited English Proficient (LEP) students to determine if the intervention had any effect on students' mathematical scores and attitudes.

English language learners referred to as LEP students are limited in English proficiency. A wide range of methods and standards are used for identifying students as LEP. In determining LEP status, the Department of Education establishes oral assessments of English language proficiency. Oral proficiency texts in English and home language surveys were the most common methods used by the districts to make this determination.

3.2 Research Questions

The major purpose of the study was to examine the effectiveness of technology integration in teaching mathematics and the effect on students' mathematics achievement and attitudes towards mathematics when students learned in a classroom or laboratory environment.

1. How does the use of technology in teaching mathematics in the class or in the laboratory influence LEP students' attitude towards mathematics?
2. How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' achievement in mathematics?
3. Are there any interactions between attitudes and achievement in mathematics for students taught mathematics using technology in different ways?

3.3 The Research Design

This study employed a variety of data gathering techniques: participant observations, FCAT pretests and posttests, interviews, target groups, and artifacts. Stake (1995) and Yin (1998) stated that in order to strengthen the research findings it should be done through multiple sources such as:

- Achievement tests to measure the cognitive aspects of the students' understanding of mathematics concepts;
- Surveys to quantify the affective attitudes toward mathematics, technology;
- interviews to collect accurate information from individual students and teachers

Others sources such as audiotapes, and field notes from every day lessons to measure social interactions among the students during the intervention, examination of concepts, and their effect among students.

This mixed methodology incorporated quantitative and the qualitative modes **(**Cohen & Manion, 1994; Keeves, 1997**).** The research design refers to the strategy to integrate the different components of the research project in a cohesive and coherent way (Trochim & Land, 1982). Numerous researchers in the field of education have recommended that quantitative and qualitative methods be combined in the same study (Tobin & Fraser 1998). Punch (1998) argued that both quantitative and qualitative data should be used because each has its own strengths and its weaknesses.

Quantitative data were obtained from the pre and post Florida Comprehensive Assessment Test (FCAT), class tests and attitude surveys. The advantage of the quantitative approach is that it measures the responses of a great many students to a limited set of questions, thus facilitating comparison and statistical aggregation of the data.

By contrast, the classic form of data is naturalistic, observation of participants in the context of a natural scene. The qualitative data in this study were obtained from interviews and classroom observations and were mainly concerned with obtaining the views of the teachers and the students about the issues being researched and to help researchers understand people and social and cultural contexts within which they work (Erickson, 1998). There are compelling reasons for including a qualitative approach within this educational study. Patton (2002) explains that qualitative research uses the natural approach that seeks to understand phenomena in context-specific settings.

3.3.1 The School Setting

Tropical Island Elementary School is located in North Bay Village, Florida and serves students in the North Bay Village area and a section of Miami Beach. These communities consist of low socio-economic families and a prominent middle class sector as well as newly immigrated Hispanic families. The school is identified for implementation of the federally supported program known as Title 1 for economically disadvantaged families. The current enrollment at Treasure Elementary Community

School is 1185 students in Pre-K through Sixth Grade. The ethnic distribution of the population is 85% Hispanic, 8% White Non-Hispanic, 4% Black Non-Hispanic, and 3% other. The school caters for a large bilingual educational population. This is an inclusion elementary school with many LEP students; the school provides the least restrictive learning environment in order to maximize the tools of learning as well as adapting to teach its core students.

Tropical Island Elementary School employs 78 full-time staff members. The leadership team is composed of the one principal, one assistant principal, one guidance counselor, one reading coach, two Title 1 resource teachers, grade level chairperson, and a media specialist. There are a total of 30 mathematics teachers and 42 multi-subject teachers on staff.

Tropical Island Elementary School provides basic education through the standard curriculum for students in kindergarten through sixth grade. The school also houses a Head Start and a gifted program. The Head Start program is geared towards the younger students who are starting their education, the gifted program allows students who are ahead of others in the classroom an opportunity to blossom and tackle more challenging education material. Additionally, the school offers Exceptional Student Education (ESE) units dedicated to offering services to mentally, physically, and emotionally challenged students. The curriculum embraces multifaceted educational initiatives that include the Comprehensive Research Based Mathematics (CRBM). CRBM is aimed at all students Pre-K to 6 Grade. According to Dr. Shannon Hardy of the Access Center (1991), the CRBM curriculum incorporates strategies to help students remember and learn in mathematics lessons. Hardy states that teachers have to use all tools available to engage and teach students. Using methods such as DRAW- (Discover the Sign, Read the Problem, Answer or Draw), a conceptual representation of the problem using lines and tallies and checks, is made.

At Tropical Island Elementary School educators are faced with various challenges namely: 3rd grade retention rate, students' Academic Improvement Plans, attendance/tardiness, and an alarming transient rate. Nevertheless, the school has maintained an "A" status for five consecutive years as evidenced by state performance tests. In order to reach that level of achievement the school has utilized coaching classes, a Saturday Academy, before/after-school tutoring, the SuccessMaker Math and Skills program, the Accelerated reader program, and Parental Involvement. One of the purposes of this study was to evaluate the effect of SuccessMaker program on students FCAT achievement in the 5th Grade at a South Florida elementary school when students are taught in a classroom or in a laboratory.

The FCAT task was administered as a pre and a post test before and after the laboratory and classroom mathematics intervention (see Section 3.3.2). The purpose of the test was to determine students' learning gains in mathematics within a semester and to rank schools according to students' gains on the FCAT test. Test materials are kept under tight security; administrators and teachers are trained to follow the test guidelines and they were forbidden to reproduce any part of the test materials. The students' final report on their achievement for the standardized test 2004-2005 FCAT results were sent from the State of Florida Department of Education to the school. Students' reports were sent home to parents.

3.3.2 The Teaching Intervention

The focus of this study is the influence of the SuccessMaker program on the FCAT scores and the attitudes to mathematics at this South Florida elementary school.

Classrooms were equipped with five computers each while the laboratory had 25 computers. SuccessMaker provided a research-based, balanced mathematics program for kindergarten through to 6th Grade and is used in combination with the mathematics text. Students had individualized support and instruction with fundamental mathematics, including concepts such as number recognition, numeration, counting, percentage, place value, regrouping, positive and negative integers, and the use of variables. By way of a little basic instruction, students have no difficulties manipulating the program. As students moved through each problem they are allowed to correct themselves if they do not have the right answer on the first try. The correct answers are confirmed by a voice reiterating what they have done. All the mathematics assignments have visual representation such as colorful pictures. The course is structured by strands or content areas. The objective in each strand is organized in increasing evenly spaced levels of difficulty and indexed by grade level units (Computer Curriculum Corporation 2000).

During the nine weeks period of the research at Tropical Island Elementary School, from January-March, there were numerous activities, including observations, students' surveys, and the analysis of student work. Fifth grade teachers maintained daily schedules for student doing Math Concept and Skills on the computer in the classroom and the laboratory. Each student was assigned a specific class time that remains constant throughout the study. Students had access to scrap paper and pencils, and the program itself contained a built in calculator for multiple step calculations. Students' class teachers manage the laboratory and generated weekly gains and managements reports and monitored the students. Students were encouraged to ask questions as they worked through the exercises. Scores were recorded on tracking sheets daily by the students in addition to data collected and recorded internally by the program. Students with low academic achievement often struggled with test and assessments because of comprehension difficulties, attention deficits and test anxiety.

Students attended the SuccessMaker laboratory daily for normally 15 minutes a session of mathematics. The entire class begins their session at the same time. The students in the laboratory are monitored closely by the teachers. Their questions are addressed immediately. There is one focus and that is working on the computer. There was a high level of discipline in the SuccessMaker laboratory along with high expectations for mastery levels. Students who complete their session before others work quietly on mathematics problems on a work-sheet that they took from the class with them. When students complete a problem correctly a yellow ribbon of approval popped up. When they fail to complete the problem correctly there is a comment "try again" and they are shown the correct answer.

Students' sessions within the classroom were geared to 15 minutes; 150 students worked for 15 minutes each in the computer laboratory daily, while the other group of 150 students work in their classroom for 15 minutes daily along with their teacher. There are 10 classes - five used the laboratory while five used their classroom. Five teachers took their students to the laboratory; while five teachers maintained their ongoing classroom computer schedule while the class was in session doing other activities. This is like a rotation; one student gets off the computer in the laboratory, one student gets on the computer in the classroom. This process takes almost all day for one class to complete daily.

In the laboratory all the students from one class get on the computer at the same time. The laboratory has 35 computers. All 5 groups have a schedule of computer time; as one class leaves the other class comes in until the all five classes have completed their sessions on a daily basis.

Consequently, students in the classroom worked on flexible schedules throughout the day. While the regular class were in progress five students worked on the computer each time. Five cups were turned down on each computer with individual students names. After the completion of each student's session the child removed their cup with their names and move away quietly. This allowed the teacher as well as the students to know who have done or not done their session. This schedule was followed until all the students had completed their sessions. Students maintain individual records of their scores for each session and they were rewarded for 80% or above of correct mathematics problems. Students working on the computer in the classroom were confronted with some form of disruption sometimes. There were times when students' questions could not be addressed immediately because the teachers were attending to other matters. Some students were reluctant to leave their assignments before it was completed so teachers had to check on students regularly to see if the session was done. Secondly, time was a factor and the entire class had to complete the session by 3pm. Reports were printed daily for reward as well as remediation. Motivational strategies were used throughout the year to keep students energized to do their best. SuccessMaker allowed students the chance for technology exploration.

3.3.3 SuccessMaker

The SuccessMaker program is a computer based mathematics software package designed by Pearson National Communications System. The aim of the program is to develop mathematical understanding, problem-solving skills, and critical thinking skills, making inferences and finding patterns. Instructional objectives are structured in strands, and each strand focus on either computation or application. The program is structured with a system with diagnostic and evaluative functions that automatically calculated each problem.

SuccessMaker individualizes instruction to the specific needs of the students and is designed to improve FCAT scores. Teachers enrolled students in the SuccessMaker program which diagnosed their functional level in mathematics, monitored different types of reports, assigned mathematics exercises, and provided immediate feedback to students and teachers. The in-depth criterion assessment provided the information needed to know exactly what expected teaching learning outcome students have and have not mastered. According to Haertel (1985), criterion-referenced tests provide a translation of test scores into a statement about the behavior to be expected of a person with that score or their relationship to a specified subject matter. The objective is simply to see whether or not the student has learned the material. As part of the school improvement plan, this study was designed to examine the program effectiveness on the FCAT in the school.

Students are empowered to work according to their learning needs with the SuccessMaker program. Students sign in their names and password and practise their mathematics concepts and skills on a timed session that lasted for 15 minutes daily. Every class was equipped with five computers while the laboratory had twenty-five computers. SuccessMaker Math Concept and Skills provided a research-based, balanced mathematic program for kindergarten through the 8th Grade; it is used in combination with the mathematics text. The course is structured by strands or content areas. The objective in each strand is organized in increasing evenly spaced levels of difficulty and indexed SuccessMaker grade level units (Computer Curriculum Corporation, 2000).

The program was developed to place students at a functional level. After 300 initial placement problems (IPM) the SuccessMaker program automatically places students at their functional level. Student placement at the correct level of difficulty is based on the student's actual work, not on placement tests. This procedure makes placement invisible to the students and occurs without the anxiety of testing.

Student data are stored automatically and students continue their individualized instruction with criterion-reference assessment throughout the school year. The assessment management is performance-based, indicating when students have learned particular content. Measures are referenced to particular levels in standards and testing programs. Students' varied abilities undoubtedly lead to uneven progress across the range of concepts and skills in a given curriculum. The concept and skills are organized into homogeneous strands such as fractions and word problems. Students work at appropriate levels within each strand.

To measure student success, the skill is assigned grade equivalent coding. For example a skill noted as 4.55 would be multiplication problem any 4th grade student in the 5th month of 4th grade should be able to complete this problem correctly. The integrated system does manage the delivery of the curriculum material so that students are presented with an individual program of study. The coursework responds with various strategies including a systematic review of mastered computation skills to ensure continued fluency. Roger, et al. (2001) claimed that SuccessMaker plots pathways through the curriculum matching the pace and level with individual student needs.

3.4 Student Sample

Three hundred participants were separated into two groups, referred as Group A and Group B each consisting of Grade 5 LEP students. Group A consisted of classroom students while Group B consisted of computer laboratory students. The curriculum for both groups was technology integrated within the mathematics program. Each group worked independently on computers for their Math Concept and Skills within either their classrooms or the computer laboratory. The students received instruction through discussions, debate, investigation and computer-integrated instruction while participating in a routine mathematics learning program. Students' achievements were posted in the classroom and they were given the opportunity to work with each other. The teacher facilitated the students' learning by serving as a guide and troubleshooter.

The mathematics computer activities in the laboratory and the classroom were designed for this research study; data were organized in charts, tables, and graphs and used as an indicator of the probability of students scoring proficient on this high stake test.

A group of 25 LEP students (13 girls and 12 boys) were randomly selected by their teachers for the qualitative part of the research which took the form of interviews. These targeted students are very involved in learning with computers, mathematics technology, classroom interactions, and they were considered to be able to provide honest responses. The school administrators and all the faculty members at the 5th Grade level supported this approach.

Initially, this researcher included the 6th grade students in the study to improve the size of the sample but although data were collected this aspect did not work out due to how the sixth grade students were allocated to the classroom and the computer laboratory and that they had a different curriculum.

With the exception of one teacher, all the others were very excited and willing to be involved even if this meant giving up their personal time. Each of the eight teachers was extremely consistent in ensuring that all their students worked on the computer as well as assisting the researcher with gathering data. Whenever there were disruptions in the schedule due to assemblies, the teachers adjusted their schedules so that they could maintain the SuccessMaker Math and Skill Program schedule.

Consequently, the study involved two groups of 150 students for investigating the research questions which refer to investigating mathematics attitudes and achievements in the classroom, mathematics attitudes and achievement in the class laboratory, and interactions between students' attitudes and achievement in mathematics. Permissions to conduct the study are shown in Appendices A and B.

