

8-26-2005

The Relationship Between Teaching Experience and Style and Primary Student Gains in Mathematics Using an Integrated Learning System

Marilyn N. Meub
University of South Florida

Follow this and additional works at: <https://scholarcommons.usf.edu/etd>

 Part of the [American Studies Commons](#)

Scholar Commons Citation

Meub, Marilyn N., "The Relationship Between Teaching Experience and Style and Primary Student Gains in Mathematics Using an Integrated Learning System" (2005). *Graduate Theses and Dissertations*.
<https://scholarcommons.usf.edu/etd/769>

This Dissertation is brought to you for free and open access by the Graduate School at Scholar Commons. It has been accepted for inclusion in Graduate Theses and Dissertations by an authorized administrator of Scholar Commons. For more information, please contact scholarcommons@usf.edu.

The Relationship Between Teaching Experience and Style and Primary Student Gains in
Mathematics Using an Integrated Learning System

by

Marilyn N. Meub

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
Department of Childhood Education
College of Education
University of South Florida

Major Professor: Stephen Graves, Ph.D.
Pamela Fleege, Ph.D.
Elizabeth Larkin, Ed.D.
Darlene DeMarie, Ph.D.

Date of Approval:
August 26, 2005

Keywords: teachers, primary students, mathematics, integrated learning system, gains

© Copyright 2005 , Marilyn N. Meub

Acknowledgements

During this research study and throughout my graduate school experience, I was fortunate to receive advice and support from a tremendous group of people. My dissertation committee, which included Dr. Stephen Graves, Dr. Elizabeth Larkin, Dr. Pamela Fleege, and Dr. Darlene DeMarie provided insight, support, and direction throughout the entire process. Dr Graves, my major professor, continually provided assistance and encouragement during the entire seven years of my graduate program as well as throughout this study. A special thanks to my dear friend for the hundreds of hours she spent reading and rereading every chapter offering suggestions to make sense of my ideas. Her expertise in writing was immeasurably appreciated. Additionally, I would like to thank the teachers and instructional technology facilitator for participating in this study by providing their time and perspective of the Successmaker program. Further, I would like to thank my family and friends for their patience, love, and encouragement. Finally, I would like to thank my mother, for the important role she has played in my life. She has always supported and encouraged me to attain goals I set for myself.

Table of Contents

List of Tables	v
List of Figures	vi
Abstract	vii
Chapter 1 Introduction	1
Statement of Problem	1
Theoretical Framework	2
Overall Purpose of Study	3
Pragmatist Framework	5
Purpose of Quantitative Study	5
Quantitative Research Question	6
Hypothesis	6
Null Hypothesis	6
Research Hypothesis	6
Purpose of Qualitative Study	6
Qualitative Research Question	6
Educational Significance of Study	7
Definitions	7
Application strands	7
Assessment	7
Classroom size	7
Computational strands	7
Computer-assisted instruction (CAI)	7
Coursework exercises	7
Course session	8
Initial Placement Motion	8
Integrated Learning Systems	8
Internalization	8
Levels	8
Math Concepts and Skills course	9
Participants	9
Primary students	9
Primary teachers	9
Research site	9
Scaffolding	9
Strand	9

Students' gains.....	10
Successmaker Enterprise.....	10
Successmaker Lab.....	10
Successmaker lab adults.....	10
Organization of Remaining Chapters.....	10
Chapter 2 Review of Literature.....	11
Overview.....	11
Integrated Learning Systems.....	12
Implementation of an ILS.....	15
Individualized instruction.....	17
Students' Ability Levels.....	18
Gender.....	19
Motivation.....	20
Theoretical Framework.....	20
Development of Computational Skills.....	20
Early Exposure to Computers.....	23
Constructivist Theory.....	24
Behaviorist Theory.....	27
Social Context.....	29
The Teacher.....	33
Teachers' Attitudes.....	34
Teachers' Collaboration and Leadership.....	36
Teachers' Judgment of Students' Ability Levels.....	37
Teachers' Expertise.....	37
Professional Development.....	39
Teachers' Roles in Implementation of Technology.....	44
Teachers' Roles in Implementation of an ILS.....	47
Summary.....	51
Chapter 3 Methodology.....	53
Participants.....	53
Selection of Participants.....	55
Ethical Consideration.....	56
Delimitations of Study.....	58
Threats to Internal/External Validity for Quantitative Component of Study.....	58
Threat of Verification/Trustworthiness, Legitimation, Authenticity, Credibility.....	60
Quantitative Instruments.....	60
Qualitative Instruments.....	62
Pragmatist Procedure.....	63
Quantitative Procedure.....	64
Qualitative Procedure.....	66
Quantitative Analysis.....	69
Qualitative Analysis.....	69

Combined Qualitative and Quantitative Data Analysis	70
Chapter 4 Results	71
Demographics	72
Quantitative Results	74
Qualitative Results	77
Time in the Successmaker Lab	79
Use of Successmaker Management System Reports	82
Integration of Successmaker into the Curriculum	84
Motivational Strategies	87
Newness to the Successmaker Program	89
Influence of Administration	90
Barriers That Inhibit Effectiveness	91
Factors Leading to Maximum Effectiveness	93
Professional Development	95
Interview with Instructional Technology Facilitator	97
Summary	99
Chapter 5 Implications	101
Introduction	101
Contributing Factors Affecting Student Gains	102
Teachers' Role	103
Teachers' Expertise	106
Teachers' Collaboration	107
Teachers' Attitudes	108
Combined Quantitative and Qualitative Data Analysis	109
Limitations of Study	110
Implications for Future Practice	111
Teachers' Role	111
Teachers' Expertise	112
Teachers' Collaboration	113
Teachers' Attitude	114
Summary	115
Suggestions for Future Research	116
References	118
Appendices	136
Appendix A: Informed Consent	138
Appendix B: Interview Protocol	141
Appendix C: Focus Group Questions	143
Appendix D: Probes/ Confirmations for Focus Groups	144
Appendix E: Instructional Technology Facilitator Interview Protocol	146
Appendix F: Years of Teaching Experience Survey	148
Appendix G: Implementation Log	149

About the Author End Page

List of Tables

Table 1	Years of Teaching Experience and Average Student Gains.....	73
Table 2	Teacher / Average IPM Level / Student Gains / Ranking in Grade.....	74
Table 3	Developing Themes Reported by Teachers with Highest Gains, Teachers with Lowest Gains, and Focus Groups.....	96

List of Figures

Figure 1	Student Ethnicity	53
Figure 2	Teacher Experience.....	54
Figure 3	Teachers’ Advanced Degrees.....	54
Figure 4	Total Years of Teaching Experience - Mean Gains 2004-2005.....	76
Figure 5	Years of Teaching Experience at Research Site – Average Student Gains.....	77

The Relationship Between Teaching Experience and Style and Primary Student Gains in Mathematics Using an Integrated Learning System

Marilyn N. Meub

ABSTRACT

The purpose of this mixed methods study was to ascertain using multiple tools and methods, the impact of teachers' interaction with primary students on mathematics performance using the Successmaker Integrated Learning System to determine effective teacher practices. The sample of nineteen primary teachers from an elementary school in southwest Florida included five first grade teachers, seven second grade teachers, and seven third grade teachers.

Data analysis included total years of teaching experience, years of experience in Florida schools, and years of experience at each grade. Both the total years of teaching and the years of teaching at the research site were correlated to the Student Gains Reports in mathematics provided by the Successmaker Management System. A Pearson Product Moment correlation coefficient was computed to determine whether and to what degree a statistical relationship existed between the variables of years of teaching experience and student gains. Total years of teaching experience and total years at the research site revealed a significant correlation of 0.77 ($p < 0.001$). The correlation between total years of teaching experience and average student gains was not significant ($r = -0.10, p = 0.674$). The third correlation between years of teaching experience at the

research site and student gains also was not significant ($r = 0.03, p = 0.897$).

Therefore, years of teaching experience did not predict total gains.

The qualitative analysis of data collected through interviews with the ITF and teachers who had the highest and the lowest student gains in mathematics at each grade, informal observations, and focus groups, revealed factors that appeared to contribute to teachers' styles and methods which affected student gains. Several factors influenced the styles and methods of the implementation of the Successmaker program. They included: (a) time in the Successmaker lab, (b) use of Successmaker Management System reports, (c) integration of Successmaker into the curriculum, (d) motivational strategies, (e) newness to the Successmaker program, (f) influence of administration, (g) specific barriers that inhibit maximum effectiveness, and (g) professional development. Furthermore, these factors can be categorized into four general themes: (a) teachers' role, (b) teachers' expertise, (c) teachers' collaboration, and (d) teachers' attitude.

Chapter 1

Introduction

Statement of Problem

Student achievement is rewarded and schools are held accountable (No Child Left Behind: Act of 2001). According to President Bush's *No Child Left Behind: Act of 2001*, ...states, districts, and schools that improve student achievement will be rewarded. Failure will be sanctioned. Parents will know how well their child is learning, and schools will be held accountable for their effectiveness with annual state reading and math assessments (Public Law 107-110 p. 2).