3.5 Quantitative Data Collection Procedures

Quantitative data were gathered through the Test of Mathematics Related Attitudes (TOMRA) attitude survey and pre and post FCAT scores for the following purposes: to measure students' attitudes to mathematics, to determine the validity and reliability of the attitude as well as classroom laboratory instruments; to evaluate the FCAT activity in terms of students' achievements, and to evaluate interactions between students' attitudes and achievement towards mathematics. Data were analyzed to achieve the three goals of the research proposed in Research Design Section 3.2.

3.5.1 Test of Mathematics-Related Attitudes

An attitude survey was chosen as one of the primary data collection instruments. A survey was used to gather information from 300 students working in the classroom and in the laboratory as part of the quantitative portion of the study.

The Test of Science-Related Attitudes (TOSRA) (Fraser, 1981) was modified as the Test of Mathematics Related Attitudes (TOMRA) to measure students' attitudes towards mathematics. Questions were adapted to generate two scales: Attitudes to Mathematics Inquiry and Enjoyment of Mathematics Lessons. The responses were based on a five-point Likert scale used in this instrument. Scoring was as follows for items designated (+): strongly agree (5), agree (4), not sure (3), disagree (2), strongly disagree (1). Items designated (-) are scored in the reverse manner. Invalid or omitted responses were scored 3. A copy of the TOMRA is shown as Appendix C. Some of the questions are positively worded while the others are negatively phrased. The attitudinal surveys were administered before and after the 9-week period of instruction.

Table 3.1 Description and sample items for each scale of the Test of Mathematics Related Attitudes used in the mathematics classroom and laboratory.

Scale Name	**Description**	**Sample Items**
Attitude to Mathematics Inquiry	Acceptance of mathematics inquiry as a way of thought	I would prefer do mathematics activities than read about them (+)
Enjoyment of Mathematics Lessons	Enjoyment of mathematics experiences	Mathematics lessons are fun.(+)

3.5.2 Achievement Measures

Information on student achievement was obtained from the performance on SuccessMaker Math Concepts and Skills in the laboratory and classroom, and the FCAT pre- and post-tests that were administered on two occasions. The FCAT pretest was administered in January while the post-test was administered 9 weeks later in March. The tests were measured on Sunshine State Standards that are set by the Florida Department of Education. The two sets of tests comprised multiple choice questions, long and short responses that are timed for 40 and 60 minutes, respectively.

3.5.3 Class Tests

Students in grades 3-10 are required to take the Interim Assessment test during the school year. The tests are administered three times a year (fall, winter, and spring). Two assessments were made prior to the FCAT test and one was made after the test. The tests assess benchmarks within the Sunshine State Standards and are aligned to the District's instructional pacing guides so students have either 40 or 60 minutes to complete the tests. The mathematics item bank provides high quality items that are being used by classroom teachers on an as-needed basis to monitor student progress after instruction or intervention has taken place. A Sample Test is shown in Appendix D.

The Interim Assessment Program is an integrated assessment system designed to help classroom teachers monitor their students' attainment of the curriculum benchmarks outlined in Florida's Sunshine State Standards. The purpose of the Interim Assessment Program is to provide educators with meaningful and timely information about the academic achievement and needs of every student.

3.5.4 FCAT Reports

FCAT test scores is a recurring theme at this elementary school. Students take the FCAT standardized test yearly in early March. Test results of students are compared to the County and State. Treasure Island Elementary School scores in 2003-2004 revealed that the students were working slightly above average on mathematics in the county and the state. The above average test achievement is a feature of the school rating awarded by the county. Family influence, race, and economic standing are not evaluated in this study but they are important factors to be considered for future examination.

FCAT scores are reported in five Achievement Levels; Level 1-5. Students who score at Levels 3, 4, or 5 are performing at or above expectations and meet the requirements of the Sunshine State Standards. When student's achievement level improves from one year to the next, that student has made progress. A student also makes progress by scoring in the same Achievement Level for two years in a row. This is because the content assessed at the higher grade is more difficult. The FCAT score is used to determine a student's annual progress from grade to grade. Developmental scores range from 0 to 3008. Reports with demographic data are the same as the school, district, and state-level reports for all subjects tested. In these reports, data are disaggregated for racial and ethnic categories, gender, and other special categories, including standard curriculum, Limited English Proficient (LEP) students. Reporting results directly to students and parents were critical in helping them understand if their child has met state requirements for promotion or graduation. The effect of this improvement was that student performances across the grades were tracked across this scale. Third graders' scores were on the lower end of the developmental scale while the scores of tenth graders appeared on the higher end. As a student moves from grade to grade, his/her performance was monitored and compared to the performance of other students in Florida. Most importantly, the yearly progress of each student was reported by the change in the developmental scale scores (Florida Department of Education, 2008).

3.5.5 Computer Assignment

The Math Concept and Skills program is designed to improve FCAT scores. The need to raise FCAT test scores is a recurring theme at this elementary school. Students' gains in achievement were measured as the difference between the students' level at the end of the initial placement motion (beginning function level) and his or her current overall course average. Scores are reported on several scales: percentiles, grade equivalents, and normal curve equivalence. The percentile score shows how the student compares with a rank order of the norming group of students. Based on Kulik's (1994) meta-analysis research, he concluded that computer-based instruction individualizes the educational process to accommodate the needs, interests, proclivities, current knowledge, and learning styles of the student.

The goal of SuccessMaker program is to develop mathematical understanding, critical thinking, problem-solving skills, making inferences and finding patterns. Instructional objectives are organized in strands with each strand focusing on either computation or application. The Math Concept and Skill (MCS) program is a closed system with all diagnostic and evaluative functions automatically calculated.

To measure the students' success, the skills are assigned grade equivalent coding. For example, a skill noted MU 5.45 would be a multiplication problem any 5 the grade student in the 4th month of 5th grade should be able to complete correctly. The grade level score is calculated using the Sunshine State Standards and supplemental data accumulated from schools across the country. Grade level score is displayed in the students' program evaluation reports along with the students' time on task on the Mathematics Concept Skill gain score (See Appendix E)

3.6 Qualitative Data Collection Procedures

The qualitative data were collected through student interviews which were audio-taped, observations of lessons, discussion with students, teacher logs and teacher interviews.

3.6.1 Student Interviews

Fontana and Frey (1994) described interviewing as 'the art of science'. The interviews relied on the nature of the interactions with the interviewees for their quality. The major kind of interviews used in this study was semi-structured consisting of 20 questions (Appendix F). Semi-structured interviews are identified by Wallen and Fraenkel (2001) as verbal questionnaires. Hitchcock and Hughes (1989, p. 83) described this kind of interview process as the "semi-structured interview", because it allows depth to be attained by providing the possibility of the interviewer investigating and broadening the interviewee's responses. A dialogue between the interviewer and the interviewee can offer room for negotiation, and development of interviewee's answers. Therefore, Bernard (1988) concluded that the benefit of the semi-structured interview is that the interviewer is in control of the process of obtaining information from the interviewee, and is open to follow new leads as they appear. Based on the informal nature of this interview it tends to resemble a relaxed conversation (two-way communication), following the interest of both parties.

In regards to qualitative research, numerous scholars (Krueger, 1994; Lincoln & Guba, 1985) advised that qualitative researchers should cautiously develop their research questions in such a way that they can produce meaningful and useful data. Open-ended questions also help minimize the episode of directing or leading students to answer questions in a set manner.

The qualitative data were collected mainly through interviews. The researcher randomly selected 25 students (13 girls and 12 boys) who were actively involved with SuccessMaker Math Concept and Skills. Patton (1990) suggested that interviews provide very different data from observations; they allow the researcher to capture the perspectives of project participants, staff, and others associated with the project.

The interviews were conducted individually at the school in the interviewer's classroom while the other students were involved with their regular assignments with another teacher outside of their classroom. The classroom was a familiar and an accommodating area for the students' interviews. In this manner, efforts were made to guarantee that the physical environment was conducive to effective interviews.

Students were provided a list of 20 questions and they responded to them in both oral and written form. After reading the students' responses, some responses needed clarification. The interviews provided the opportunity to judge students understanding of the concept related mathematical ideas. The oral interview was conducted, recorded on audiotape and transcribed providing in-depth information. Spradley (1979) argued that interviews provide the opportunity for participants to explain themselves and their situations. Based on Erickson's (1998) recommendation, students were shown the transcription and as a result revisions were made. The main purposes for the interviews were to assess students' opinion about the mathematics activities on the computer and to gain additional insights on the responses given on the attitude survey.

According to Smith (1995) the advantage of the semi-structured interviews is that there is an attempt to establish relationship with the interviewee, the order of question is less important, and the interviewer is less restricted to probe interest area that arise, and the interview can follow the area of concerns or interest. The in-depth interviews also encourage capturing of respondents' perceptions in their own words, a desirable strategy in qualitative data collection. This allowed the researcher to present the meaningfulness of the experience from the respondent's perspective. The interview questions were based on students' views about mathematics and provided feedback on mathematics activities done in the classroom and laboratory. Southerland, Smith and Cummins (2000) argue that the freedom to ask for clarifications, focus on errors, misconceptions, and gaps in knowledge makes the interview more fruitful than more traditional methods of assessment.

3.6.2 Classroom Observations

At least once per week during the period of the study the interviewer visited each group that participated in the study. During these visits observations were noted in a logbook. A system was developed to guide the researcher's observations. Some areas that were noted were as follows:

1. The level of student interest and participation.
2. Students' level of interaction on SuccessMaker Math Concept and Skills.
3. Type of lesson - organized and clearly presented
4. The quality of interpersonal relations between the instructor and students.
5. Students' attitudes during the task
6. Students' achievement after the session
7. Time on task

Photographs of students working on the computers are shown in Appendix G.

Several discussions took place with the teachers which helped this researcher understand the events that took place while observing the classrooms. According to Adler and Adler (1994), the observation technique of data collection is often criticized for its limited validity as the researcher relies on his or her own beliefs thus making results more susceptible to bias. This point was taken into account during the data collection and analysis.

Group A - Students in the classroom These students worked on the computers in the classroom daily for 15 minutes. A list of names posted next to the computer. As soon as students had completed their 15-minute session they would walk quietly and touch the student whose name is next on the list. The process was slow because the students had to take turns. There were also distractions sometimes that slowed the process further as well as some students trying to listen to the teacher who was teaching at the same time as the students were using the computer.

Group B – Laboratory Students These students worked on the computers in the laboratory daily for 15-minutes. These students had their own computer and start the 15-minute task at the same time during the one hour lesson. A few of the LEP students may take a few extra minutes. The students were extra quiet because the distractions were less; teachers were not teaching lessons during this time, so students worked diligently on the computer. When the students completed their session early, they were able to work on the mathematics sheet that they took from their class assignment. Teachers walked around giving assistance where it was needed the entire laboratory session.

On a whole, students were fully engaged during the sessions in both classroom and laboratory and they displayed a positive attitude. There were no disruptions from the class because they focused on the task at hand. The researcher as well as the class teachers moved quietly around and observed the students. The successes as well as difficulties were noted and the students were excited about their achievements. A short discussion at the end of the class revealed that students wanted their sessions to be extended. Students as well as teacher showed a lot of interest in the program. Verbal and non-verbal communication was also noted. Some of the students did not mind working independently, others wanted the computer learning with teachers as a guide, while some other students could work either way.

3.7 Triangulation

Triangulation is a key tenet of the approach in gathering data for this study and a wide variety of evidence was gathered for the purposes of triangulation. MacLean and Mohr (1999) have recommended several ways teacher researchers can analyze the data that they have collected. As opposed to relying on one single form of evidence or perspective as the basis for findings, multiple forms of diverse and redundant types of evidence are used to check the validity and reliability of the findings (Wiggins, 1998). Over-relying on any one form of evidence may impact validity of the findings. By using multiple forms of evidence and perspectives, a truer portrait of the student can be developed (Wiggins, 1998).

The two basic goals in questionnaire design were to obtain information relevant to the purposes of the survey, and to collect the information with maximal reliability and validity. The statistical methods used to establish validity and reliability are discussed below.

3.8 Quantitative Data Analyses

3.8.1 Reliability of the Instruments

Reliability refers to the extent to which assessments are consistent; the smaller the reliability, the larger the error, and in contrast the larger the reliability the smaller the error. The reliability of a research instrument concerns the extent to which the instrument yields the same results on repeated trials. Carmines and Zeller (1979) explained that the tendency toward consistency found in repeated measurements is referred to as reliability.

3.8.2 Validity of the Instruments

Validity is the extent to which a test measures what it claims to measure. It is vital for a test to be valid in order for the results to be accurately applied and interpreted. The two basic ways of validating and refining survey instruments in this study is to look at the interview survey and the FCAT test scores. The interview survey sought a positive correlation between the SuccessMaker use and FCAT test scores.

3.8.3 FCAT Scores

The evaluation instrument used in this study was the Florida Comprehensive Assessment Test (FCAT), used a pre- and post test. The test was developed by the Florida Department of Education for assessment purposes for measuring students' achievement at different grade levels. The Florida Comprehensive Assessment Test is a norm-referenced test as well as a criterion-reference test that measures individual student performance against national norms. FCAT is designed specifically for Florida students; it is used for promotion and graduation purposes at the elementary, middle, and high school levels. Student reading and mathematic scores are reported in three ways, by achievement level, by scale score, and by developmental score. The scale scores, range from 100 to 500 for each subject area and grade level; they are divided into five categories from 1 (lowest) to five (highest), called achievement levels. The developmental scale score was introduced to track student progress over time and across grade levels. By using FCAT developmental scores, parents can monitor their student's academic progress from one grade to the next. The FCAT Score is used to determine a student's annual progress from grade to grade. Developmental scores ranged from 86 to 3008. FCAT Scores are equated to the base year so score from year to year can be compared. For example, for Grade 10 Reading and Mathematics, the base year is 1998. Equating means that even though a grade level test may contain different questions, each student who performs at the same skill level in different years will earn the same FCAT score. The FCAT Score is used to determine a student's annual progress from grade to grade.

3.8.4 Statistical Analysis

Data collected were statistically analyzed to check the validity and reliability of instruments in the study (see Chapter 4). Analysis of variance (ANOVA) was used to determine the ability of each attitude scale and the FCAT scores to differentiate between the students in the classroom and laboratory. The statistics calculated provided an estimate of association between the both laboratory and classroom students and the FCAT scores. The Laboratory and Classroom students were used as units of analysis.

3.9 Qualitative Data Analyses

Qualitative modes of data analysis provide ways of discriminating, investigating, comparing and contrasting, and interpreting meaningful patterns or themes. Stainback and Stainback stated that "qualitative researchers seldom claim that their reports are totally unbiased....they do try to let the reader know, to the best of their knowledge, what their perspectives and biases were and how they collected and analyzed their data, to allow the reader to judge for him or herself the potential usefulness of the findings" (1988, pp.83-84).

3.10 Combination of Quantitative and Qualitative Analysis

The data from achievement tests, surveys, audiotapes, and interviews were examined to observe the results the technology intensive units had on students' attitude and achievement. A large amount data were analyzed to provide a detailed view into how the students responded to the activities and the technology during the instructional period. The analysis of these data is described in the next chapter.

Table 3.2 Relationship between research questions, data collection, and analysis.

Research Questions	Data Collection	Data Analysis
1. How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' attitude towards mathematics.	TOMRA scales Inquiry Enjoyment	Reliability Table 4.1 ANOVA Tables 4.2 and 4.3 and Figures 4.1 and 4.2
2. How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' achievement in mathematics?	FCAT Pre-tests and Post-tests Grade Tests	Tables 4.4 and Figure 4.3 t-tests Tables 4.5
3. Are there any interactions between attitudes and achievement in mathematics for students taught mathematics using technology in different ways?	Classroom compared to Laboratory	Table 4.6

The data were combined to produce a view of cognitive development during the instructional period, affective development toward mathematics, and cooperative interactions among group members. The intention was to see if the instructional period enhanced the students' conceptual development, affective development, and cooperative interactions within the instructional setting for these LEP students.

The relationship between the research questions, data collection, and analysis is shown in table 3.2.

3.11 Summary

This chapter described the research questions, research methods, and sample size, procedures for collecting data, interviews, survey instruments, and how the data was analyzed. They were examined to observe the effects of technology on FCAT scores when students were taught in the classroom or in the laboratory. On a whole, the methods can be described as a mixture of quantitative and qualitative approaches. Denzin (1978) identified this process as methodological triangulation, because it involves the convergence of data from multiple data collection sources.

Three hundred students responded to the mathematics attitude survey, they learned mathematics through technology – either in the classroom or in the laboratory - and responded to the FCAT pre- and post-tests. The two sub groups consisted of 150 students each and this formed both the quantitative and the qualitative parts of the study. The qualitative data from 25 students from each group were used to balance different information presented in the study.

CHAPTER 4

RESEARCH FINDINGS

4.1 Overview of Chapter 4

The purpose of this chapter is to report on the findings as a result of the data analyses. This chapter discusses the TOMRA instrument in terms of reliability and validity and the responses to the three research questions are addressed. This study evaluated the claims of the effectiveness of integrating technology in mathematics and the impact it has on the FCAT scores for the 2004-2005 school years in the classroom compared to in the laboratory.

Section 4.1 presented the Overview of the chapter 4, Section 4.2 presents Quantitative Data in terms of the three research questions and Section 4.3 describes the Qualitative Data obtained from the student interviews. Section 4.4 presents the Summary of the Chapter.

4.2 Quantitative Data

4.2.1 Response to Research Questions based on the Quantitative Data

The first analysis was concerned with the reliability of the two scales of the Test of Mathematics Related Attitudes. As shown in Table 4.1, there was a range of Cronbach-alpha reliability values for the pre-test and post-tests for both the classroom instruction group and the laboratory instruction group for both scales. The high post-test Cronbach-alpha values of 0.83 and 0.82 for the Attitudes towards Inquiry in Mathematics scale and the Enjoyment of Mathematics Lessons scale, respectively, in the classroom instruction group provides some confidence about these responses. The pretest values for the Attitudes towards Inquiry in Mathematics scale for the classroom instruction group and the posttest value Enjoyment of Mathematics Lessons scale for the laboratory instruction group are also acceptable values according to Nunnally (1978) with 0..69 and 0.60, respectively. However, the low reliability values of 0.40 for the pre-test on the Attitudes towards Inquiry in Mathematics scale for the classroom instruction group and 0.33 for the Attitudes towards Inquiry in Mathematics scale for the laboratory instruction group are very low so discussion of the analysis of this scale must be considered with some caution.

Table 4.1: Reliability coefficients of dimensions of TOMRA for Grade 5 students in classroom-based instruction and laboratory-based instruction

	Classroom instruction (N = 150)		Laboratory instruction (N = 150)	
TOMRA scales	Pretest	Posttest	Pretest	Posttest
Attitude towards inquiry in mathematics	0.40	0.83	0.41	0.33
Enjoyment of mathematics lessons	0.69	0.82	0.52	0.60

4.2.2 Response to Research Question 1: How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' attitude towards mathematics?

Attitude to inquiry scale

Responses to the attitude to inquiry scale are shown in Table 4.2.

Table 4.2: Descriptive statistics of students' attitude towards inquiry in mathematics between classroom-based instruction and laboratory-based instruction in Grade 5

Measure	Classroom instruction (N = 150)		Laboratory instruction (N = 150)	
	Mean	SD	Mean	SD
Attitude towards inquiry in mathematics (pretest)	3.13	0.54	3.10	0.53
Attitude towards inquiry in mathematics (posttest)	3.00	0.91	3.24	0.65
Difference Score Post-Pretest	-0.13		+0.14	

The data revealed that for the classroom instruction group the mean score went down from 3.13 to 3.00 and for the laboratory instruction group the score increased from

3.10 to 3.24. All these mean scores were close to the central point of neither agree nor disagree and there were no statistically significant differences between the mean pre and posttests for either group. There was a statistically significant difference between the pre and post difference scores for the two modes of instruction (F=7.27, $p < .005$) and these data are illustrated graphically in Figure 4.1.

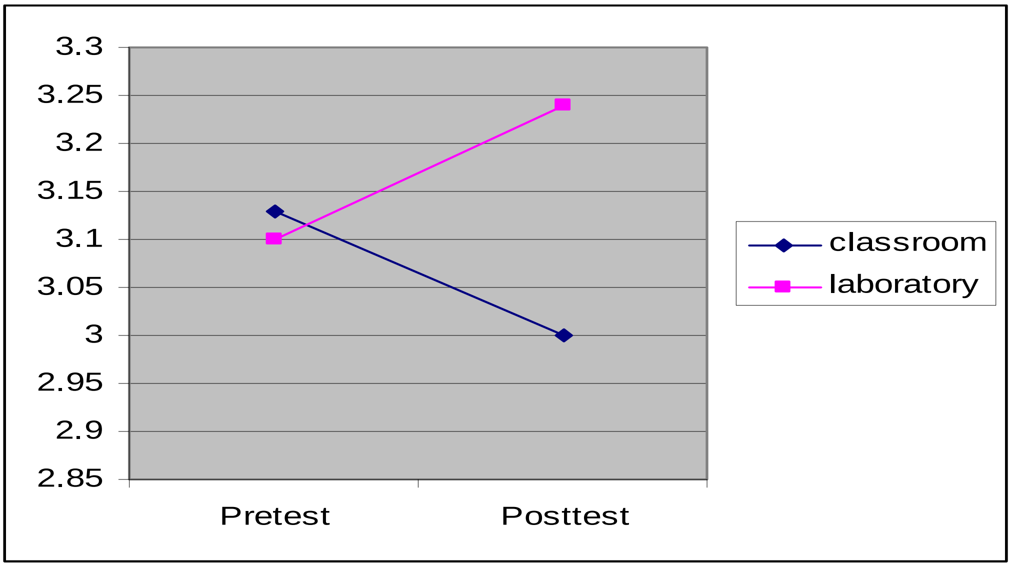

Figure 4.1: Comparison of students' attitude towards inquiry in mathematics between classroom-based instruction and laboratory-based instruction in Grade 5

Enjoyment of mathematics lessons scale

Responses to the enjoyment of mathematics lessons scale, shown in Table 4.2, revealed that for the classroom instruction group the mean score decreased from 2.99 to 2.84 and for the laboratory instruction group the score increased from 3.08 to 3.10. As in the attitude to inquiry scale, all these mean scores were close to the central point of neither agree nor disagree though the mean score for the posttest for the classroom instruction group had more of tendency to disagree with the positive statements about enjoying mathematics. There were no statistically significant differences between the mean pre and posttests for either group and there was no statistically significant difference between the pre and post difference scores for the two modes of instruction (F= 2.36, p = 0.128) and these data are illustrated graphically in Figure 4.2. In other words in neither the laboratory nor the classroom did students increase or decrease their enjoyment of mathematics during the nine weeks of implementation.

Table 4.3: Descriptive statistics of students' enjoyment of mathematics lessons between classroom-based instruction and laboratory-based instruction in Grade 5

Measure	Classroom instruction (N = 150)		Laboratory instruction (N = 150)	
	Mean	SD	Mean	SD
Enjoyment of mathematics lessons (pretest)	2.99	0.73	3.08	0.65
Enjoyment of mathematics lessons (posttest)	2.84	0.95	3.10	0.67
Difference Score Post-Pretest	- 0.15		0. 02	

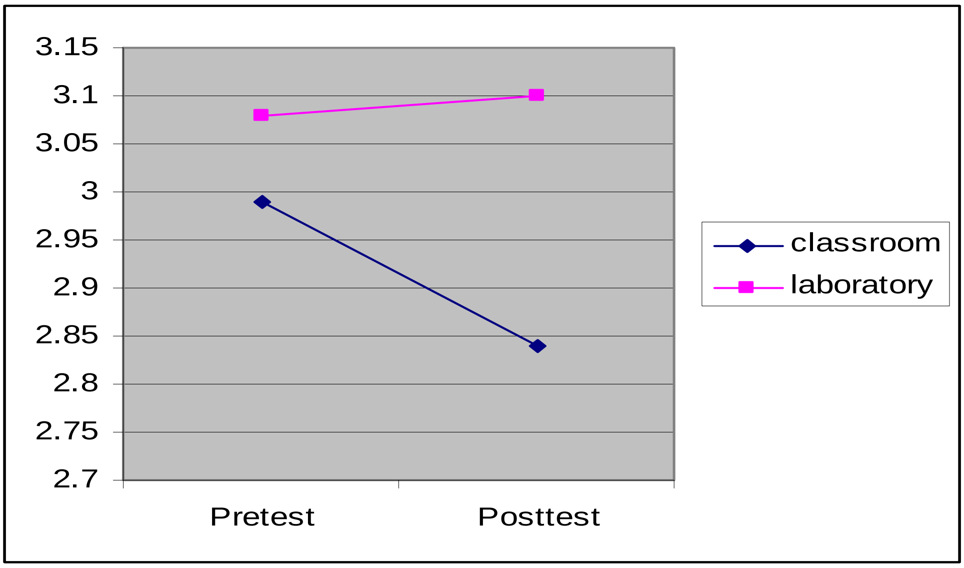

Figure 4.2: Comparison of students' enjoyment of mathematics lessons between classroom-based instruction and laboratory-based instruction in Grade 5

4.2.3 Research Question 2: How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' achievement in mathematics?

FCAT standardized test

The component of the study to measure achievement in mathematics after the instructional period for this study was the FCAT standardized test. The FCAT showed an increase in achievement scores from the pre-achievement test to the post achievement test for both the Classroom Group and the Laboratory Group after the nine weeks of the implementation.

As shown in Table 4.4, the FCAT scores for the Classroom Instruction group increased by 115 from 1495 to 1610 and for the Laboratory Instruction group by 95 from 1539 to 1634. This evaluation showed that the differences in improvement in FCAT scores for students in both instructional programs were not statistically significant ($F = 1.35$, $p = 0.246$). However, after nine weeks of implementation there were statistically significant differences using paired sample t-tests between the pretest FCAT and posttest FCAT scores for the Classroom Group ($t = 9.40$; $p < 0.0001$) and the Laboratory Group ($t = 7.42$, $p = 0.000$)

Table 4.4 Comparison of students' FCAT scores between classroom-based instruction and laboratory-based instruction in Grade 5

Measure	Classroom instruction (N = 150)		Laboratory instruction (N = 150)	
	Mean	SD	Mean	SD
FCAT scores (pretest)	1495	231	1539	282
FCAT scores (posttest)	1610	169	1634	221
Difference Scores Post-pretest	115		95	

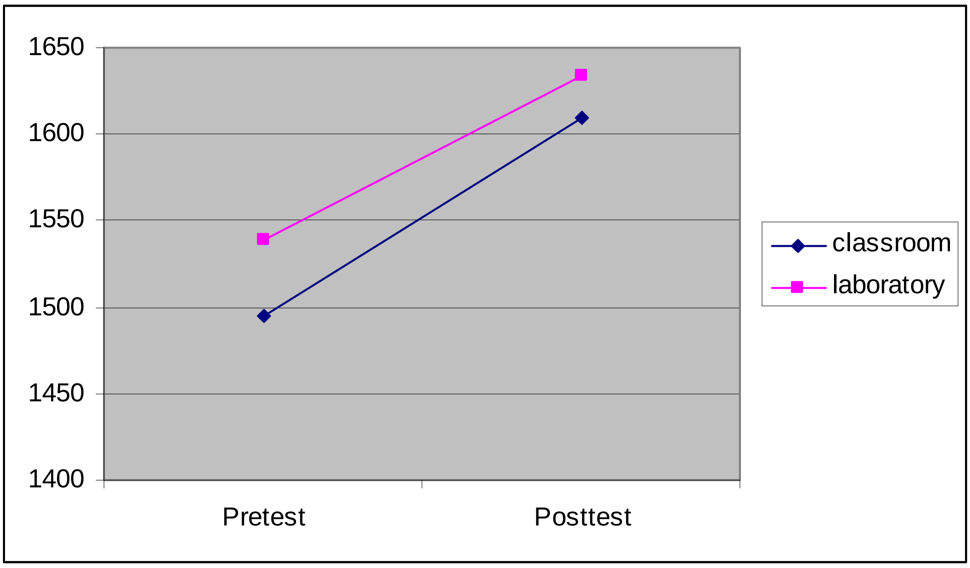

Figure 4.3 Comparison of students' FCAT mean scores between classroom-based instruction and laboratory-based instruction in Grade 5

Mathematics Marks

The Mathematics tests included multiple-choice questions for Grades 5 students with short and extended responses (see Appendix D for an example). Performance tasks required students to analyze the question, find a way to solve it and write a detailed explanation of the solution in their own words. Answers included charts and graphs. Mathematics questions were selected from previous years' FCAT questions. Scores were presented to students in letter form A, B, C, D, with F indicating total failure. Teachers monitored the test throughout the entire session.