The federal government has urged schools to use technology as a tool to attain this heightened academic achievement as stated in the *Goals 2000: Educate America Act of 1994* (Shields & Behrman, 2000). Since 1996, when the federal government initiated the federal Education-rate, or E-rate program, which provides discounts on the cost of telecommunications services and equipment to all public and private schools and libraries, more than \$6 billion have been provided to help schools and libraries obtain computers and maintain connection to the Internet (Shields & Behrman, 2000). In turn, individual school districts have invested their funds for technology with high expectations of increasing students' gains. Computer-assisted instruction (CAI) is one technology-based method that has been used for more than 30 years to overcome children's shortcomings in arithmetic, reading, and writing (Blok, Oostdam, Otter, & Overmaat, 2002). More recently, the computer-assisted instruction combined with

computer-managed instruction to create the Integrated Learning System (ILS). However, despite the funding and attention, some classrooms are not showing adequate students' gains.

Theoretical Framework

Supplying schools with computers is not enough. The U.S. Department of Education under President Clinton, the National Council for the Accreditation of Teacher Education (NCATE), and the National Association for the Education of Young Children (NAEYC) believe teachers' roles influence the ways in which students experience computers (Becker, 1993, 2000; Shade, 1996; Solomon, 1986). According to the principles advocated by Vygotsky (1978, 1986), teachers' roles exist to provide a scaffold to children's problem solving. Seen as key interventionists, teachers provide help when children have difficulty, but stand aside when they succeed (Underwood & Underwood, 1990; Vygotsky, 1978, 1986). Based on Vygotsky's (1978) theoretical framework, teachers' scaffolding will help children who are having difficulty, which in turn should foster internalization to increase academic gains during ILS use.

In 1996, the National Assessment of Educational Progress (NAEP) reported that students whose teachers had professional development in computers outperformed students on standardized tests than those students whose teachers did not (Archer, 1998). Training is essential for computers to be an effective teaching tool (Archer, 1998; Becker 1993; Fulton, 1988; Haughland, 1999). The *No Child Left Behind* (2001) education reform stated one of the leading causes for the poor performance of U.S. students in the area of mathematics is the lack of proper teacher training. More than 20 states have begun to form partnerships with colleges and universities for the purpose of raising mathematics

standards for students by providing mathematics training for teachers (No Child Left Behind, 2001).

The role of teachers change with the inclusion of an ILS. In this new role, teachers are still actively engaged in the teaching process, but as facilitators of instruction as opposed to distributors of information. The amount of inservice training teachers receive before implementation of an ILS, as well as during its use is critical to the effectiveness of the ILS (Blickhan, 1993). Equally important are follow-up opportunities for teachers to collaborate and share effective strategies (Becker, 2000). Other factors affecting ways in which students experience computers in the educational setting include: teachers' attitudes, collaboration and leadership, judgment of students' ability level, expertise, and roles in implementation and integration of technology (Becker, 2000; Ginsburg & Zelman, 1983; Rogers & Newton, 2001; Solomon, 1986).

Overall Purpose of Study

According to the U.S. Department of Education, America's schools are not producing the excellence in mathematics required for global economic leadership in the 21st century. Mathematics is a critical requirement for the information age. Achievement must be improved to maintain our country's economic leadership. While technology advances with lightening speed, stagnant mathematics performances in schools shortchange our students' future and endanger our nation's prosperity and our nation's security (U. S. Department of Education).

The 2003 National Assessment of Educational Progress (NAEP) reported the average mathematics scores showed continued improvement since 1990 for students in both fourth and eighth grade. The percentage of fourth graders performing at or above the

Proficient level in the NEAP mathematics assessment rose from 13% to 32% between 1990 and 2003. The 2003 report did not report data from twelfth grade students, however, in their 2000 report, the NAEP included twelfth grade students which revealed scores had not improved since 1996 and a closer look at these scores reveals that the biggest drop occurred at the lowest levels of achievement. An examination of the 2003 data also revealed the largest percentage of fourth grade students at the below basic level are found in the Black and Hispanic populations. These are the students who most need our help and who can least afford to lose any more ground (U.S. Department of Education, 2004).

Over the past decade, researchers have scientifically documented the best ways to teach reading. The same must be outlined for teaching mathematics. Accumulating research on children's capacities and learning in the first six years of life confirms that early experiences have long-lasting outcomes. Educators are beginning to glean a fuller picture of the mathematics young children are able to acquire and the practices to promote their understanding.

However, there is no consensus of the research regarding factors predictive of increased primary students' gains in mathematics using an ILS. Additionally, few studies have examined the relationship between teaching experience and teachers' effectiveness on students' gains in mathematics using an ILS. Thus, the overall purpose of this research is to ascertain, using multiple tools and methods, the impact of teachers' interaction with primary students on mathematics performance using an ILS to determine effective teacher practices. As yet, this knowledge is not in the hands of most early childhood teachers (NAEYC Position Statement, 2002). The findings from this research may be

used to guide professional development training to meet district, state, and national expectations.

Pragmatist Framework

This research study is a concurrent mixed methods design utilizing both quantitative and qualitative approaches simultaneously throughout the study (Tashakkori & Teddlie, 1998). A mixed methods approach has been selected because it will provide stronger inferences and answer the research questions better than a single method approach (Tashakkori & Teddlie, 2003). The use of both post-positivist and interpretivist paradigms is supported by pragmatists who view both approaches as integrative in manner and needed for comprehensiveness and meaningful understanding (Greene & Caracelli, 1997). Both types of data will be collected at the same time and independently and then merged through triangulation and used best to understand the research problem (Teddlie & Tashakkori, 2003). By using separate methods for qualitative and quantitative methods, weaknesses in each method will be strengthened by the other method (Creswell, Plano Clark, Gutmann, & Hanson, 2003). Combining the two paradigms provides an examination of the phenomenon from different contextual factors, which can strengthen the power of inferences and conclusions (Rocco et al., 2003).

Purpose of Quantitative Study

The purpose of the quantitative aspect of this study is to determine whether years of experience of primary teachers are related to primary students' gains in mathematics using an ILS. Generally, the skills in which people engage on a daily basis become honed over time. Therefore, it is reasonable to posit that as teachers gain experience they become more adept in meeting students' needs, which results in increased students'

gains. This will be researched by collecting data documenting teachers' years in the classroom, as well as data on students' achievement levels.

Quantitative Research Question

The following research question will be addressed in the quantitative portion of this study: Are years of experience of primary teachers related to primary students' gains in mathematics using an ILS?

Hypothesis

Null hypothesis 1. Years of teaching experience are not related to primary students' gains in mathematics using an ILS.

Research hypothesis 1. Years of teaching experience are related to primary students' gains in mathematics using an ILS.

Purpose of Qualitative Study

The purpose of the qualitative phase of this study is to determine those teachers' practices which result in primary children showing a greater-than-average gain in mathematics using an ILS. This will be researched by collecting data through in-depth interviews and focus groups.

Qualitative Research Question

The following research question will be addressed in the qualitative portion of this research: What are the differences in teaching styles and methods between primary teachers with students showing higher-than-average gains in mathematics versus primary teachers with students showing lower-than-average gains using an ILS?

Educational Significance of Study

The information from this study will be helpful for teachers to learn how best to use their time when engaged in ILS use to increase students' achievement more effectively. Computer-assisted instruction has long been associated with a behaviorist

theory of stimulus response (Yazdani, 1987). Support for the research hypothesis could lead to a modification of this theory to include teachers as an integral variable.

Definitions

Application strands. Application strands include number concepts, geometry, measurement, word problems, applications, problem solving, science applications, and probability and statistics (Pearson Education Technologies, 2003).

Assessment. Assessments include a series of test items designed to measure students' current knowledge as accurately as possible (Pearson Education Technologies, 2003).

Classroom size. Classroom size refers to the number of children in the Successmaker lab during the mathematics course session.

Computational strands. Computational strands include addition, subtraction, multiplication, division, fractions, decimals, equations, and speed games (Pearson Education Technologies, 2003).

Computer-assisted instruction (CAI). Computer-assisted instruction is a computer program that requires student responses on what is already known, or by trial and error. It is believed that if the occurrence of an operant is followed by the presentation of a reinforcing stimulus, the strength of it increases (Yazdani, 1987).

Coursework exercises. Coursework exercises are designed to detect and address students' errors as quickly as possible (Pearson Education Technologies, 2003).

Course session. Course session refers to a scheduled CAI course session lasting 15 minutes every day. Extenuating circumstances, including assemblies and arriving late, affect this time. Students' absences also influence the time on each session (Pearson Education Technologies, 2003).

Initial Placement Motion (IPM). Initial Placement Motion is designed to obtain students' appropriate learning levels in the course, which is neither too easy nor too difficult for individuals. This placement mode of operation differs from the instructional mode, not in content used, but in the variation of learning tasks presented to students (Pearson Education Technologies, 2003).

Integrated Learning System. Integrated Learning System is a complex, integrated hardware/software management system using computer-based instruction, which consists of three essential components: the curriculum content, the record system, and the management system (Underwood, Cavendish, Dowling, Fogelman & Lawson, 1996).