Table 4.5: Comparison of students' mathematics marks between classroom-based instruction and laboratory-based instruction in Grade 5

Measure	Classroom instruction (N = 150)		Laboratory instruction (N = 150)		t values	Effect size (Cohen's d)
	Mean	SD	Mean	SD		
Mathematics marks	52.94	16.51	41.85	16.06	5.90**	0.68

**$p < 0.001$

On the mathematics tests, the mean score of the classroom instructed group (52.94) outscored the mean score of laboratory instruction group (41.85) by 11.09 points. This difference was statistically significant ($t = 5.90$, $p < 0.001$) with an effect size of 0.68.

One explanation for these differences is that there were more level 2 and 3 LEP students in the classroom than the laboratory. All LEP levels are distributed throughout the classes. Although not planned, overall there were more level 1 students in the laboratory group. Level 1 students are the ones who have just start learning English. Naturally, the activities on the test are complex with multiple challenges. Although they are limited in language skills they are given the same grade 5 mathematics test. During the mathematics test, the level 1 LEP students' learning tasks were not adjusted in terms of linguistic complexity, so the mathematics test were not as simple for them as it was for other students. Unique mathematical terms, symbols, and expressions that occur in mathematics discourse present major difficulties for these Level 1 students to clarify their mathematical thinking as well as solving the problems. In brief, the lack of proficiency in English may have contributed to this significant difference. A few of these students were new to the country as well.

4.2.4 Research Question 3: Are there any interactions between attitudes and achievement in mathematics for students taught mathematics using technology in the classroom and in the laboratory?

As shown in Table 4.6, associations between students' attitude within the classroom and the laboratory were investigated by the use of simple correlation and multiple regression analyses by using two units (classroom and laboratory mean.). The regression analysis was used to study the associations between the FCAT posttest scores and the posttest means of the TOMRA dimensions. The relatively low R (and hence R^2) values for both modes of instruction indicate low associations which are also not statistically significant between the FCAT posttest scores and the posttest means of the Interest and Enjoyment factors. The posttest Enjoyment factor makes the stronger unique contribution in explaining the FCAT posttest scores (dependent variable) in both modes of instruction. However, this contribution is not statistically significant in both modes. Also, the correlations between the posttest Interest and

Enjoyment factors in both modes of instruction appear to be relatively low and not statistically significant.

Table 4.6 Simple correlation (r), multiple correlation (R) and standardized regression coefficient (Beta) for association between mathematics attitude scales and mathematics achievement scores (measured by FCAT) for students in the classroom and laboratory instruction groups (N=300)

TOMRA Scales	FCAT posttest score			
	Classroom Instruction (N = 150)		Laboratory Instruction (N = 150)	
	r	β	*r*	β
Attitudes towards mathematics inquiry	-0.02	-0.12	0.03	0.01
Enjoyment of mathematics lessons	0.05	0.13	0.09	0.08
Multiple regression, R	0.09		0.09	

4.3 Qualitative Data Obtained from Interviews

4.3.1 Overview

Twenty-five students from each instructional group (12 boys and 13 girls) were interviewed individually subsequently to their answering of the TOMRA instrument. The interviews were conducted in February through March in the classroom and in the library and took place during and after school hours. Ten individual interviews and six group interviews were conducted. Interviews were focused on students doing mathematics assignments on the computer and the way they enjoy the activities.

Student interviews were held on the school site during January/February 2004-2005 school year. Students' responses to the questions were aimed at gathering information on their use of computer in their mathematics class. Interviews were conducted with individual students (see Appendix G for an example) as well as with groups of five students (see Appendix H for an example). A semi-structured interview approach was used where questions were structured around a number of areas, namely, students' experiences, and background of using computers in their mathematics class, if they believed learning took place, if working on the computer improved their work, as well as how the addition of computers influenced their interaction with their peers (see Appendix I for an example). Students were probed for any development or adjustments that they would prefer to see in their computer class. The interview framework was flexible as students discussed different questions that related to their experiences. The author used discretion in allowing some students to expand outside of the interview framework and the relevant portion was pursued in the investigation.

In this section, for each of the 20 interview questions, selected student responses and a summary of those responses for each instructional group is presented. In the following part of this chapter, Section 4.4, aspects of these interviews are used to respond to the first two research questions.

4.3.2 Group A: Classroom-based Students

The researcher had a discussion with the students advising them of the interview, that there was no need to be anxious, and to provide the best answers to the questions. Six students had individual interviews and five group interviews were conducted. These answers are based on fifth grade students whose responses were representative of the others.

1. Have you worked on computer since the beginning of the school year?

Most of the students indicated that they have worked on the computer since the beginning of the year. Two students stated that they have just started to work on the computer.

> You know that it is fun to work on the computer. But I really need longer sessions on the computer. Students should have lots of games especially mathematics games. The computer is useful because I learn a lot more.

Out of 25 students, 23 students stated that they have used computer since the beginning of the school year. Two students started that they were new to the country and their only experience was limited to playing a few games on the computer at home.

2. Did your teacher provide clear instructions for you to use the computer?

All the students' agreed that the instructions were clear during and after the orientation. They praised the demonstration of the icons and how the program being used. These students did well on the icon quiz.

> I love the instructions; it was clear to me. Yes, some of us kids don't know what the icons mean or how to fix the computer when it froze up. The computers give problems sometimes. The teacher fixes it or gets the technician to do it. When kids don't understand something they put up their hands and the teacher explains it over and over.

Out of 25 students, 24 stated that their teachers provide clear instructions while 1 student, stated that the instructions are difficult for him to understand or remember sometimes.

3. Was it difficult for you to use the computer to do your mathematics assignment?

All the students expressed their excitement in doing mathematics on the computer although it was difficult for three students. The three students were still learning mathematics vocabulary words so they commented that they do not understand all of the words sometimes.

> Mathematics is fun we should do it most of the day … I love the computer because of the pictures, graphics and sound. Using the computer to do mathematics is good because it corrects you right away. I wish we could take our mathematics test on the computer.

Out of 25 students, 22 students stated that they have no difficulties while three were struggling with understanding English and applying mathematics skills.

4. Did you feel uncomfortable during any part of the assignment? Explain the answer.

Only five students stated that they were uncomfortable sometimes because they wanted all the problems to be correct and it makes them feel anxious. Sometime they are fearful of clicking the answers. Due to the timing on the computer they feel that they are being rushed. The other students were comfortable doing the assignment on the computer.

> I don't like that clock, if I take too long to put my answers down then it mark my work wrong. I always remember to hurry up before it's too late. We do not have problems with working on the computer.

Out of 25 students, five stated that they were uncomfortable because of the built in clock that time them with each problem. Twenty students are comfortable with the assignment.

5. What did you like about working in the classroom on the computer?

Some students prefer to work on the computer in the classroom because of its flexibility. They stated that they love their classroom and they are more focused and get a lot done. They claimed that there is more help available for them.

> The time looks longer in the classroom and you can get back to your work right away. I don't need to wait for the slow ones. No one knows if you take too long, only the teacher. The scores with the stars hanging on the wall makes the kids feel great.

Out of 25 students, 18 students like to work in the classroom independently; while seven students stated that they get can get more assistance from their peers and that is why they like to work on the computer in the classroom.

6. What did you dislike about working in the classroom on the computer?

Some students dislike the idea of waiting on other students to get off the computer in the classroom so that they can have their turn. Some students stated that they do not like the constant movements in the classroom while others love the working environment.

> Some students skip you and take your turn when you are not looking.

> Most of us listen what's going on in the class and that causes us to make mistakes.

> Only LEP student's levels 1 & 2 use the headphone for mathematics. We should all have headphones so we can't hear what's going on in the classroom.

Out of 25 students, 22 students favored the classroom while three students seem to have mixed views concerning their dislike.

7. What activity or activities did you enjoy this year?

Most of the students rated physical education as being most enjoyable, while three stated that they were fascinated with the science experiments. Three students considered them selves as "book worms" who wanted to read all the time because they enjoyed it.

> I love football. I go to practice everyday. Guess what… I will be a pro one day. I hope to play for the "Dolphins.

Out of 25 students, 19 students liked to work on the computers and enjoyed physical education. Three students favourite activity is reading while another three favour science experiments.

8. What activity or activities you did not enjoy this year?

Most students detested the interim testing which consisted of mathematics and science items. They all stated their frustration about the ongoing testing in mathematics and science.

> The interim tests make us nervous…it was difficult and we don't like it. Why do we have to take it; its crazy, we don't know most of the answers to the questions anyway. We may fail it. Only two students may pass because they are super smart.

Out of 25 students, 20 students were terrified of the interim testing while five students hated any form of testing.

9. What career would you like to engage in? What motivates you to pursue this career?

Ten students selected professions that involved mathematics, while nine students wanted to be professional athletes while the other six students selected trade-related fields. Most of the students stated that they decided on this career after meeting the professions during Career Day at Treasure Island Elementary School. Other students stated that they wanted to be like their parents who are in the same profession.

> Mathematics is fun like being an accountant or a salesman… they make a lot of money. Athletes such as footballers and basketball players have lots of fun and they earn more money than everyone. You know, yea, that’s the way we can buy the biggest mansion, pretty cars and just about everything in the world. A doctor and a nurse help people and that is the reason for wanting to go in that career.

Out of 25 students, 10 selected professions that involved mathematics, nine students wanted to be professional athletes while the other six students selected health-related fields.

10. Would you like to attend college? Explain your answer.

Eighty percent of students wanted to go to college while the other students wanted to attend a vocational school to learn a vocational skill. They stated that they wanted good paying jobs as the reason that they wanted to go to college.

> My mom says that she wants me to go to college so I can be rich and have a better life. I want to be a baby doctor.

Out of 25 students, 20 students wanted to go to college while five students wanted to attend a vocational school.

11. What kind of jobs are your parents involved in?

Students’ responses ranged from nurses, homemakers, carpenters, clerks, handyman, escort, and teacher’s aide and police officer.

> Some moms stay home. They take care of the babies. You know there are lots of bills that my parents have to pay. They have to go to work and it's long hours on the job.

All parents of the 25 students are involved in some kind of professional work; there are six nurses, four homemakers, three carpenters, four clerks, two escorts, and three teachers, one police officer and two postal workers.

12. Do you use mathematics in your every day lives? Explain your answer?

The students were eager to discuss the different types of mathematical problems that they apply to their everyday lives. They identified many areas.

> Yes. We buy food, clothes… I can tell the time… measure my juice and use percentage when there is a sale in the store. You know... I set my alarm clock and goes off every morning at 7 am so that we can be here in school on time. Its fun picking up the groceries'... I watch the weight, calories, pound and ounces, as well.

All 25 students stated that they use mathematics in their daily lives. They gave clear explanations as in the comment above.

13. What is the reaction like among your classmates after the computer session and the reward stars are posted based on the computer scores?

Students were elated but anxious as they push themselves to score higher. They love the reward ribbon each time they get a correct answer. They pointed out areas that they don't understand so that the can get help. A few students stated that they would like the scores to be a private. They don't like other students looking at their scores.

> I am so happy… it's a high score. Students always keep a check on these stars. You know five reward stars can trade in for a "no homework" pass. Wow! Smiles everywhere. We can't wait for the reward ribbon after the morning assembly.

Out of 25 students, 19 had a positive reaction towards posting of the scores and the reward stars. Six students thought that after the computer session the scores should not be posted, the reward stars should be done privately.

14. Does working on the computer help you to understand some of the mathematics skills?

The students' answers were positive. They mentioned how comfortable they are because the computers help them to understand the mathematics problems. The students contributed their understanding of the mathematics problems to the visuals and the tools that they accessed readily on the computer. They argued that the immediate feed-back helped them to review and make corrections to the problems.

> It is the computer that makes me so good at doing mathematics this year. Yea, I am a champ now. I use to struggle so I tried and tried …I solve the problems by just getting the help from the computer. In class you get frustrated sometimes because you don't know how to do the problems. It is different on the computer… there is no fear.

Out of 25 students. 24 students stated that working on the computer help them to understand the mathematics skills. One student said that he hated mathematics and did not want to learn it anywhere.

15. Are there any changes that you would like to see to improve your work on the computer?

Some students stated that they needed extended time on the computer. Some students said that speed games that related to their standard will increase their thinking as well as working faster on the computer. Two students think that more vocabulary words should be introduced because they are LEP students who don't understand all the words.

> Fifteen minutes for mathematics is way too short for us kids. I need more time. Time-tables speed games would be fun on the computer.

Out of 25 students, 22 students wanted changes that will improve their work while three students did not need any changes.

16. Would you like to do more mathematics daily with the teacher or on the computer? Why?

Over half of the group wanted to do mathematics daily with the teacher, while the others wanted to do mathematics on the computer. They also claimed that the computer cannot explain when they do not understand.

> I prefer the computer because I am not embarrassed when my problems are wrong. My classmates don't know my score and I get and the computer helps me. You know…. we love the illustrations and the mathematics symbols. The symbols remind us kids constantly of what should be done.

Out of 25 students, 16 students wanted to do more mathematics with the teacher while nine only wanted the computer.

17. Do you learn from each other on the computers? Explain your answer.

The students stated that sometimes they learn from each other. For example, when a group of students are having the same problem (simplifying fractions) the teacher set short sessions on that skill and we worked in pairs on the problems. Other times they don't because of the different levels each person is on. The students helped each other with translation from English to Spanish.

> You see, I am just learning English so the other kids read to me and explain to me sometimes.

All 25 students stated that they have learned from each other on the computer.

18. Do you feel that teachers should be replaced by computers?

This question generated a lot of discussion for and against. On a whole the students think that they would have too many difficulties without the teacher. They were concerned that very little class assignment would be done.

> Computers are fun but we need teachers. I would play around a lot.
> Teachers are more needed I guess. Some of us think that the school should do a little experiment test by giving us the computers only for one week then we would see how it works. Who would be in charge of us?

Out of 25 students, 22 students felt that teachers should not be replaced by computers. Three students felt that it would be great for them to only work with a computer.

19. How do you interact with mathematics lesson on the computer versus the teacher?

Some of the students feel more comfortable with interacting with the computer than the teacher when doing mathematics.

> I love to use the computer, it explains the lesson to you and I don't have to wait on the teacher.

Out of 25 students 17 students stated that they interacted well with the computer while eight students have some difficulties.

20. Is the program the Math Concept and Skills adequate for you? Explain why?

The students stated that they loved the program although it gets difficult sometimes. The group was concerned about the way some of the problems are presented. It has too many word- problems.

> This is our favorite program, it is great. Yeah, we learn a lot. Sometimes its hard because of the word problems. Yeah … its too much reading, they can set out the problems without the words.

Out of 25 students, four students found the program difficult for but still thought it is a great program. Twenty one students praised the program immensely.

4.3.3 Group B Laboratory Students

A group of 25 students participated in Group B doing mathematics in the laboratory. The researcher had a discussion with the students informing them of the interview, that there was no need to be anxious, and they were encouraged to answer the questions honestly. Six students had individual interviews and five group interviews were conducted. These answers are based on fifth grade students whose responses were representative of the others.

1. Have you worked on computer since the beginning of the school year?

The students indicated that they have worked on computer since the beginning of the year. Only two students were not a part of the call at the beginning of the school year so they had not had to work on the computer.

> The more I use the computer the easier it is. I love working on the computer because I get to work on my own. I'm really good at the games and sometime try to beat the clock.

Out of 25 students, 22 students indicated that they have worked on computer since the beginning of the year. Two students have started later.

2. Did your teacher provide clear instructions for you to use the computer?

All the students received instructions and they agreed that the instructions were clear. Four students commented that although it was clear it was difficult for them sometimes.

> Sometimes I can't remember what the symbol is for and I don't want to click on it because it may mess up my work. The teacher has to tell me what it is and show me how to do certain things.

All 25 students stated that they were satisfied with the instructions because they were clear.

3. Was it difficult for you to use the computer to do your mathematics assignment?

Reading and comprehending the mathematical problems was a challenge for some students. This can be attributed to students' level of English. When someone reads the problem in both languages they are able to function well in mathematics. Some students struggle to complete their mathematics assignments but they said that they are convinced that they are learning from the computer.

> It's difficult because I don't understand English good. It takes me longer than others to complete the mathematics work.

Out of 25 students, 13 students stated that they had no difficulties while the other 12 are struggling with the language.

4. Did you feel uncomfortable during any part of the assignment? Explain the answer.

Students stated that they feel uncomfortable only when they saw new problems such as fractions (multiplication and division) and geometry. They were uncomfortable because they don't know how to do them.

> I'm afraid to put the wrong answers in the computer. I feel lost because of the fractions and geometry that is new. My teacher did not teach all of that as yet. We all were calling her for help.

Out of 25 students, 10 students did not feel uncomfortable during the assignment. However, 15 students felt uncomfortable when they are faced with new challenges.

5. What did you like about working in the laboratory on the computer?

All of the students like the idea of not waiting on someone to get off the computer. They all have their individual computer; it allowed them to get a head start as well as work independently, learning at their own pace. Some students stated that they were more focused so they get good scores on their mathematics.

> It's great that we don't need to wait for someone to finish their computer session; most of us are done about the same time. Most of us are very excited when we get a star for our scores in the laboratory. Its "cool" for us to work in there; we are special; some classes are not allowed to go on the computer in there. The teacher always gets to see what we are all doing; oh, t because she is only helping us with mathematics.

Out of 25 students, 19 students had positive statements while six students had some mixed reactions.

6. What dislike about working in laboratory on the computer?

There were mixed reactions to this question. Some students did not like the laboratory because it was too quiet and there were limited interaction with their peers. Others stated that there is no time for socialization; it is total silence in the laboratory. Some students restated that they felt rushed due to the timer on the program. Students who had difficulty with language were at times discouraged. They claimed that they rushed themselves to keep up with the classmates and they needed more time; these students felt left behind.

> Everyone knows that you take more time than them so some of us don't like to work in there. It's hard sometimes because of the English; it makes me fall behind others. I have to wait until the teacher shows us how to do the work sometimes.

Out of 25 students, 20 students had some form of dislike while on the computer in the laboratory while five students seem to have mixed views concerning their dislikes.

7. What activity or activities did you enjoy this year?

Physical education and reading and mathematics were considered the favorites this year among the students. Some of the students rated physical education as being most enjoyable, while the other students enjoyed reading and mathematics this year.

> We like to play games outside. Sometimes my friends and I like to read books. Everyone likes the math speed games… its fun

Out of 25 students, 21 students enjoyed physical education and math speed games and four students enjoyed reading.

8. What activity or activities you did not enjoy this year?

The students stated that they struggle with mathematic and science on the computer as well as when it is being taught because they do not like the subject.

> We have problems with the English, it takes me long to do test on the computer. I think taking mathematics test on the computer is better than the old way. I prefer doing the math games because it has less words. Science words are very hard for us.

Out of 25 students, 10 students did not enjoy mathematics while 15 did not enjoy science.

9. What career would you like to engage in? What motivates you to pursue this career?

There was a selection of health-related fields, professional football and basketball from among the students.

> I want to be a doctor or a football player. This is neat….. can you imagine Dr Bill in a big hospital or being a big football star.

Out of 25 students, 11 students selected health-related fields while 14 chose being professional athletes.

10. Would you like to attend college? Explain your answer.

Most of the students wanted to go to college while the others wanted to attend a vocational school and the Police Academy. They all stated that they wanted good paying jobs when they completed school.

> I want a job that pays a lot of money. I want to drive a pretty car like my Dad. My mom said that you can't buy anything if you don't have a good job. My teacher lists our favorite jobs on the board and we compare them and then we did the calculations. Wow… I am going to study very hard.

Out of 25 students, 18 students wanted to go to college, two students wanted to go to a vocational school to learn a skill while the other three students wanted to attend the Police Academy to be policemen.

11. What kind of jobs are your parents involved in?

Parents' jobs varied; some parents are teachers, nurses, carpenters, clerks, gardeners, entrepreneur, and bank teller.

> My mom works with her dad at the bank. My dad is a gardener and works everywhere. He runs his own business. I love to go to his job and help with him on Saturdays. I pick up the thatch and put it in his truck; he gets to come home quicker.

Out of 25 students, three parents are educators, six health professionals, six construction workers, five clerical workers, four entrepreneurs and one bank teller.

12. Do you use mathematics in your every day lives? Explain your answer?

The students were excited about mathematics in your every day lives. They spoke about purchases in the stores and at the supermarkets. Students pointed out the games they played and how measurements impact the game such as football.

> I help my mom make cookies and cupcakes. We use the measuring cups for the sugar and flour and milk. We set the timer on 20 minutes so that we know that they are cooked.

All 25 students gave explanations about the way they used mathematics in their lives.

13. What is the reaction like among your classmates after the computer session and the reward stars are posted based on the computer scores?

Most of the students are happy when the scores are high. A few students stated that they would like the scores to be a private matter.

> I sometimes don't get high scores so I don't want it on the board. How about my friends seeing that I did bad and talk about it.

Out of 25 students, 21 reacted positively towards the star reward system while four students are afraid of it.

14. Does working on the computer help you to understand some of the mathematics skills?

All the students acknowledged their understanding of the mathematics skills is a direct result of using the computer and the computer tools such as the visuals. They also love the immediate feedback and it helps them to correct themselves.

> Sometimes I need the teacher to explain it to me. But I like knowing what I got right or wrong now not later. I really like that.

Out of 25 students, 24 were certain that the computer help them to understand while one student had some reservations.

15. Are there any changes that you would like to see to improve your work on the computer?

Some students wanted longer sessions on the computer as well as mathematics games that are related to the standard that they are working on. The students also wanted mathematics definitions and vocabulary word games.

> I wish there wasn't a time limit, because it makes me nervous.

Out of 25 students, 22 students wanted changes to improve the work on the computer while three students see no need for changes.

16. Would you like to do more mathematics daily with the teacher or on the computer? Why?

Most of the students prefer the computer because they said they are not embarrassed when their problems are incorrect. They love the illustrations and the mathematics symbols. It reminds them constantly of what should be done. Only one student's preference was for the teacher only. The reason given was that the teacher takes a lot of time in making sure you learn the skill.

> I like when the teacher explains it. I don't have to read the computer and it makes it easier.

Out of 25 students, 22 students like working with the computer while three students wanted to be left alone.

17. Do you learn from each other on the computers? Explain you answer.

The students stated that they helped each other sometimes. It is not possible at times because of the levels and how advanced the work becomes at times. Some of the students suggested that other students help them with translation from Spanish to English before they understand the computation problems as well as other skills.

> My friend explains the English to me sometimes because I don't understand it. We help each other all the time.

Out of 25 students, 23 stated that they learn from each other but two students said that are independent of the others although working with them is OK.

18. Do you feel that teachers should be replaced by computers?

Many students commented that computers are fun but we do need teachers. The students were concerned that lack of discipline would result in chaos in the classroom.

> I love my teacher. She always helps me with the math and explains other work to me. Most of us would play on the computer without a teacher being there.

Out of 25 students, 18 students wanted teachers to remain in the classroom while seven students wanted computers to replace teachers.

19. How do you interact with mathematics lesson on the computer versus the teacher?

There were some undecided students in this group. They were not sure so they said they love both. They are able to work independently as well as get help from the teacher when needed.

> My teacher helps us when we get stuck at a level. The computers don't do that. The teacher form small groups and explain the problem to us.

Out of 25 students, 21 students wanted teachers' assistance and three students wanted to depend solely on the computer.

20. Is the program the Math Concept and Skills adequate for you? Explain why?

This group was concerned about the way some of the problems are presented. These LEP students stated that there were too many word- problems.

> I like the math problems that are just numbers, it is easier to understand and do.

Out of 25 students, 22 students agreed that the Math Concept and Skills have adequate challenge for them while two students said that they are ready for more challenges.

4.4 Response to Research Questions based on the Qualitative Data

Response to Research Question 1: How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' attitude towards mathematics?

A summary of the qualitative portion of the study revealed that the boys as well as the girls believe that that Successmaker activity was important to their learning of mathematics. However the students are convinced that the program would serve them better if more time was allotted for them to work on the computer. Most of the students stated that they needed a longer time than 15 minutes on the computer, especially the level one students. They said by having a longer time they would do better because their session would be longer and they would have more time to think.

Some students written responses were not very clear but they explained what their responses meant. I gathered from their explanation as well as their interest and the positive attitude that they love mathematics even if they had some problems in doing it.

Research Question 2: How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students' achievement in mathematics?

The SuccessMaker Math Skill and Concept have increased the students' ability to comprehend word problems through various symbols, pictures, graphs and listening skills. Students also agreed that the activity integrated mathematics skills that they learn –such as geometry, fraction and graphing. Both boys and girls agree that they love SuccessMaker program because it is student-friendly and has contributed greatly to their learning of mathematics. The interviews shed important light on the qualitative part of the study. Although, the students felt that working in laboratory would guarantee better results because there were no distractions, the results proved otherwise. There were no significant differences. On the other hand, the students felt that the SuccessMaker program excellent integration with concepts learned from their teachers' instructions empowered them to succeed on the FCAT test.

4.5 Summary of Chapter

This chapter has presented findings of the study by addressing each of the three major research questions individually. The methodology of this study can be described as mixed methods using both qualitative and quantitative approaches. These two approaches were achieved with 300 students within ten classes. Individual and group interviewed were conducted among 50 student participants.

Initially for the first research question, the validity and reliability of attitude instrument towards mathematics for the classroom and laboratory groups was established. The analysis of the first research question showed that while there were no statistically significant differences between pre and post tests for each group, there was a statistically significant difference between the two modes of instruction in terms of attitude towards inquiry.

The second research question focused on achievement in mathematics using the FCAT standardized test scores. Data presented in section 4.2.3 showed an increased in achievement scores from FCAT pretest to posttest from both laboratory and classroom. However, the evaluation showed that the differences in improvement in FCAT scores for students in both instructional programs were not statistically significant. There were statistically significant differences using paired sample t-tests between the pretest FCAT and posttest FCAT scores for both groups.

The third research question dealt with the association between students between achievement and attitudes within their classroom and laboratory. Data presented in section 4.2.3 showed no statistically significant correlations between Inquiry in Mathematics lessons and Enjoyment of Mathematics lessons and the FCAT posttest score in both the classroom instruction and the laboratory instruction. Neither classroom nor laboratory instruction differentially contributed towards students' FCAT scores.

The results from the interview with 50 students yielded patterns consistent with overall findings on the quantitative information surveys with 300 students, suggesting that students who participated in the computer tasks in the classroom or laboratory activities have positive attitudes towards mathematics. Overall, the quantitative and quantitative findings support the effectiveness of Success-Maker activities and its impact on the FCAT scores.

Chapter 5

Conclusions, Limitations and Implications

5.1 Introduction

This chapter is divided under the following headings. Section 5.2 is an Overview of the Thesis and includes a summary of the first chapter, the literature reviewed, the research methods and the results. The Limitations of the Study and Implications and Significance of the Study are provided in Section 5.3. A Summary of the Chapter is in Section 5.4.

The purpose of this study was to examine the effectiveness of the SuccessMaker Math Concept and Skills (MCS) program on attitudes towards mathematics and achievement in mathematics as measured by FCAT mathematics scores among grade five elementary school students in southern Florida, United States of America. Students in this study received instruction either in the classroom or in the laboratory and their attitudes towards mathematics and their achievements were compared.

The main outcomes of this research involved:

1. The validation of a generally applicable test for assessing student attitude towards mathematics among elementary school students in southern Florida.
2. A comparison between classroom and laboratory learning of mathematics of the SuccessMaker activities in terms of students' attitudes to mathematics, students' school mathematics achievement, and students' mathematics achievement on the FCAT test.
3. An investigation of any associations between outcomes of the student achievement and attitudes.

In recent years technology has played a greater role in the education of students. However, mixed reviews have been noted in numerous research studies and the validity and reliability of some research has been questioned. Since the passage of the

No Child Left Behind in 2001, all elementary school educators find themselves seeking scientifically proven academic programs to enhance students' achievements.