Internalization. Internalization refers to a theory of Vygotsky (1978), which posits that any function in children's cultural development appears twice, or on two planes. First, it appears on the social plane among people, and then on the psychological plane within children. Internalization of newly learned strategies is paramount in Vygotsky's (1978) theory.

Levels. Levels in the Mathematics Concept and Skill (MCS) program include K-8. This level correlates with grade level objectives as set by national standards (Pearson Education Technologies, 2003).

Math Concepts and Skills course. Mathematics Concepts and Skills course is an interactive practice and assessment in elementary mathematics foundations (Pearson Education Technologies, 2003).

Participants. Participants are a voluntary sample taken from the population of all primary teachers located at the research site.

Primary students. Primary students refer to students in this study who are currently enrolled in first, second, or third grade at the research site.

Primary teachers. Primary teachers are teachers who teach first, second or third grade.

Research site. The research site for this study is an elementary school located in the southwestern part of Florida. This school has been an A-rated school by the Florida Department of Education and has a current population of 844 students from pre-kindergarten through fifth grade.

Scaffolding. Scaffolding is explained by Vygotsky (1986, p. 188) as “...what the child can do in cooperation today he can do alone tomorrow...” Learning must be seen as a collaboration of active children and an active social environment in a Vygotskian classroom (Vygotsky, 1986).

Strand. A strand is composed of learning objectives identified by course level, corresponding to the level of difficulty of the material. The material for each strand spans several years of school instruction (Pearson Education Technologies, 2003).

Students’ gains. Students’ gains are defined as gains made by students as measured by a report generated by Successmaker Management System, which shows students’ gains made since IPM (Pearson Education Technologies, 2003).

Successmaker Enterprise. Successmaker Enterprise is a part of NCS Pearson.

Successmaker lab. Successmaker lab is a computer lab at the site of this study, which consists of 30 iMac computers situated around the outside perimeter of a room. Each station has a set of headphones. Students face the wall when sitting at the computer and work individually, unless assisted by an adult.

Successmaker lab adults. Successmaker lab adults may include teachers, university interns, students' parents or grandparents, volunteers, and/or aides.

Organization of Remaining Chapters

The remaining chapters present relevant information to this study. Chapter 2 is a review of the literature that pertains to computers and students' achievement, and the role of teachers in the effective implementation of the software available in schools. Chapter 3 will discuss the methodology to be utilized to address both the qualitative and quantitative questions addressed in this proposal. In Chapter 4, the results of the study will be presented including quantitative and qualitative outcomes. Chapter 5 will provide a discussion of the findings, a summary, and recommendations for future practice and research.

Chapter 2

Review of Related Literature

Overview

Improving students' academic gains is the driving force behind many education mandates, incentives, reforms, and accountability. Strategies to increase primary students' achievement in mathematics include various types of computer-managed instruction. Due to the complexity of students' achievement, extensive research exists in the domain of increasing students' achievement and decreasing the achievement gap. Chapter 2 examines the existing literature as it relates to the factors predicting achievement in mathematics made by students using an ILS.

This evaluation of literature focuses on ILS models, theoretical framework, and teachers' roles. Additionally, the following factors are examined: implementation of an ILS, individualized instruction, students' ability levels, gender, motivation, development of computational skills, early exposure to computers, constructivist approach, behaviorist approach, social context, teachers' attitudes, teachers' collaboration and leadership, teachers' judgment of students' ability levels, teachers' expertise, professional development, and teachers' roles in integration and implementation of technology. Each factor is reviewed based on its relationship to the achievement gains made by primary students in mathematics using an ILS. Chapter 2 concludes with a summary of the

research surrounding the factors predicting the increased achievement in mathematics of primary students using an ILS.

Integrated Learning Systems

During the late 1970s and the 1980s, the U. S. Department of Education subsidized Chapter I (renamed Title I in 1995) and Special Education with the financial resources to invest in instructional technology. The needs of students serviced by these agencies called for highly individualized software which focused on basic skills. This need inspired educational software companies to create products to meet the demands of the specialized market. As a result, computer-assisted instruction (CAI) was introduced to schools after two decades of research undertaken at universities, corporations, and multi-million dollar expenditures by federal and state governments, as well as by corporations (Magidson, 1978; Suppes & Macken, 1978).

More recently, twelve private vendors developed computer systems that took CAI to new heights by adding sophisticated management systems (Estep, McInerney & Kosmoski, 1999). These ILS models became one of the fastest-growing and largest markets for technology in schools. In 1990, schools spent approximately \$200 million on ILS technology (Bailey, 1992). This software-based approach has served more than 2 million students in 16,000 schools across the country (National Clearinghouse for Comprehensive School Reform, 2002).

With Congress, the President, and state and national organizations supporting accountability, individual school districts have invested their funds for technology with high expectations of increasing students' gains. Educators have examined various ILS models that complement school improvement goals and work toward closing the

achievement gap. One of the most successful models found is based on the Success-in-the-Making (Successmaker) approach, developed in 1967 by Patrick Suppes of Stanford University, and Mario Zanotti, a nationally renowned psychometrist.

An ILS is a complex, integrated hardware/software management system using computer-based instruction, which consists of three essential components: the curriculum content, the record system, and the management system (Underwood, Cavendish, Dowling, Fogelman & Lawson, 1996). Lessons are integrated into the standard curriculum and courseware is delivered on a networked system that spans several grade levels. The management system collects and records results of students' performance. An ILS can randomly generate problems, adjust the difficulty and sequence of problems based on students' performance, and provide appropriate and immediate feedback (Bailey, 1992). Feedback makes an important contribution to students' motivation and encouragement, improves confidence, and is especially effective when it is adaptive (Rogers & Newton, 2001).

This mastery-learning model supports the belief that the use of technology in the classroom can accelerate learning. The software automatically determines students' paths through the computer program. Students are able to complete increasingly more difficult work, as measured by embedded assessments, which align with national, state and local education objectives (Pearson Education Technologies, 2002).

The combination of individualized instruction and a management system makes an ILS appealing to school districts. However, these systems are not a trivial expense for a school. The initial outlay of cash for a school to purchase an ILS averages from \$60,000 to \$100,000. Sixty thousand dollars will buy twenty-six student stations, a computer that

functions as the server, a printer, and the coursework (Estep et al. 1999). Becker (1992) argues that perhaps monies could be better spent on mandating smaller classes, raising teachers' salaries to attract more educated people into the teaching profession, purchasing printed material, providing inservice training for handling classroom managements problems, or training in the use of other innovative instructional programs.

Much school time is spent on administrative or classroom management tasks and moving students from one activity or instruction location to another. Little time is left for attending to academic learning. Today, the cost of computer hardware constrains schools to make a choice between having a sufficient number of computers in an inconvenient, temporary, rigid computer lab, and an insufficient number of computers in more convenient classroom locations. Either way, the cost and space requirements of computer-based approaches to learning still hinder the creation of smoothly running systems. However, an ILS, running under automatic scheduling, tends to encourage more academic learning in the same way any scheduling system would (Becker, 1993).

Assuming the premise that an ILS does dramatically increase students' achievement, it is understandable why many districts facing public scrutiny over test scores are quick to devote large portions of their budgets toward the purchase and maintenance of an ILS (Estep et al. 1999). Exceptional academic progress by those students who use an ILS has been a major lure for districts to invest in these systems. However, according to Estep et al. (1999) the claim that this hefty investment results in increased students' achievement, compared to achievements in similar schools, which do not use an ILS, is unsubstantiated. They report that with few exceptions, the data to support these claims have come from the vendors, school districts with heavy

investments in the system, and consultants hired by the vendors. Independent researchers are hard pressed to offer studies with a scientifically acceptable design. School districts that have purchased an ILS are reluctant to put some students on the systems and then deny others the same opportunity for the sake of developing experimental and control groups (Estep et al. 1999). Becker (1992) states the poor quality of most evaluations and the likely bias of reported information provides too weak a platform for district purchasing decisions.

Implementation of an ILS. The Milken Exchange on education technology examined over 700 empirical research studies, a study of the entire state of West Virginia, a national sample of fourth and eighth grade students, and newer educational technologies. They reported that students with access to computer-assisted instruction, or ILS technology, or simulations and software that teach higher-order thinking, or collaborative networked technologies, or design and programming technologies showed positive gains in achievement on researcher constructed tests, standardized tests, and national tests (Schacter, 1999).

A three-year longitudinal study (1995-1998) assessing the impact of the Successmaker ILS on students' achievement was conducted in the Methacton School District Elementary Schools, Pennsylvania. The average for the three years of SAT-9 quartile rankings for third, fourth, and fifth grade students using this ILS technology exceeded the average percentile rankings of the four years prior to the implementation of Successmaker (Pearson Education, 2002).

The Department of Education Training and Youth Affairs conducted a three-year research study (1997-2001) using the Successmaker ILS. Researchers noted that the

systematic use of an ILS in primary schools produced substantial growth in number achievement for most children. Children in the study gained an additional six months, on average, in mathematics compared with children who worked with the normal school curriculum. In the areas of curriculum that were particularly suited to computer presentation (i.e., spatial thinking), there was some evidence that gains could be as great as one year. After working with an ILS for three years, fifth grade children could have performance levels equivalent to sixth grade children (Fitzgerald & Fitzgerald, 2002).

A pilot study was initiated by the Loudoun County Public Schools, Virginia, during the 1996-1997 school year. The purpose of the study was to evaluate the use of the Successmaker ILS on students' achievement in mathematics. The population of students in second through fifth grade showed an achievement improvement in mathematics, which was not shown in the schools that did not use Successmaker (Pearson Education, 2002).

Studies conducted in early childhood classrooms that utilized computer-assisted instruction in mathematics showed positive effects. Deatsman and Keough (1989) reported the greatest gains were in the use of drill- and-practice for primary grades. Brinkley and Watson (1987-1988) reported three-year olds learned sorting from a computer task as easily as from a concrete task. Gains in counting and numeral recognition skills were also reported for kindergartners (Corning & Halapin, 1989). A study by McCollister, Burts, Wright, and Hildreth (1986) of 53 kindergarten children suggested that the computer may be superior to the teacher for children able to proceed through lessons rapidly, however, teacher-assisted instruction appeared to be more appropriate for the facilitation of new concepts.

Individualized instruction. One of the key features of an ILS is that students have an individualized and personalized learning program (Bailey, 1992). The management system keeps records of students' performance and, in the case of Successmaker, moves them through the levels of difficulty as appropriate. This system also allows teachers to set up various course options to focus on the needs of students. When students perform well, they can make rapid progress onto higher levels of difficulty. When they experience problems, they are given more practice and may be given additional tutorial and support questions on various skills. In addition, the statistical data of students' accomplishment generated by an ILS are presumed to be useful for guiding instruction, remediation, and placement (Becker, 1993). These data are gathered automatically and can be printed out in a series of different reports for parents, teachers, and administrators. The management system can also predict future performance (Pearson Technologies, 2002).

Slavin (1983) suggests that the most difficult problem of school and classroom organization is accommodating instruction to the needs of students with different levels of prior knowledge and different learning rates. The primary distinguishing characteristic of an ILS is that it provides, through individualized task sequences, a solution to the pervasive problem of classroom heterogeneity. An ILS provides a fast pace for self-teachable students who are ahead of the class. It provides students who are further along in their understanding than the rest of the class with a more appropriate level of instruction. These students are unobstructed from the slower pace of a classroom, caused by teachers' responsibility to attend to other students' learning difficulties. At the same time, an ILS provides a slower pace for students who work slowly, who lack prerequisite understanding for dealing with the pace of instruction set by the typical students in the

class, or who have specific learning disabilities which interfere with rapid pace mastery. Thus, through individualization, an ILS directly addresses the problem of appropriate level of instruction for students (Slavin, 1983).

A further benefit for academic learning time provided by an ILS is that it provides individualized materials thereby relieving teachers of the mechanics of handling individualized assignments and further increases the proportion of teachers' time available for direct instruction and providing personal tutorial or remedial assistance (Slavin, 1983).

Students' ability levels. Fitzgerald and Fitzgerald (2002) found that those children who scored low on the second grade mathematics pre-test made significant and substantial gains during the first year of ILS use. In subsequent years, this group tended to maintain or slightly increase their gains. Similarly, Dale Mann's 1999 study of West Virginia's Basic Skill/Computer Education (BS/CE) program had similar findings in that all low-achieving students' test scores rose to a greater extent than other students' test scores on the Stanford Test. In contrast, children in the Fitzgerald and Fitzgerald (2002) study who scored high on the second grade mathematics pre-test maintained their percentile ranking, but displayed no evidence of gain.

Another study conducted by Cheryl Laub, in the Hempfield School District, Pennsylvania, during the 1994-95 school year, examined the impact of ILS technology on elementary students' achievement in mathematics. The study was designed to investigate the rate of learning of low-, average-, and high-achieving students in the use of the Successmaker courseware, Math Concepts and Skills. The results showed higher-achieving students' mean scores increased more than the average-achieving students'

mean scores, and the average-achieving students' mean scores increased more than the low-achieving students' mean scores. These results conflict with both the Mann study (1999) and the Fitzgerald and Fitzgerald study (1997-2001), in which low-achieving students made the greatest gains.

According to the Slavin model, the outcome of an instructional intervention is only as successful as its least successful component - level of instruction, time, incentive, and instructional quality (Becker, 1993). This evidence came from the results of examining an ILS program's effectiveness on three groups of students in the same ILS classroom: students in the lower-, middle-, and upper-portion of one class' initial achievement distribution. The individualized ILS seemed to work best for students in the upper-group, which raised their test scores substantially. In addition, an ILS also helped the students in the lower-portion of the class distribution. However, students at the middle of the starting distribution profited least from the ILS. Becker (1993) purports that the results from this research showed that for students below the class mean, an ILS intervention should replace teacher-directed instruction.

Gender. The results of the Department of Education Training and Youth Affairs research study indicated that males scored at a uniformly higher level than females on the second grade mathematics pre-test in each of the three years of the study (Fitzgerald & Fitzgerald, 2002).

This result of gender differences in gains contradicts the Mann study (1999) of the BS/CE program, which analyzed a representative sample of 950 fifth grade students' achievement from 18 elementary schools across the state. In this study, girls and boys did not differ in achievement.

Motivation. Motivation is key to learning, and perhaps teachers' most critical job is to see that students are motivated to work on instructional tasks until they can accomplish the desired objectives. An ILS provides what at first seems to be a highly motivational environment for students to learn and practice important concepts. These programs incorporate visually-appealing graphics, often include games or other challenging activities, and have interesting content. However, the repetitive nature of design of large-in-scope computer-based systems soon begins to diminish the enthusiasm of student users. Becker (1990) reports the results of a study which showed the more experience students had with computers in other classes, the less effective their experience was in the class where students' achievement was measured.

Theoretical Framework

A joint statement of the National Association for the Education of Young Children (NAEYC) and the National Council of Teachers of Mathematics (NCTM) affirms that high quality, challenging, and accessible mathematics education for three- to six-year old children is a vital foundation for future mathematics learning. Mathematics helps children make sense of their world outside of school and helps them construct a solid foundation for success in school. In every early childhood setting, children should experience effective, research-based curriculum and teaching practices. Such high quality classroom practice requires policies, organizational supports, and adequate resources that enable teachers to conduct this challenging and important work (NAEYC Position Statement, 2002).

Development of computational skills. Educators use IQ and achievement test scores to predict future school achievement. However, these tests show relatively little

about the processes through which children learn, and ways in which to teach children more effectively. As a result, research on children's thinking has focused increasingly on the specific processes involved in learning (Siegler, 2005).

As children develop computational skills, they develop a process in selecting appropriate strategy choices in mathematics, which include choosing whether to state answers from memory or revert to more time-consuming alternatives. In the first few years of school, children use a wide variety of strategies to solve single-digit arithmetic problems. In addition to retrieving answers from memory, they also count on their fingers from one, count from the larger of the two addends and infer answers from knowledge of related problems (Geary, Fan, & Bow-Thomas, 1992).

Siegler (2005) points out that as children gain experience, their strategy use changes in different proportions. The most striking change is toward increased use of retrieval. After a few years of adding and subtracting, most children retrieve answers to most of their basic facts. Their use of strategies other than retrieval also change. During this same period, children also solve arithmetic problems increasingly quickly and accurately. The changes in speed and accuracy develop because of changes in which strategies are used and because of changes in the extent to which each strategy is efficiently executed. Children tend to choose the fastest approach that they can execute accurately (Siegler, 2005).

The manner in which children choose so adaptively among the alternative strategies was examined in the Siegler and Shipley (1995) strategy-choice model. Siegler (1998) stated that the mechanism by which children make this choice involves two interacting parts: "a representation of knowledge about particular problems, and a process

that operates on the representation to produce performance” (p. 287). This representation involves associations of varying strengths between each problem and potential answer both correct and incorrect. Representations of different problems can be thought of as “varying along a dimension of peakedness”(p. 288).

A study conducted by Kerkman and Siegler (1993), revealed that children who executed backup strategies the most accurately in first grade used retrieval the most often by second grade. A peaked distribution resulted from most of the associative strength being concentrated in a single answer. If a child had a peaked area, there was less frequent need for children to use overt strategies, which resulted in fewer errors, and shorter solution times (Siegler, 1993).

This model has illuminated the ways in which children differ from each other. The model suggests two dimensions along which children could differ in the peakedness of their distribution. The first reflects differences in how well children know correct answers to the problem. The second reflects differences in the level of certainty needed before children stated a retrieved answer (Siegler, 1998).

An examination of the presentation format of the Successmaker ILS reveals a consistency with the strategy-choice model. When students are first presented with a new problem, visual manipulatives are available for the students. This is not only true for basic facts, but includes visual support for word problems, coins, measurement, and place value. Backup strategies are presented each time children answer a question incorrectly. As children begin to improve accuracy of a set of facts through rehearsing, the manipulatives no longer are shown on the screen. However, as soon as children show difficulty by giving an incorrect answer, the visual manipulatives are presented on the

screen again. If children continue to give an incorrect answer, the program counts the objects both visually, by showing the numbers and auditorally, by saying the numbers to assist the child in mastery. This immediate remediation helps increase automaticity and confidence. Individual children who are able to master computation skills faster, have continual quick reviews in each math session using Successmaker, while allowing them the time to be exposed to more problems that are complex.