5.2 Overview of the Thesis

5.2.1 Summary of the first Chapter

Chapter I began with the rationale for the thesis. Students at all educational levels throughout the United States, especially Limited English Proficient (LEP) students, experience tremendous difficulties in learning mathematics. One response to students' low test scores has been the actions taken based on the No Child Left Behind Law made by the Department of Education. Consequently, high stake testing has changed the course of teaching mathematics so that much more pressure is placed on the classroom teacher. As a result of the experiences with teaching LEP students, the researcher contemplated that the use of SuccessMaker Math Skills and Concept program along with working to achieve the Sunshine State Standards, the Competency Based Curriculum, and national guidelines for mathematics education would broaden students' understanding of the subject. According to the National Council of Teachers of Mathematics (NCTM), mathematics instructional programs should use technology to help all students understand mathematics and should prepare them to use mathematics in an increasingly technological world. Indeed, research has shown that technological aids such as calculators and computers have improvement effects on students' attitudes toward mathematics.

5.2.2 Summary of the Literature Review Chapter

This chapter was dedicated to a review of the literature that served as a basis for gaining a better understanding of prior research applicable to this study. The literature review was designed to inform the three research questions, namely: (1) How does the use of technology in teaching mathematics in the class or in the laboratory influence LEP students' attitude towards mathematics?; (2) How does the use of technology in teaching mathematics in the classroom or in the laboratory influence LEP students achievement in mathematics?; and (3) Are there any interactions between attitudes and achievement in mathematics for students taught mathematics using technology in different ways?

The literature reviewed the FCAT SuccessMaker program that is designed to integrate technology into mathematics skills and concepts, such as collecting data, observing, organizing and interpreting data, predicting, measuring, reasoning and thinking. All of these skills and concepts have been used in the classroom and laboratory activities. The literature dealing with the use of SuccessMaker in the classroom and laboratory served as a basis for the instructional intervention used in the present study.

An historical review in the field of technology and the Florida Comprehensive Achievement Test (FCAT) was provided. Motorola and Deubel along with the pioneer work of SuccessMaker Enterprise's Pearson Digital Learning developed this mathematical software to raise the level of achievement for each student as determined by the state testing program Florida Comprehensive Achievement Test (FCAT).

The literature review argued that combining quantitative and qualitative research methods to answer the research questions, including the significance of mixed methods in educational research, was the best approach. According to Patton (2002, p. 585) researchers use “both aspects of qualitative and quantitative methods in their studies because they need to know and use a variety of methods to be responsive to nuances of particular empirical and idiosyncrasies of specific shareholder needs”.

Studies related to technology and in the way students view the use of computer in their mathematics learning and their attitude towards the subject was reviewed. The research showed that students viewed computers in a positive way when the work was related to learning mathematics. In addition, the literature review documented the various concepts related to instructional factors, individualized instruction, curriculum aliment, accountability and student achievement.

5.2.3 Summary of Research Methods Chapter

This chapter described the research methods, the sample size, the procedures for collecting data that included interviews and the instruments, and how the data were analyzed. On a whole the methods of the study can be described as a mixture of quantitative and qualitative approaches. The study group comprised 300 Grade 5 Limited English Proficiency (LEP) students in two groups of 150 students in the classroom or laboratory. The FCAT scores and the attitude surveys represented the quantitative portion of the study. The qualitative data, gathered from 25 students (12 girls and 13 boys) in each of the two groups through interviews, were used to provide confirming or disconfirming evidence in relation to the information provided in the surveys.

Careful attention was given to the students' responses, about working on the computer, either in the laboratory or in the classroom, on Math Concept and Skills structured around the Sunshine state Standards, the Competency-Based Curriculum, and the National State guidelines for mathematics education. The use of technology in mathematics was intended to play a major role in the improvement in students' achievements in mathematics. The survey instrument chosen to measure students' attitudes towards mathematics was the Test of Mathematics Related Attitudes (TOMRA), based on selected items from the Test of Science Related Attitudes (TOSRA. The adapted version for this study consisted of 20 questions assessing two scales of TOMRA namely, Attitudes of Mathematics Inquiry and Enjoyment of Mathematics Lessons (Fraser 1987).

5.2.4 Summary of the Results Chapter

Reliability of the Attitude Questionnaire

An initial goal of the study was to validate the use adopted version of the Test of Science Related Attitudes (TOSRA) to the Test of Science Related Attitudes (TOMRA) attitude survey that was used in the research. The TOMRA was administered to a sample size of 300 English Language Proficient students in ten 5th Grade classes. The Cronbach alpha coefficients (Cronbach, 1951) were used to assess internal consistency of the scales; an acceptable value is in the region of about 0.7. As shown in Table 4.1, the posttest reliabilities for the posttests for the classroom instructed group was acceptable but the other values were below 0.7. There is no obvious reason for these differences and comments are made about this aspect in the limitations section of this chapter.

Attitude towards mathematics differences between classroom and laboratory instruction

There was no statistically significant increase in attitude to inquiry scale scores from the pretest (Mean = 3.10) to the posttest (M = 3.24) for the students in the laboratory and from the pretest (Mean = 3.13) to the posttest (M = 3.00) for the students in the classroom. However, when the two groups were compared, there was a statistically significant difference between the pretest and posttest for the two groups in favour of the laboratory class ($F = 7.27$, $p < 0.005$). In other words, the attitude towards inquiry for the laboratory group was significantly more positive than the classroom group following the period of intervention.

Similarly, there was no statistically significant increase in enjoyment of mathematics lessons scale scores from the pretest (Mean = 3.08) to the posttest (M = 3.10) for the students in the laboratory and from the pretest (Mean = 2.99) to the posttest (M = 2.84) for the students in the classroom. However, when the two groups were compared, there was no statistically significant difference between the pretest and posttest for the two groups ($F = 2.36$, $p = 0.13$). In other words, the enjoyment of mathematics for the laboratory group was not significantly more positive than the classroom group following the period of intervention.

Mathematics Achievement on School Tests

There was statistically significant difference in the achievement on the mathematics tests in favour of the Classroom instructed group (Mean = 52.92) compared to the laboratory instructed group (Mean = 41.85) ($t = 5.90$, $p< 0.001$). A noted in Chapter 4, there were more level 2 and 3 LEP students in the classroom than the laboratory. During the test the level 1 LEP students learning tasks were not adjusted in terms of linguistic complexity, so the mathematics test were not simpler for them than it was for other students. Unique mathematical terms, symbols, and expressions that occur in mathematics discourse presented major difficulties for them to clarify their mathematics thinking as well as solving the problems. The lack of proficiency in English may have contributed to this statistically significant difference.

FCAT Achievement in Mathematics

As shown in Table 4.4 and Figure 4.3, both groups achieved statistically significant differences in the achievement on the FCAT mathematics tests: Classroom: pretest (M = 1495) to the posttest (M = 1610), t = 9.40, $p < 0.01$); Laboratory: pretest (M = 1539) to the posttest (M = 1634), t = 7.42, $p < 0.01$). There were no statistically significant differences between the classroom instructed group compared to the laboratory instructed group. The FCAT pretest and posttest were two sources of information that were used to assess academic achievement. On a whole, the result supported a positive influence of student using technology on their mathematics activities in the classroom and laboratory.

Relationships between students' attitudes to mathematics and achievement in mathematics

As shown in Table 4.6, for the students in both the classroom instruction and the laboratory instruction, there were no statistically significant correlations between Interest in Mathematics lessons and Enjoyment of Mathematics lessons and the FCAT posttest score. Neither classroom nor laboratory instruction differentially contributed towards students' FCAT scores.

Student Interviews

One of the major components of this research was to evaluate students' understanding of the concept-related mathematical ideas as they used the computer in the classroom or the laboratory. The goal of the investigation was to obtain the students' insights on the phenomena under study. Students' interviews formed the basis for the qualitative part of the study. A group of 25 students (13 girls and 12 boys) was selected to participate in the interview.

The qualitative data were collected through the interview schedule which consisted of 20 questions; students responded both orally and in written form. After reading the students' responses, some responses needed clarification. As a result of Erickson (1998) recommendation, students were shown the transcription and as a result revisions were made. The main purposes for the interviews were to assess students' opinion about the mathematics activities on computer and to gain additional insights on the responses given on the attitude survey.

5.3 Limitations, Implications and Significance of the Study

This section describes the limitations of the study (Section 5.3.1) and offer ideas for future studies (Section 5.3.2).

5.3.1 Limitations of the Study

A number of constraints served as limitations in this study. However, steps were taken to reduce these effects. Despite the wealth of data collected, it is evident that more study is needed to positively determine the effect of the SuccessMaker program on students' attitudes to mathematics and on the FCAT mathematics scores at the elementary school in this study. The mathematics curriculum has employed a variety of packaged computer programs which can be incorporated into the teaching programs of teachers in this school to help improve students' mathematical abilities.

School schedules and location

Schedule changes, state tests, school assemblies, teachers' absences as well as school projects made it difficult sometimes for students to maintain a steady routine on the computer. Secondly, computer rooms were fully booked in advance, so securing several weeks of class time was challenging. This situation forced the researcher to be pro-active, fill in for other teachers where possible and seek additional help from other teachers.

Another limitation was students attending special classes, such as gifted classes, on a daily basis. They attend these classes throughout the day in some classes as well as part time in others. The researcher had to coordinate and work closely with all the teachers and this created some arduous times because it was challenging to have ten classes and 15 teachers directly involved with this study.

With the FCAT examination fast approaching, some teachers were concerned about my constant visits as well as giving up their time to discuss their observations of students in the Laboratory and the Classroom. Some teachers expressed their thoughts by saying, “We are doing this only because it’s you”.

The statewide Florida Assessment Test (FCAT) is designed to measure students’ skills in reading, writing, and mathematics. During the 2004-2005 school year, Fifth Grade students took the FCAT tests; 45 % scored level 3 and above (maximum score is 5) on the mathematics part of the test while they scored 57% on the reading part of the test.

The school is located in a metropolitan area with a diverse community, both culturally and economically. The ethnic distribution of the population is 85% Hispanic, 8% White Non-Hispanic, 4% Black Non-Hispanic, and 3% other. The school is identified for implementation of the federally supported program known as Title 1 for economically disadvantaged families. The research does not reflect the same aspect as the district due to the make-up of the academic achievement of the school where the study was done. Therefore the result of this study should be generalized and interpreted with prudence.

Student language facility

As indicated throughout this thesis, language was a major limitation for level 1 and 2 LEP students. Some students had to use the Spanish dictionaries for translation and understanding of words while they were filling out the questionnaires. Others asked their teachers to explain the meaning of words.

Attitude instrument reliability

As noted in chapters 3 and 4, although TOSRA and TOMRAS are robust instruments, the scales for the TOMRA used to measure attitudes to mathematics in this study were not consistently reliable. These results may have impacted negatively on the measurement of this construct, leaving open the need to repeat this study to achieve higher reliability values when given to all student groups.

5.3.2 Implications for Future Study

Future studies on the use of SuccessMaker Math Concept and Skills program on students' FCAT achievement scores and attitude towards mathematics would need a comprehensive study for a longer period, using a larger sample size, and at other schools with a different ethnic composition, and socio-economic status that reflects the entire district.

Miami-Dade County is ranked the fourth largest school district in the United States of America. A massive amount of money is being spent on technology in terms of new software, professional development and upgrading schools to use the equipment. However, a large percentage of teachers, at all educational levels, especially in elementary schools, are not trained to use computers as an effective teaching tool. Other teachers are reluctant to move away from their comfort zones and apply themselves to modern innovative methods of teaching. Administrators along with these two factors have hampered some of the progress in the effectiveness of technology use within the classroom and the laboratory.

In this present research qualitative data were solely based on student interviews. For future research qualitative data that includes case studies or ethnographical studies, and narratives is recommended. Anderson and Arsenault (1998) argue that the "fundamental assumption of qualitative research paradigm is that an insightful understanding of the world can be gained through observation and conversation in natural settings rather that through experimental manipulation under fabricated conditions" (p. 119). Where quantitative researchers seek causal determination, prediction, and generalization of findings, qualitative researchers seek instead illumination, understanding, and extrapolation to similar situations (Strauss & Corbin 1990, p. 17).

5.4 Summary of the Chapter

Although there were no statistically significant differences in the comparison of the FCAT results based on students working in the classroom and in the laboratory, there were statistically significant differences in the student attitudes to wards enquiry in mathematics in favour of the computer-based group.

Secondly, based on the use of the computer activities in the classroom and in the laboratory, one may conclude that there was a positive influence on both students' attitudes and achievements. These findings are based on qualitative information (interviews, which involved 25 students) and the quantitative data (surveys, FCAT scores, which involved 300 students) supporting the general effectiveness of the computer activities on the students achievements.

As a result of the demands of the high stake testing, educators have no choice but to monitor their students' achievement closely. Based on the researcher's findings consideration should be given to a longitudinal study of the relationship between SuccessMaker and students achievement on FCAT mathematics.

However in concluding this study serious questions arise for areas associated with the future of these students and the future for mathematics education. Some future areas of research deal with extended issues within mathematics education for LEP students. Some areas that can be explored are the continuation of positive attitudes toward mathematics technology in future mathematics classes and the continued professional development of current teachers with this technology. More time should be attributed to students using the technology in the areas of mathematics.

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Appendix A

Research Consent Form

Dear Parents,

My name is Velma Palmer and I am currently teaching a fifth grade class at Treasure Island Elementary School. I would like to ask you for your permission to have your child, ___________________________, participate in a study that will be conducted at this school.

I am conducting this study to comply with the requirements of a doctorial program at Curtin University of Technology, Pert, Australia.

Your child will be responding to two questionnaires that address student attitudes towards mathematics. The pretest and posttest will be administered in January and February respectively.

Your child will also be taking the FCAT mathematics pretest and posttest in January and March. Finally, I will access your child's school record to obtain his/her scores on the standardized tests.

Your child's name will not be used or published in any report of the study. The purpose of the study will be to access the effects of using the computer in mathematics activities in preparation of the standardized tests.

The study will also determine how students' attitudes affect their achievement in mathematics in the elementary school.

Please indicate if you give your permission for your child to participate in this study.