Early exposure to computers. The 1980s and even the early 1990s heard numerous critics rail against the use of computers with young children. David Elkind, a former president of the National Association for the Education of Young Children (NAEYC), and a former student of Jean Piaget has been concerned about the efficacy and appropriateness of early exposure to computer instruction. Elkind (1987) views the computer as a vehicle to accelerate children in their development, to put them at risk for negative attitudes and failure, and to prevent them from actively manipulating the environment (Brown, 1996).

In a September 12, 2000 statement, The Alliance for Childhood announced various serious health hazards that computers pose to children including: risk of repetitive stress injuries, eyestrain, obesity, social isolation, and for some, long-term damage to physical, emotional, or intellectual development. Additionally, technology was cited as distracting children from strong personal bonds with caring adults. Cordes and Miller (2000) documented teachers have been observing children in our electronic society becoming alarmingly deficient in generating their own ideas.

Much of the concern for using computers in the early childhood learning situation is rooted in the findings of Piaget (Shade, 1996). Piaget defined a level of

development from approximately eighteen months to six to seven years of age, which he called the intuitive, or the preoperational level. Numerous educators express the most concern about computer instruction during this developmental stage. They assert that children at the preoperational stage of thinking need opportunities to construct their own knowledge through manipulation of three-dimensional, sensory-stimulating objects. These hands-on activities are regarded as important components of constructivist learning (Brown, 1996).

Constructivist theory. At present, the most influential learning theory is called “constructivism” or “progressivism” (Bowman, 1999). Constructivism centers on student activity. Constructivists direct attention toward the construction of environments suitable for learning by discovery, which includes settings where students may explore and, thereby, construct new understandings for themselves (Cook, 1993). It emphasizes the importance of young children constructing their own knowledge through their own creative activity, as opposed to simply being told correct answers by others.

Kohn (1993) purports that if our goal is quality, or a lasting commitment to a value or behavior, children’s desire for the construction of knowledge needs to be founded on the power of intrinsic motivation. Kohn defines intrinsic motivation as the “desire to engage in an activity for its own sake – that is, just because of the satisfaction it provides” (p.290). Kohn believes it is important “to avoid rewarding people for engaging in an activity or behavior that we would like them to find intrinsically motivating” (p. 87). Wolfgang (2000) purports that the use of superficial reinforcers disregards developmental theory that views the child’s actions with regard to developmental constructs.

According to Kohn (1993), the source and nature of the motivation is equally as important as the extent to which someone is motivated. The motivation to learn should be nurtured in an environment where intellectual curiosity is encouraged. Young children do not need to be rewarded to learn. They have a desire to learn if they are interested in what they are learning. When students are enthusiastic and motivated, they will be more likely to take seriously the things they are learning by finding them meaningful and worthwhile.

Kohn (1993) believes the type of motivation influences the effectiveness of the motivation. Stars, incentive plans, praise, and other extrinsic motivators only provide motivation for a short period because they are inducements outside the task itself. Wolfgang (2000) describes extrinsic motivators in terms of *social reinforcers*, which include verbal praise and teacher attention, *activity reinforcers*, such as earning a toy, and *tangible reinforcers*, including stickers. Kohn (1993) purports that rewards, like punishments, actually undermine the intrinsic motivation that promotes optimal performance.

Shade (1996) and Shade and Davis (1997) purport that some early childhood educators have misinterpreted Piaget's theory of the preoperational stage as implying that children younger than the age of seven can develop cognitively only by manipulating materials with their hands and therefore should not use a tool employing symbolic contents, such as a computer, in an educational setting (Shade, 1996; Shade & Davis, 1997). Sheingold (1986) points out that many activities in which young children participate are symbolic: finger play, modeling figures with play dough, and even singing. Clements (1987) believes children cannot only complete the functional tasks of using a computer, but they can also talk meaningfully about their computer activity, work

successfully in dyads, help one another, take turns, and share the computer, while enjoying enhanced development in each curriculum area. Shade (1996) states it is erroneous to conclude that Piaget meant only three-dimensional, solid forms when he used the word 'concrete.' He also calls further scrutiny to his claim by questioning the length of time that educators have used flat two-dimensional picture books in early childhood. Clements and Nastasi (1993) agree that "what is concrete to children may have more to do with what is meaningful and manipulatable than with its physical characteristics" (Clements & Nastasi, 1993 p. 259). Clements and McMillen (1996) point out that it cannot be assumed that children's conceptions of manipulatives are similar to those of adults' conceptions.

Seymour Papert, a mathematician, one of the early pioneers of Artificial Intelligence, and an internationally recognized seminal thinker about how computers can change learning, sees learning as a constructivist process. Papert's whole philosophy of educational computing is rooted firmly in Piagetian theory. Papert asserts that the knowledge children acquire is shaped and facilitated by the knowledge that they already have, which Piaget labeled the process of assimilation and accommodation of new information by pre-existing schema. As a result, Papert advocates the 'learning by doing' or self-discovery approach to learning, where children are allowed to discover knowledge for themselves, at their own pace, and in ways suited to their own individual style of thinking (Simon, 1987).

In his widely influential book, Mindstorms: Children, Computer, and Powerful Ideas (1980), Papert pointed out that microcomputers could be used to simulate environments that provide children with the conditions necessary for the reorganization

of their understanding, and he argued that children could acquire powerful problem-solving tools very effectively by learning to program. The support for the claim made for having children learn to program is that through interaction with a physical microworld, they will acquire a toolkit of general problem-solving subskills (Underwood & Underwood, 1990).

Becker and Riel (1999) purport that teachers' philosophies are largely constructivist but that school bureaucratic culture and public expectations for measurable documentation of students' achievement severely constrain most teachers from implementing constructivist pedagogy in daily practice. Roschelle, Pea, Hoadley, Gordin and Means (2000) assert that although active, constructive learning can be integrated into classrooms without computers, the characteristics of computer-based technologies make them a particularly useful tool for this type of learning.

Behaviorist theory. While some educators state that computers are linked to constructivist theory, others have found computers linked to the behaviorist theory. Behaviorists attempt to arrange environments to help children to learn and grow, not accidentally or through hoping, but intentionally and through professional actions (Neisworth & Buggey, 1993). A fundamental principle of behaviorism is that behavior is controlled by its consequences, and learning depends on its outcome. For example, when a behavior continues, the consequence must have been reinforcement. On the other hand, if the frequency of the behavior decreases, the consequence must have been punishment.

This prevailing behaviorist theory of Skinner and the programmed learning machines of the previous century influenced the development of computer-assisted instruction (Yazdani, 1987). Today, an ILS requires learners to be actively involved in

responding to stimuli provided. Based on a “behaviorist” theory of learning that emphasizes stimulus, response, and reward, an ILS gives students a certain number of problems (sometimes after a pre-test), offers direct feedback on whether the answer is correct or incorrect, and dispenses a reward for correct performance. Rewards range from a verbal prompt (“Great job!”) to a game, which may occupy the students for longer than the actual drill (Healy 1998).

According to the behaviorist approach, human learning is primarily a psychological phenomenon that occurs between the individual learner and the task of content to be mastered, rather than a social phenomenon in which interpersonal dialogue transforms understanding. Competence is acquired by reading, listening, or watching relevant information and by calculating answers or choosing from among preselected answers to presented questions. Consequently, students’ ability to master skills and principles depends principally on the knowledge and skills that they already possess and on the motivation to attend to their task. Since each individual in a typical heterogeneous classroom has a different set of prior skills and understandings, instructional activities are constructed best on an individual basis rather than according to the traditional school practice of subjecting all students in a class to the same tasks at the same time (Becker, 1993).

Patrick Suppes, designer and president of Computer Curriculum Corporation (CCC), which produces and markets his computer-based educational material, came to computers from a background in philosophy and logic. He has a logical approach to mathematics, and a behaviorist mathematical modeling theory of learning. Suppes’ active involvement in children’s learning of mathematics began in the mid-1950s in a

precomputer setting. He believes that mathematics or any other subject matter can be broken down into individual facts, and that the relationship among individual facts or elements can be organized hierarchically. Behaviorism tends to favor fragmentation of knowledge into small units, and elementary arithmetic lends itself to such an approach (Solomon, 1986).

Computers are particularly attractive to Suppes because they deliver exercises to different children in the same teaching styles; and yet computers can be programmed to individualize the content by selecting easier or harder exercises, depending on how students have performed in the past. Suppes' analyses of computational skills have shown that the computer does as well in five to ten minutes per student per day as effective teachers conducting the same sort of drill-and-practice in 25 minutes per student per day, at least for poor and minority students (Solomon, 1986). Suppes' approach is attractive to different people for different reasons. Theorists support the clear intellectual structure and scientific pedigree. Empiricists favor that the effectiveness can be measured. Administrators advocate its clear cost structure. Teachers enjoy it because they are free to do other activities.