______ I give permission for my child to participate in this study.

______ I do not give permission for my child to participate in this study.

Parent's Signature ______________________________________Date_____

Appendix B

School District Consent Form

Miami-Dade County Public Schools

giving our students the world

Office of Program Evaluation
Executive Director
Dr. Robert A. Collins

March 21, 2005

Velma Palmer
5910 SW 62 Street
Miami, FL 33143

Dear Ms. Palmer:

I am pleased to inform you that the Research Review Committee of the Miami-Dade County Public Schools (MDCPS) has approved your request to conduct the study, "Effectiveness of Integrating Technology in Mathematics Among Limited English Proficiency (LEP) Students in Terms of Student Achievement and Attitude." The approval is granted with the following conditions:

1. Participation of a school in the study is at the discretion of the principal. A copy of this approval letter must be presented to the principal.

2. The participation of all subjects is voluntary.

3. The anonymity and confidentiality of all subjects must be assured.

4. Parent permission forms must be secured for all participating students prior to the beginning of the study.

5. If data are drawn from a participating student's educational records at his/her school, a completed Permission for Release of Records and/or Information from Records form (FM 1867) bearing the parent's signature must be retained in the student's cumulative folder. The FM 1867 form is available from the schools.

6. The study will involve approximately 300 MDCPS students in grades 5 and 6 at a single school.

7. Teacher participation is voluntary.

8. Disruption of the school's routine by the data collection activities of the study must be kept at a minimum. Data collection activities must not interfere with the district's testing schedule.

It should be emphasized that the approval of the Research Review Committee does not constitute an endorsement of the study. It is simply a permission to request the voluntary cooperation in the study of individuals associated with the MDCPS. It is your responsibility to ensure that appropriate procedures are followed in requesting an individual's cooperation, and that all aspects of the study are conducted in a professional manner. With regard to the latter, make certain that all documents and instruments distributed within the MDCPS as a part of the study are carefully edited.

The approval number for your study is 1164. This number should be used in all communications to clearly identify the study as approved by the Research Review Committee. The approval expires on June 30, 2008. During the approval period, the study must adhere to the design, procedures and instruments which were submitted to the Research Review Committee. If there are any changes in the study as it relates to the MDCPS, it may be necessary to resubmit your request to the committee. Failure to notify me of such a change may result in the cancellation of the approval.

If you have any questions, please call me at (305) 995-7501. Finally, remember to forward an abstract of the study when it is complete. On behalf of the Research Review Committee, I want to wish you every success with your study.

Sincerely,

Joseph J. Gomez

Joseph J. Gomez, Ph.D.
Chairperson
Research Review Committee

JJG:fp

APPROVAL NUMBER: 1164	APPROVAL EXPIRES: 6-30-08

Appendix C

TOMRA Questionnaire: Actual Form

<table>
<tr>
<td>
1. This test contains a number of statements about mathematics. You will be asked what you yourself think about these statements. There are no “right” or “wrong” answers. Your opinion is what is wanted.
2. All answers should be given on the separate answer sheet. Please do not write on this booklet.
3. For each statement, draw a circle around :
SA if you STRONGLY AGREE with the statement;
A if you AGREE with the statement;
N if you are NOT SURE;
D if you DISGREE with the statement;
SD if you STRONGLY DISAGREE with the statement.
</td>
<td>
Practice Item
It would be interesting to learn about angles.

Suppose that you AGREE with this statement, then you would circle A on your Answer Sheet, like this

SA A N D SD

If you change your mind about an answer, cross it out and circle another one.

Although some statements in this test are fairly similar to other statements, you are asked to indicate your opinion about all statements.
</td>
</tr>
</table>

DIRECTIONS

INQ

1. I would prefer to work out the answer than to be told.	SA	A	N	D	SD
2. Working out the answer is not as good as finding out the answer from the teacher.	SA	A	N	D	SD
3. I would prefer to work out the answers than to read about them.	SA	A	N	D	SD
4. I would rather agree with other people than work out the answer for myself.	SA	A	N	D	SD
5. I would prefer to work out my own answers than to find out information from a teacher.	SA	A	N	D	SD
6. I would rather find out an answer by asking an expert than by working out the answer myself.	SA	A	N	D	SD
7. I would prefer to solve a problem by working out the answer than be told the answer	SA	A	N	D	SD
8. It is better to ask the teacher the answer than to find it out by working out the answer.	SA	A	N	D	SD

9. I would prefer to work out the answer to a problem than to read about it in mathematics textbooks.	SA	A	N	D	SD
10. It is better to be told mathematics facts than to find them out from working out answers.	SA	A	N	D	SD
11. Mathematics lessons are fun.	SA	A	N	D	SD
12. I dislike mathematics lessons.	SA	A	N	D	SD
13. School should have more mathematics lessons each week.	SA	A	N	D	SD
14. Mathematics lessons bore me.	SA	A	N	D	SD
15. Mathematics is one of the most interesting school subjects.	SA	A	N	D	SD
16. Mathematics lessons are a waste of time.	SA	A	N	D	SD
17. I really enjoy going to mathematics lessons.	SA	A	N	D	SD
18. The material covered in mathematics lessons is uninteresting.	SA	A	N	D	SD
19. I look forward to mathematics lessons.	SA	A	N	D	SD
20. I would enjoy school more if there were no mathematics lessons.	SA	A	N	D	SD

Appendix D

Mathematics Test Questions for Mathematics Marks

Name: ________________________ Class: __________________ Date: __________ ID: A

Math Intervention 5th Grade

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ **1** **Four decimal numbers are shown below.**

0.511 0.453 0.552 0.044

Which of the decimal numbers has the LEAST value?

A 0.511
B 0.453
C 0.552
D 0.044

____ **2** **Ernie's doorway has a height of 84 inches.**

1 foot = 12 inches

What is the height, in feet, of the doorway?

F 8 feet
G 7 feet
H 6 feet
J 5 feet

____ **3** **Siri's school year is starting in 6 days.**

24 hours = 1 day

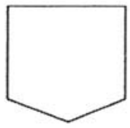
How many hours are equivalent to 6 days?

A 24 hours
B 36 hours
C 72 hours
D 144 hours

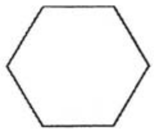
1

Name: ______________________ ID: A

____ **4** **Which shape below has 2 obtuse angles and 2 acute angles?**

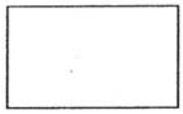


F



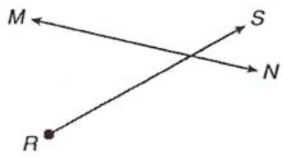
H

G



J

____ **5** **A picture from Jaylin's math book is shown below.**



Which figure is included in the picture?

A Ray *SN*
B Point *X*
C Line *MN*
D Line segment *RN*

____ **6** **Trisha's cat weighs 144 ounces.**

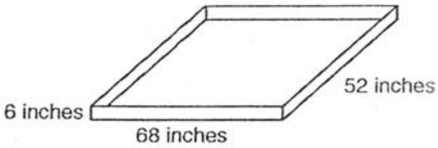
16 ounces = 1 pound

What is the weight, in pounds, of Trisha's cat?

F 12 pounds
G 10 pounds
H 9 pounds
J 8 pounds

Name: ________________________ ID: A

____ **7** **Sandra is going to fill the sandbox shown below to the top with sand**



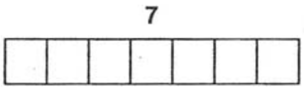
Volume = length × width × height

How many cubic inches of sand will Sandra need to fill the sandbox to the top?

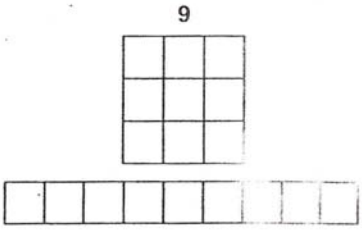
A 126 cubic inches
B 408 cubic inches
C 3,536 cubic inches
D 21,216 cubic inches

____ **8** **A class is making groups of rectangles on graph paper. Which rectangle group was created using a prime number of squares?**

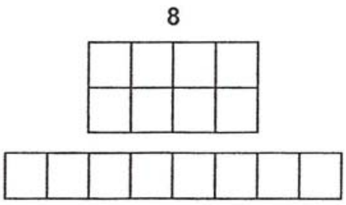
F



H



G



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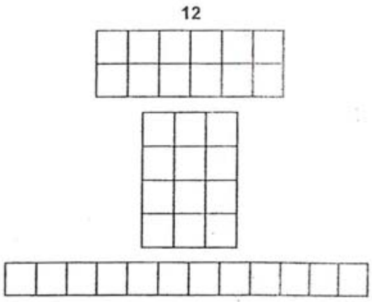
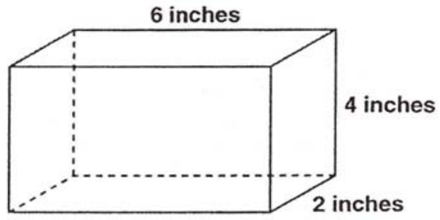


Name: ______________________ ID: A

____ **9** **Destiny's mom had a gift box with the dimensions shown below.**



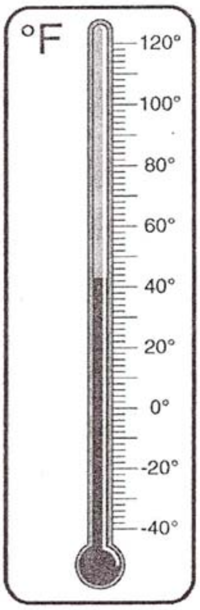
Volume = length × width × height

What is the volume, in cubic inches, of the gift box?

A 48 cubic inches
B 46 cubic inches
C 24 cubic inches
D 12 cubic inches

Name: ________________________ A

____ **10** **The temperature at 8:00 a.m. one day is shown on the thermometer b...**



The temperature increased 5°F each hour. Which is CLOSEST to the temperature at 11:00 a.m. that same day?

F 26°F
G 36°F
H 46°F
J 55°F

____ **11** **Quinton read for 20 minutes last night.**

60 seconds = 1 minute

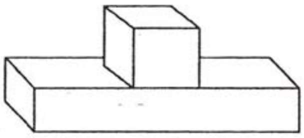
For what number of seconds did Quinton read?

A 12 seconds
B 120 seconds
C 1,200 seconds
D 12,000 seconds

Name: ______________________ **ID: A**

____ **12** **Jonas made a block building using a cube and a square pyramid. Which block building could be the one Jonas made?**

F



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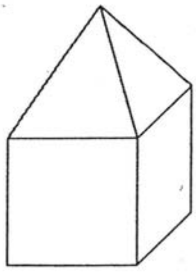
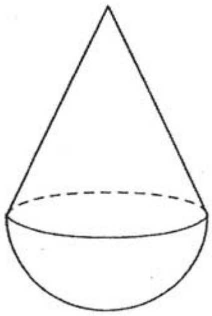
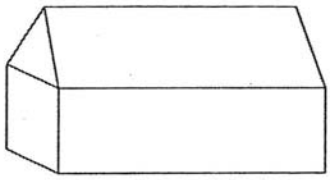


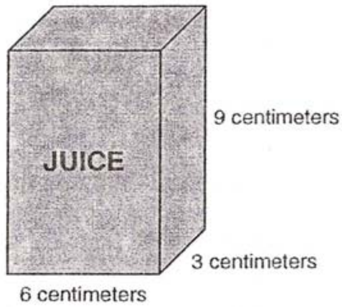
G



J



____ **13** **A small juice box is shown below.**



Volume = length × width × height

What is the volume of the box, in cubic centimeters?

A 18 cubic centimeters
B 27 cubic centimeters
C 54 cubic centimeters
D 162 cubic centimeters

____ **14** **Kris had 2 gallons of gas in a gas container. He used $\frac{1}{4}$ of a gallon of [illegible] to mow his lawn**

1 gallon = 4 quarts

Exactly how many quarts of gas were left in the container?

F 4 quarts
G 6 quarts
H 7 quarts
J 8 quarts

lame: ______________________ ID: A

___ **15** **Four students each weighed a pencil and recorded their results in the table below.**

Student Results

Name	Weight of Pencil
Sarah	$\frac{1}{3}$ oz
Liu	0.3 oz
Brad	$\frac{1}{4}$ oz
David	0.4 oz

Which list of names is in order from the student with the LIGHTEST pencil to the student with the HEAVIEST pencil?

A David, Liu, Sarah, Brad
B David, Sarah, Liu, Brad
C Brad, Liu, Sarah, David
D Brad, Sarah, Liu, David

___ **16** **Delia arranged all of her seashells into 4 equal rows. Then she rearranged them all into 10 equal rows. What is the smallest possible number of seashells Delia could have?**

F 12
G 14
H 20
J 40

___ **17** **The mass of Jarrod's math book is 1024 grams. His backpack has a mass of 830 grams.**

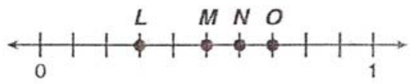
$\boxed{\text{1 kilogram = 1000 grams}}$

What is the total mass, in kilograms, of Jarrod's math book and backpack?

A 0.1854 kg
B 1.854 kg
C 18.54 kg
D 185.4 kg

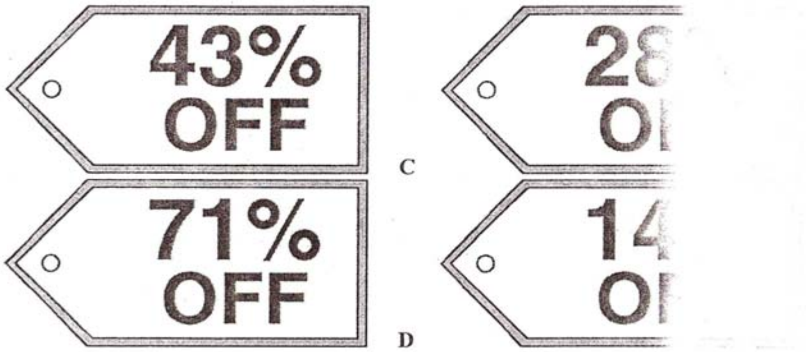
Name: ________________________ A

____ **18** Which letter names a point that represents $\frac{3}{5}$ on the number line be



F *L*
G *M*
H *N*
J *O*

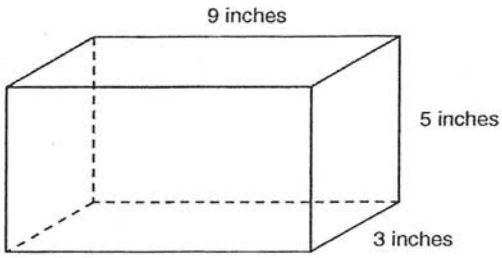
____ **19** Which sign shows a percent off that is less than $\frac{1}{4}$?