Social context. Computers are often referred to as a tool to facilitate learning (Davis & Shade, 1997; Underwood & Underwood, 1990). The definition of a tool is something that helps to solve problems; an instrument that facilitates performing an action. Tools can be either physical, extending our abilities to do things beyond our natural capacities or mental, extending our mental abilities (Bodrova & Leong, 1996). According to Vygotsky, tool use stimulates thinking because of the flexibility it imparts to the action (Ratner, 1991). The general consciousness that is associated with tool use is

a voluntary consciousness that decides how, when, and which tools to use (Ratner, 1991). Tool use also stimulates relational thinking between the instrument and the goal (Ratner, 1991).

Vygotsky believed development was formed when concrete spontaneous concepts were restructured into systematic, abstract concepts during school instruction (Vygotsky, 1978). Vygotsky continued that the proper development of children's minds depended on learning how to use various psychological tools (scientific concepts). Vygotsky argued that children's intellectual growth was not an autonomous, self-guided affair as Piaget claimed, but depended largely on social tools such as spoken language, written language, and mathematical procedures that their culture provided for them. According to Newman and Holzman (1993), there is a distinction to be made between 'tools for results and tools and results.' The former refers to acquiring a tool in order to do something new, such as a calculator to do sums more quickly. The latter infers that the tool is inseparable from the development in question.

According to the principles advocated by Vygotsky (1978,1986), teachers' roles exist to provide a scaffold to children's problem solving. Teachers often guide children as they approach problems, thus facilitating growth (Clements, 1993; Underwood & Underwood, 1990). The strategies of more competent people provide a temporary framework that allows children to think in more advanced ways than they otherwise could when working independently.

Vygotsky's perspective has led researchers and theorists to examine ways in which computers perform in those activities typically shared between children and parents or children and teachers. It is with this purpose that researchers are trying to

identify the processes that might mediate effective peer collaboration, and to help anticipate the special features that computers might have for collaborative work. Research tends to suggest a potential for learning within peer interaction that goes beyond any benefits from watching more able partners (Crook, 1987).

Using technology to promote such collaborative activities can enhance the degree to which classrooms are socially active and productive, and can encourage classroom conversations that expand students' understanding of the subject (Clements & Sarama, 2000; Roschelle et al., 2000). Similarly, the research currently being conducted indicates that computer use can contribute to children's self-perception and affect children's socialization in a variety of ways in school and at home. In the school environment, shared computers often have been found to lead to groups' interaction and cooperation rather than social isolation.

Young children's social interactions in a computer center are found to resemble interactions in other play areas. Computers can facilitate social interaction and cooperation, friendship formation, and constructive group play (Wartella & Jennings, 2000). The role of computers in fostering social relationships is further supported by observations that children usually turned to each other, rather than an adult, for computing advice, even if an adult was available (Clements, 1987).

Learning research has shown that students learn best by actively constructing knowledge from a combination of experience, interpretation, and structured interactions with peers and teachers. Curricular frameworks now expect students to take active roles in solving problems, communicating effectively, analyzing information, and designing solutions; skills that go far beyond the mere recitation of correct responses. Becker

(1993) purports most CAI software, including that of the ILS, remains inconsistent with research in child and adolescent learning conducted over the past few decades by social psychologists, cognitive psychologists, and social linguists. This new research on learning argues that childhood learning is primarily a social activity. More specifically, most competence is attained only through learners' active integration of their previous beliefs with new ideas comprehended primarily through dialogue, and are not attained merely by remembering, applying, and practicing a given algorithm (Becker, 1993).

An early concern that computer technology encourages asocial and addictive behavior by isolating children, as mentioned by the Alliance for Childhood (2000) was alleviated by research. In contrast to what has been assumed, it was demonstrated that computers serve as catalysts for social interaction (Clements & Sarama, 2000). However, the software children use affects children's social interaction. Open-ended programs such as Logo foster collaboration. Drill-and-practice software, on the other hand, encourages turn-taking and competition. Additionally, the physical environment also affects children's interactions (Clements, 1999). Several computer-based applications, such as tutorials and drill-and-practice exercises, do engage students individually.

This interdependence of adults and children in contributing to emergent understanding through joint involvement in culturally-meaningful activities is at the heart of Vygotskian school experiences (Berk & Winsler, 1995). A basic premise of Vygotsky's theory is that uniquely human, higher forms of mental activity are derived from social and cultural contexts and are shared by members of those contexts because these mental processes are adaptive (Berk & Winsler, 1995). Vygotsky considered developmental accomplishments as outgrowths of the social situation (Bodrova & Leong,

1996). Social contexts give students the opportunity to successfully carry out more complex skills that they could not execute alone (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

Mevarech (1993) conducted a study to examine the differential effects of cooperative and individualized CAI on achievement in mathematics. The results showed that while high-achieving students benefited equally well in cooperative and individualized computer-assisted instruction, low-achieving students tended to progress faster in cooperative CAI than in individualized CAI. In addition, the study showed that interpersonal relationships relating to both academic recognition and social acceptance were more positive in cooperative CAI than in individualized CAI.

The Teacher

Cognitive research has shown that learning is most effective when four fundamental characteristics are present: (1) active engagement, (2) participation in groups, (3) frequent interaction and feedback, and (4) connections to real-world contexts (Roschelle et al., 2000). Some of the pioneers in learning research also have been pioneers in exploring how technology can improve learning. These connections are not coincidental. As scientists have understood more about the fundamental characteristics of learning, they have realized that the structure and resources of traditional classrooms often provide quite poor support for learning, whereas effectively-used technology can enable ways of teaching that are much better matched to how children learn (Roschelle et al., 2000).

Many factors affect the ways in which students experience computers in the educational setting including: teachers' attitudes, collaboration and leadership, judgment

of students' ability level, expertise, and roles in integration and implementation of the technology (Becker, 2000; Ginsburg & Zelman, 1983; Rogers & Newton, 2001; Solomon, 1986).

Teachers' attitudes. Solomon (1986) believes that the most important factor in the way students experience computers lies in teachers' attitudes. The way in which teachers utilize the computer is influenced by teachers' attitudes toward the educational purpose and appropriateness of the computer. The computer can be relegated to a dust collector in the corner of the classroom or developed into an integral part of the learning experience based on teachers' attitudes toward its drawbacks or benefits. Teachers' understanding and involvement with the computer is a key factor influencing its effectiveness (Solomon, 1986).

Teachers must value the use of computers for enhancing the learning of important skills and content. Becker (2000) affirms teachers are not likely to integrate a software application into the curriculum unless it is compatible with their instructional goals. Becker (2000b) purports that it is becoming increasingly obvious that all the staff development and technology support in the world might not be effective if teachers have beliefs about teaching and learning that contradict the assumptions of the training and support. Dexter, Anderson and Becker (1999) interviewed 47 teachers regarding their perceptions of the impact of computers on their classroom practice. For the most part, teachers viewed computers as helping them implement changes to their pedagogy that they wanted to accomplish, but which they had previously been unable to accomplish. Teachers who had adopted more progressive teaching practices over time felt that computers helped them to change; but they did not acknowledge computers as the

catalyst for change. Instead, they cited reflection upon experience, classes taken, and the context or culture of the school as the catalyst (Dexter, Anderson, & Becker, 1999).

A teacher attitude survey conducted at the Methacton School District Elementary Schools (1995-1998) revealed that teachers were more comfortable with computers in 1998 than in 1995, when an ILS was implemented at their site. In 1998, the teachers were more strongly in agreement that computer technology had forced them to rethink the way in which they traditionally delivered instruction than in 1995 (Pearson Education, 2002).

The Teaching, Learning and Computing National survey, funded by the National Science Foundation with additional funds provided by the Office of Educational Research and Improvement, U.S. Department of Education, conducted by Becker, Ravitz and Wong (1998), through the Center for Research on Information Technology and Organizations survey, reported particular types of software were used more often when the applications were consistent with teachers' philosophies and objectives for the use of technology. For example, according to the survey, the two types of software most commonly used by students under their teachers' direction were word processing and reference materials on CD-ROM. The findings from this 1998 survey also revealed these applications paralleled the two objectives that teachers most frequently selected as most important for students' computer use: (1) expressing themselves in writing, and (2) finding out about ideas and information. Similarly, teachers who assigned the use of presentation software were those who most valued computers for their role in helping students to learn how to present information to an audience. In addition, teachers were three times more likely to have their students use the Internet if they held more constructivist beliefs about teaching in general.

Becker's (2000) analysis of the 1998 data indicates that these types of teachers believe in devoting attention to student interest, focusing on critical thinking and real-world application, and using complex problem solving in small groups to help students learn. This contrasts those teachers with more traditional beliefs who employ practices that focus on curriculum coverage (Becker, 2000). Additionally, positive attitudes toward technology by both teachers and students, as well as teacher training in technology led to the greatest students' achievement gains (Mann, Shakeshaft, Becker, & Kottkamp, 1999).

Teachers' collaboration and leadership. Becker's (2000) examination of the 1998 national survey of schools and teachers suggests further that teachers' attitudes regarding collaboration with each other has an impact on the way in which students experience computers. Becker (2000) reports teachers who professionally interact with their peers on instruction, subject matter issues, mentoring, and teaching workshops are more likely to have their students use computers regularly during lessons with more types of software than teachers whose sole focus is on their own classroom. More specifically, the most professionally engaged teachers are ten times more likely to be highly-active computer users (Becker, 2000), utilizing email, multimedia authoring, and presentation software. Those teachers oriented toward collaboration with each other and toward leadership roles in their professions are the strongest users of technology.

As teachers explore software and build skills, Haughland (1999) proposes that opportunities must be given to them to mentor other teachers who are having difficulty with a program they have already explored. Mentors provide teachers with affirmation, support, and new possibilities for using computers in their classrooms. It is essential that the teacher-training environment be one of acceptance that promotes exploring ideas,

raising questions, and discussing concerns or problems (Haugland, 1999). Becker (2000) claims one of the best ways for teachers to develop effective strategies for integrating technology into curricula is through networking and collaborating with other teachers. Yet, teachers have difficulty finding time to engage in such networking, which often does not count toward requirements for professional development. To encourage and reward teachers for time spent networking and collaborating with other teachers to enhance classroom learning by using computers, Becker (2000) proposes that federal, state and local education agencies allow such time to count toward professional development requirements.

Teachers' judgment of students' ability levels. Another factor influencing the way in which students experience computers is teachers' judgment regarding students' ability levels. According to the 1998 data collected, students categorized as low-achieving used substantially more drill-and-practice exercises, whereas students categorized as high-achieving used more spreadsheet/database and email software. The differential opportunity for high-achieving students to use more intellectually complex software is the result of many factors, among them teachers' expectations and beliefs about how different groups of students can use computers successfully. Becker (2000) believes if low-achieving students are to experience more opportunities to work with complex software applications, teachers will need time and practice to develop methods for using software successfully, otherwise, low-achieving students are likely to continue using computers primarily for more narrowly focused drill-and-practice exercises.

Teachers' expertise. The way in which children experience computers depends greatly on teachers' expertise with computers (Archer, 1998; Shade & Davis, 1997). The

1998 national survey found that teachers' expertise with computers range from 75% who stated they could display a disk's directory, to only 18% who indicated they could develop a multimedia document. Those teachers with the broadest expertise in using computers were the most likely to use applications on the leading edge of computer use in their subject (Becker, 2000).

As the number of computer-using teachers rapidly increases, researchers caution that not all efforts to use computers with students are equally defensible, and many years are required for teachers to become accomplished as computer-using instructors (Sheingold & Hadley, 1990). Teachers' skill in using computers certainly has an impact on how they use computers, and how they view their role (Becker, Ravitz, & Wong, 1999).

In a report for the Milken Family Foundation, Kathleen Fulton (1997) used the term "technological fluency" to describe the changing definition of what students are required to achieve with technology. Technological fluency is a combination of the informational skills, communication skills, and technology skills necessary to function in a technological environment. For students to acquire technological fluency as a part of their educational experience, their teachers must be technologically fluent (Mills & Tincher, 2003). Teachers with technological fluency would be characterized by modeling technology use in the classroom, applying technology across the curriculum, applying technology to problem solving and decision making in authentic learning environments, and applying technology to facilitate collaboration and cooperation among learners (Bransford, Sherwood, Hasselbring, Kinzer & Williams, 1990; Spiro, Feltovich, Jacobson & Coulson, 1992). Shade and Davis (1997) purport all that stands in the way of teachers

maximizing the potential benefits of computers in education is a lack of training. The need for training and education is more extensive and complex than anyone imagined when computers were first introduced in schools. However, teacher training is essential for computers to be an effective teaching tool (Archer, 1998; Chapman, 2000; Fulton, 1988; Haugland, 1999; Mills, 2000-2001).

Professional development. Fulton (1988) asserts training must begin in the preservice education. Recent calls for inclusion of technology in teachers' education from nationally-recognized certification and accreditation agencies demand that graduating teachers not only know how to use technology personally but also are able to use technology appropriately in their classroom. The International Society for Technology in Education (ISTE, 1992) defined its curriculum guidelines for teacher preparation programs. These 13 requirements reflect the fundamental concepts and skills necessary for applying technology in educational settings, and are recommended by ISTE as a component of all teachers' education program, regardless of the specialization.

The National Council for the Accreditation of Teacher Education (NCATE, 1994), which certifies teacher preparation institutions, incorporated the ISTE recommendation into their standards regarding technology in teachers' education. Among other requirements, NCATE standards dictate that candidates complete a well-planned sequence of courses and/or experiences with educational technology, including the use of computers and other technologies in instruction, assessment, and professional productivity (Shade & Davis, 1997).

Improving teachers' education to include technology is not a goal by merely tacking a few courses onto the certification requirements. Educators prepared with such

limited opportunities would be highly unlikely to ever integrate this instructional tool into their curriculum, despite its potential benefits for teaching and learning. If technology is treated as an add-on and taught in isolation in the preservice programs, it will continue to be considered an add-on in public education (Shade & Davis, 1997). Preparing new teachers who are integrators of technology will require a professional education curriculum that is infused with opportunities for teacher candidates to learn with technology and model technology use throughout their professional preparation (Mills & Tincher, 2003).

One of the most important components of teachers' professional preparation and a focus of teacher reform efforts is the internship or student teaching experience. If teacher candidates intern in classrooms where cooperating teachers use technology creatively and regularly, teacher interns observe technology's promise and problems in real-life settings (Fulton, 1988). Papert (1993) affirms that because a large percentage of the technology being used today will be obsolete tomorrow, the only truly valuable technological skill to be instilled in teacher education students is the habit of using technology as a tool to accomplish whatever task is currently being addressed. Sheingold (1990) also points out that integrating technology in schools and classrooms is not so much about helping people to operate machines as it is about helping teachers to integrate technology as a tool for learning.

Preservice training serves only the introduction. In 1996, the National Assessment of Educational Progress (NAEP), known as the "nation's report card," documented that students whose teachers had professional development in computers outperformed students on standardized tests than those students whose teachers did not (Archer, 1998).

Chapman (2000) maintains that professional development must top the list of things to do when any school thinks of using computers. To use computers effectively in their classrooms, teachers must have certain levels of expertise in basic computer operations (Chapman, 2000).

In its January 2003 report, *No Dream Denied: A Pledge to America's Children*, the National Commission on Teaching and America's Future (NCTAF) contended that, contrary to popular belief, the main challenge facing schools in their quest for qualified teachers is not in recruitment, but retention. Moreover, the key to retaining good teachers, according to the NCTAF, is effective professional development. The missing ingredient is finding a way for school systems to organize the work of qualified teachers so they can collaborate with their colleagues in developing strong learning communities that will sustain them as they become more accomplished teachers. Technology training is an integral part of this support.

Teachers' preparation must continue throughout teachers' professional lives as new technologies and software applications are introduced into education. Teachers' training should include not only how to use the technology, but how to effectively integrate these tools into the existing curriculum (Archer, 1998; Fitzgerald & Fitzgerald, 2002; Fulton, 1988; Haughland, 1999; Mills, 2000-2001, Shade & Davis, 1997). Experts are recognizing that one component of the most successful new models of professional development is technology that supports "anytime, anywhere learning communities" where educators can converse, collaborate, and share best practices (Salpeter, 2003).

Hadley and Sheingold (1993) purport that time is the main ingredient to improving teachers' computer use, and that inexperience is the main impediment to

exemplary use of computers. This contradicts Becker's 1994 findings, which determined that exemplary computer-using teachers had no distinct advantages over other computer-using teachers as far as resources or student achievement or abilities. Rather, they taught in an environment that helped them become better computer-using teachers, they had prepared themselves better to use computers in their teaching, and they had allowed technology to have an impact on the manner in which and the content of what they taught. Becker (1994) believes that to use computers appropriately and successfully with students, teachers need to gain perspectives about teaching and learning. Certain workplace conditions might influence how well teachers gain these pedagogical perspectives, conditions such as the existence of communication networks among computer-using teachers, formal staff development opportunities, the full-time presence of a school-based computer specialist, and school leadership that modeled and encouraged exemplary uses of computers (Becker, 1994).

Mills and Tincher (2003) have established a set of technology standards and indicators to describe best practices for expert teaching and student learning using technology. Their model is based on the conceptualization and development of the Concerns-Based Adoption Model (CBAM), which is a comprehensive systematic change model that allows change investigators and facilitators to understand organizational change from the point of view of the persons affected by the change (Surry, 1997). CBAM provides for the development of diagnostic tools based on the design of the innovation being evaluated and the operational patterns of those using the innovation. One of these diagnostic tools is the Innovation Configuration Matrix or Map (ICM). The ICM delineates an innovation in the form of a two-dimensional matrix with the various

configuration components along one dimension of the matrix and a scale that renders closer approximations of conceptualized implementation or use along the other dimension of the matrix.

Based on this model, Mills and Tincher (2003) formulated an ICM, the Technology Integration Standards Configuration Matrix (TISCM), based on the developmental stages, standards, and indicators of technology professional development as a tool to use in the evaluation of technology integration among teachers. They believe that teachers experience several stages as they develop into expert technology integrators, which are tracked by TISCM.