A
C


B
D

Name: ____________________ ID: A

____ **20** **Ariana's jewelry box has the dimensions shown below.**



Volume = length × width × height

What is the volume of Ariana's jewelry box?

F 45 cubic inches
G 135 cubic inches
H 136 cubic inches
J 225 cubic inches

____ **21** **Which scoreboard shows scores that are prime numbers?**

A

Home	13
Visitors	27

B

Home	15
Visitors	23

C

Home	17
Visitors	29

D

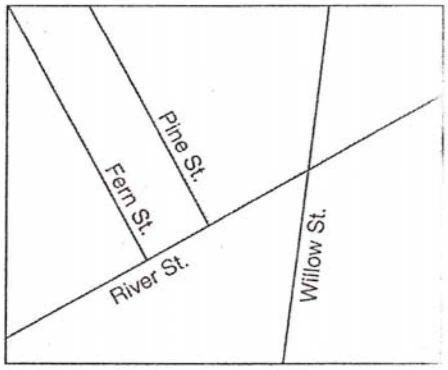
Home	19
Visitors	25

Name: ____________________ A

____ **22** **Mr. Zuni assigned each student in his science class an experiment us... ...rs. Which list shows 3 prime numbers?**

F 3, 7, 13
G 4, 6, 12
H 5, 3, 10
J 10, 11, 13

____ **23** **Vance drew the map below to show the location of four city streets.**

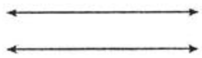


Which streets appear to be parallel?

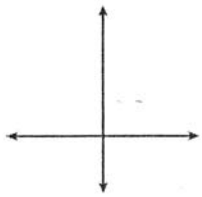
A River Street and Pine Street
B River Street and Willow Street
C Fern Street and Pine Street
D Fern Street and River Street

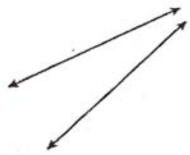
Name: ________________________ ID: A

____ **24** **Noelle drew 2 parallel lines on her paper. Which pair of lines appears to be parallel?**

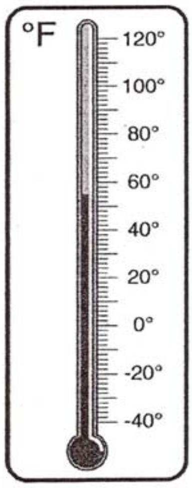
F 

H 

G 

J 

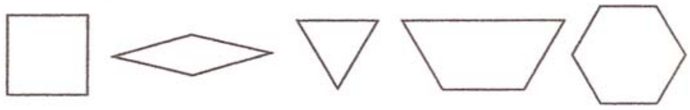
____ **25** **The thermometer shows the temperature at 3 p.m.**



If the temperature drops 3 degrees each hour for 4 consecutive hours, what will the temperature be at 7:00 p.m.?

A 12 degrees
B 42 degrees
C 44 degrees
D 66 degrees

24 Draw a circle around each quadrilateral shown below.



On the lines below, explain what makes a shape a quadrilateral.

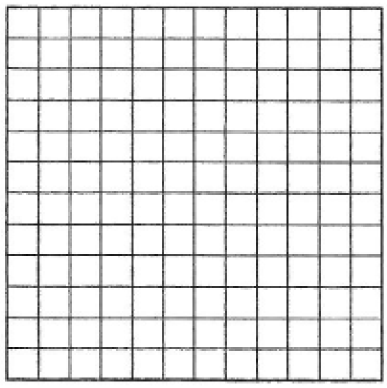
25.

On the grid below, make a bar graph showing the number of students who prefer each type of lunch.

Be sure to include:

- labels for the units on the axes
- appropriate numbers for the scale
- accurately graphed data

FAVORITE CAFETERIA LUNCHES



Using the information from your bar graph, write two statements that compare the data about students' favorite cafeteria lunches.

1) ____

____

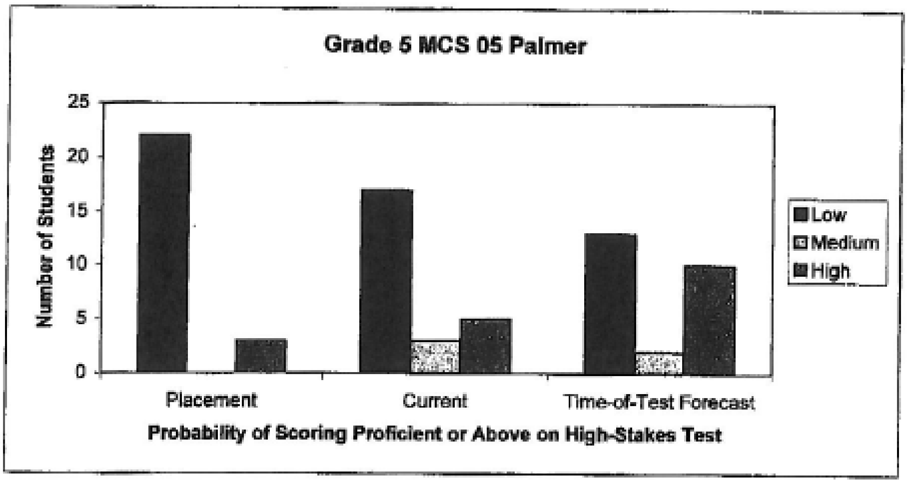
2) ____

____

Appendix E

Grade Level Scores from SuccessMaker

HIGH-STAKES FORECAST: MATH FOUNDATIONS



Name	IPM Level	Current Level	Mastery Indicator	Session Length	Total Time	Time-of-Test Forecast	Additional Mins/Wk for Med Prob of Proficiency	Additional Mins/Wk for High Prob of Proficiency
	3.80	4.12	100%	12	8:12		93	200+
	4.79	5.37	85%	12	11:29			
	4.03	4.33	100%	12	8:33		50	200+
	3.30	3.41	0%	12	7:15		200+	200+
	2.76	2.90	100%	12	7:31		200+	200+
	5.00	5.60	90%	12	6:57			
	3.52	4.07	100%	12	17:55		8	200+
	3.72	3.89	95%	12	8:37		200+	200+
	4.89	5.99	80%	12	17:12			
	4.74	5.05	90%	12	11:21			12
	4.54	5.04	100%	12	11:11			
	3.79	4.11	95%	12	11:38		67	200+
	4.50	4.79	100%	12	5:49			102
	4.22	4.39	100%	12	8:26		39	200+
	6.20	6.40	100%	12	6:11			
	4.01	4.12	0%	12	11:04		65	200+
	4.60	6.14	85%	12	19:41			
	6.26	6.44	0%	12	5:13			
	4.70	5.35	100%	12	14:50			
	3.02	3.07	0%	12	5:22		200+	200+
	6.00	6.26	100%	12	7:31			
	4.23	4.37	95%	12	7:17		51	200+
	3.83	4.08	100%	12	13:08		200+	200+
	4.05	4.24	100%	12	6:28		82	200+
	4.54	4.94	100%	12	10:20			

Forecast Target: 5.9

Red/Double Underline indicates students who placed more than 1.5 years below courseware target level or who are currently working below acceptable performance levels.

Date Run: 04/19/05

Last Session Report

Math Concepts and Skills

This report lists the students whose last session date is on or before 04/19/05.

05 Palmer

Student Name	Performance				Support		Usage		
	Current Course Level	Exercises Correct	Exercises Attempted	Percentage Correct	Time-Outs	Help Used	Session Date	Actual Session Length	Total Sessions
05 Palmer									
Math Concepts and Skills									
	4.36	27	41	66	0	0	04/19/05	0:12 *	81
	5.83	0	2	0	1	0	04/14/05	0:04 *	219
	4.57	19	26	73	3	0	04/19/05	0:13	78
	3.54	4	11	36	0	0	04/19/05	0:13	63
	3.20	13	19	68	0	0	04/19/05	0:13	105
	6.41	47	70	67	0	0	04/18/05	0:13	88
	6.32	14	22	64	2	0	02/24/05	0:14	190
	5.32	3	4	75	0	0	04/19/05	0:10 *	147
	5.52	18	23	78	1	0	04/19/05	0:13	145
	4.51	17	35	49	0	0	04/19/05	0:13	149
	5.48	16	26	62	0	0	03/16/05	0:14	69
	4.54	1	4	25	0	0	04/12/05	0:04 *	128
	6.80	2	2	100	0	0	04/15/05	0:12 *	124
	4.19	1	3	33	0	0	04/13/05	0:08 *	85
	6.98	4	7	57	0	0	04/19/05	0:02 *	446
	6.88	17	21	81	0	0	04/19/05	0:13	68
	5.79	0	0	–	0	0	04/19/05	0:00 *	358
	3.15	0	3	0	1	0	04/19/05	0:07 *	58
	6.73	18	23	78	0	0	04/19/05	0:13	98
	4.47	19	28	68	0	0	02/10/05	0:12	43
	4.31	7	11	64	1	0	04/19/05	0:07 *	134
	4.43	1	1	100	0	0	04/19/05	0:01 *	126
	5.29	5	10	50	0	0	04/19/05	0:14	99
23 students									
Mean:	5.16	11	17	59	0	0		0:10	135
Standard Deviation:	(1.15)	(11)	(16)	(26)	(1)	(0)		(0:05)	(93)

Date Run: 04/19/05

PEARSON Education Technologies

Last Session Report

Math Concepts and Skills

This report lists the students whose last session date is on or before 04/19/05.

05 Palmer

Summary Data	Performance				Support		Usage		
	Current Course Level	Exercises Correct	Exercises Attempted	Percentage Correct	Time-Outs	Help Used	Session Date	Actual Session Length	Total Sessions
Total: 23 students									
Mean:	5.16	11	17	59	0	0		0:10	135
Standard Deviation:	(1.16)	(11)	(16)	(26)	(1)	(0)		(0:05)	(93)

Legend:

* Student exited the session early

-- Data not available or applicable

Date Run: [illegible]

PEARSON Education Technologies

Cumulative Performance Report

Math Concepts and Skills

Student Name	Current Course Level	Gain Since IPM	Time Spent Since IPM	Total Time Spent	Total Sessions	Total Exercises Attempted	Total Exercises Correct	Total Skills Completed	Total Skills Mastered	Percentage of Skills Mastered	AP
05 Palmer											
Math Concepts and Skills											
	4.45	0.65	11:57	14:41	97	1838	1319	139.00	137.00	98	*
	5.96	1.17	25:48	27:45	287	4060	2484	214.00	194.00	90	*
	4.68	0.65	15:47	18:44	96	2128	1499	139.00	134.00	96	*
	3.65	0.35	7:39	13:26	82	933	692	62.00	61.00	98	*
	3.38	0.62	16:38	19:23	123	1788	1279	139.00	139.00	100	*
	6.63	1.63	19:20	20:48	106	4639	2977	274.00	254.00	92	*
	5.46	0.72	19:59	22:59	191	2312	1540	136.00	129.00	94	*
	5.75	1.21	24:02	26:59	182	3143	2298	237.00	233.00	98	*
	4.69	0.90	25:45	28:21	204	3892	2387	205.00	191.00	93	*
	4.61	0.39	14:28	19:26	161	1558	1001	84.00	82.00	97	*
	6.95	0.75	16:15	19:57	225	2042	1158	97.00	90.00	92	*
	4.19	0.18	9:31	15:12	88	960	551	24.00	21.00	87	
	7.19	2.59	40:15	41:42	516	7307	4629	453.00	418.00	92	*
	7.08	0.82	14:14	16:38	84	1988	1385	122.00	117.00	95	*
	5.88	1.18	31:12	33:48	433	3151	2173	222.00	215.00	96	*
	3.24	0.22	7:34	11:19	80	914	571	30.00	28.00	93	*
	6.85	0.85	17:42	21:11	133	2141	1526	133.00	128.00	96	*
	4.35	0.52	20:45	24:57	174	1909	1313	109.00	106.00	97	*
	4.52	0.47	16:10	18:59	178	1945	1225	100.00	97.00	97	*
	5.36	0.82	18:05	21:17	114	2105	1603	162.00	160.00	98	*

20 students **Percentage of students with AP : 95%**

Mean:	5.24	0.83	18:39	21:53	178	2,538	1,681	154	147	95
Standard Deviation:	(1.22)	(0.53)	(7:44)	(7:02)	(114)	(1477)	(926)	(94)	(87)	(3)

Appendix F

Interview Forms for Semi-Structured Interviews with Individuals and Student Groups

Name__________________________ No.________ Date_________

1. Have you worked on a computer since the beginning of the school year?

2. Did your teacher provide clear instructions for you to use the computer?

3. Was it difficult for you to use the computer to do your mathematics assignment?

4. Did you feel uncomfortable during any part of the assignment? Explain the answer.

5. What did you like or dislike about working in the laboratory on the computer?

6. What did you like or dislike about working in the classroom on the computer?

7. What activity or activities did you enjoy this year?

8. What activity or activities did you not enjoy this year?

9. What career would you like to engage in? What motivates you to pursue this career?

10. Would you like to attend college? Explain your answer.

11. What kind of jobs are your parents involved in?

12.	Do you use mathematics in your every day lives? Explain your answer?
13.	What is the reaction like among your classmates after the computer session?
14.	Does working on the computer help you to understand some of the mathematics skills?
15.	Are there any changes that you would like to see to improve your work on the computer?
16.	Would you like to do more mathematics daily with the teacher or on the computer? Why?
17.	Do you learn from each other on the computers? Explain you answer.
18.	Do you feel that teachers should be replaced by computers?
19.	How do you interact with mathematics lesson on the computer versus the teacher?
20.	Is the program the Math Concept and Skills adequate for you? Explain why?

Appendix G

Photographs of Students Working on the Computers