The findings of their study reveal that technology training activities need to focus more on instructional strategies and methods to integrate technology into student learning than on activities to increase skills using computer hardware and software application (Mills & Tincher, 2003). The teaching of software applications and computer operations lends itself to cost-effective, short-term instruction while technology integration training would require more labor- and time-intensive, resource-rich approaches such as mentoring, pull-out, or self-paced. Additionally, this study suggests that developing technology integration expertise in teachers cannot be achieved through the provision of a technology course or two built into the professional education curriculum (Mills & Ragan, 1998).

NAEYC states that institutions of higher education and other organizations that provide preservice and in-service education have a responsibility to:

- incorporate experiences that permit educators to reflect on the principles of early childhood education and ways in which technology can support and extend these principles
- provide teachers concentrated time to focus on how best to use educational technology and to develop a plan for the use of educational technology in a school or early childhood program
- permit hands-on training with appropriate software programs to assist teachers in becoming familiar and comfortable with the operation and features of hardware and software (NCATE, 1995)
- offer on-site and school-based training on effectively integrating technology into the curriculum and assessment process

Teachers' roles in implementation of technology. As technology becomes easier to use and early childhood software proliferates, young children's use of technology becomes more widespread (Haughland, 1997; Shade & Davis, 1997). Therefore, early childhood educators have a responsibility to critically examine the impact of technology on children and be prepared to use technology to benefit children (Shade, 1996). NAEYC asserts that "teachers' roles are critical in making certain that good decisions are made about which technology to use and in supporting children in their use of technology to ensure that potential benefits are achieved" (p.11). This position statement emphasizes the central role teachers must elect to ensure that the potential benefits of technology for young children are realized. Decisions such as which software to use, and whether to use the computer as an add-on or integrate it across the curriculum, are just a few of the

critical decisions teachers must make as computers becomes part of their early childhood curriculum (Shade, 1996).

For technology to recreate or reorganize the learning environment, computers must be viewed in terms of function rather than application, process rather than approach (Becker, 1994; Hadley & Sheingold, 1993). According to Sandholtz, Ringstaff, and Dwyer (1997) technology integration includes five stages: entry, adoption, adaptation, appropriation, and invention. Entry stage teachers use text-based materials and instruction to support teacher-directed activities. Adoption-stage teachers use technology for keyboarding, word-processing, or drill-and-practice software. Adaptation-phase teachers integrate new technologies into classroom practice and students use word processors, databases, graphic programs, and CAI. Appropriation-stage teachers begin to understand the usefulness of technology and students work at computers frequently as project-based instruction begins to take place. In the invention stage, learning becomes more student-centered as multi-disciplinary, project-based instruction, peer tutoring, and individually paced instruction occurs.

The NAEYC Position Statement (1995) stated teachers must carefully observe children using software to identify both opportunities and problems to make appropriate adaptations. Teachers should look for ways to use computers to support the development and learning that occur in other parts of the classroom, and the development and learning that occurs when classroom learning complements activities on the computer.

According to NAEYC, teachers should participate with children in computer activities and encourage children to use computers on their own and with peers. Teachers should integrate technology into the daily routine and position the computers in the

classroom, rather than in a computer lab. Software should be chosen to enrich curriculum content, other classroom activities, or concepts; promote and ensure equitable access to technology for all children; and promote positive social values. Early childhood educators must devote extra effort to ensure that the software in classrooms reflects and affirms children's diverse cultures, languages, and ethnic heritages. Teachers need to work with parents to advocate appropriate technology applications for all children (NAEYC Position Statement, 1995).

Teachers must perform several different roles in a computer-enriched classroom (Haughland 1997; Thouvenelle & Bewick, 2003). When children are first introduced to computers in the classroom, teachers begin as instructors. Davis and Shade (1997) state young children need time to become familiar and comfortable with technology. During this initial period, teachers must assume active roles, guiding children through new software and encouraging exploration. As children gain experience with computers and are able to perform tasks independently, teachers gradually move into the role of facilitators, providing guidance and support when needed, and ensuring appropriate behavior (Shade & Davis, 1997).

Davis and Shade (1997) purport children will be more likely to appreciate the computer as a practical tool for integrated learning if they see teachers using them in highly visible ways: for whole- and small-group instruction; or for information, communication, and products for the classroom. At this point, teachers are modeling ways to integrate the computer into the learning environment. Additionally, the role of teachers must be that of critics. It is the responsibility of the teachers to provide rich, challenging, and appropriate learning environments by taking an active role in evaluating

and selecting software that will best enhance children's learning and development (Davis & Shade, 1997). In Piagetian terms, the skills of learning are inherent in children and cannot be taught directly, and teachers' roles in such classrooms are to provide an environment attuned to children's development in order that appropriate intellectual leaps can be made as efficiently as possible (Crook, 1994).

Teachers' role in implementation of an ILS. The integration of technology in classrooms is a complex process that entails supporting curriculum goals through the instructional use of computer technology to enhance student learning (Dockstader, 1999). One way to better understand the difficult instructional issues associated with the integration of computer technology in classrooms is to analyze how teachers implement computer technology (Mills & Ragan, 2000). Schools cannot expect to experience gains in learners' achievement and motivation from ILS instruction if ILS programs are not properly implemented. Mills and Ragan (2000) purport that ILS implementation is better understood when the focus of implementation is shifted from the technology to the people who use the technology. An Integrated Learning System Configuration Matrix (ILSCM) was designed to measure the quality of implementation of ILS courseware by teachers. The measure was used to determine if there was a difference in the operational patterns of teachers implementing an ILS, and identify implementation practices of teachers that indicated implementation fidelity. A related issue to those of adoption and implementation is that of adaptation. From teachers' points of view, the critical question for successful use of technology is not so much how to implement it as designed, but how to adapt it so that it fits within their instructional approach (Mills & Ragan, 2000). The results of their study indicate that the best ILS implementation practices included

integration with classroom instruction, training in the use of an ILS, and the use of motivational strategies. The results of the Mills (1998) study are better understood when contextual phenomena of the implementations are examined because the question of instructional effectiveness using an ILS or other formats of computer-delivered instruction may be as much an implementation issue as a matter of instructional design (Mills & Ragan, 1998).

Becker, Ravitz, and Wong (1999) suggest the most significant aspect of teacher involvement with computers is not their own professional use, but the role teachers play in directing students' use of technology. Teachers' roles in implementing ILS instruction and integrating ILS activities with classroom activities is a critical factor in determining the effectiveness of ILS programs with regard to students' achievement (Brush, Armstrong, Barbrow & Ulintz, 1999). Becker (1992) performed a meta-analysis of 32 evaluative studies of ILS programs and found that a critical ingredient for successful student outcome was the integration of teacher-led classroom activities with computer-based activities. Becker found that teachers who were the most effective implementers of ILS instruction incorporated the ILS instruction with classroom instruction. These conclusions were supported by Blickhan (1993) who documented those teachers who integrated classroom activities with ILS activities tended to be more effective users of ILS instruction.

Mills and Ragan (1998) designed a study to determine the most important factors influencing successful ILS implementation. They concluded that ILS implementation must be teacher-driven. Many teachers assume a passive instructional role in the ILS lab, allowing students to work on the computers without any teacher intervention (Brush,

Armstrong, Barbrow & Ulintz, 1999). However, this does not ensure that the student will grasp the underlying structure of important ideas and concepts. Fitzgerald and Fitzgerald (2002) indicate that the extent of the gains, in part, depends on the involvement of teachers in generating reports and integrating ILS activities into other classroom activities. Their study also reports that there is a clear preference by teachers for ILS workstations to be located in classrooms to allow ILS learning to be integrated with other curriculum activities. It is important that teachers bridge classroom instruction to the ILS lessons on a regular basis, for example using math manipulatives to learn a concept, then pursuing the same concept in the ILS format (Blickhan, 1993).

A major reason for the lack of teacher involvement is that teachers are informed that the ILS is designed to provide students with individualized instruction. This tends to dissuade teachers from utilizing the software in ways that they believe are educationally sound (Brush et al, 1999). Brush (1998) affirms that if teachers are provided with access to more open-ended software that provided them with more flexibility, in terms of coordinating the computer activities conducted in the lab with activities conducted in the classroom, then perhaps teachers would use the software more appropriately. This software would allow teachers to take more ownership of the computer activities, provide a wider variety of activities to students when they are in the computer lab, and provide opportunities for interaction between and among students while they are working on the computer activities. In turn, coordination between classroom activities and ILS activities would have a positive effect on both students' achievement and students' attitudes (Becker, 1992; Mills & Ragan, 1998). The result of a study conducted by Brush, Armstrong, Barbrow, and Ulintz (1999) indicated that the students of teachers who used

either the exploration software or a combination of the foundations and exploration software in their instructional activities performed significantly better on standardized achievement measures than students of teachers who used only the foundations software.

The use of an ILS transitions teachers' roles from deliverers of instruction to managers of instruction. As managers of instruction, teachers are still actively engaged in the teaching process, but as guides or facilitators of instruction as opposed to distributors of information (Blickhan, 1993). Teachers select whether to assign reteaching lessons or advance students to more challenging work in their areas of strength. Once the novelty of the computer assignments wear off, students realize they are being held responsible for the learning that should be taking place. Motivating students during ILS becomes an important and difficult task for teachers. Blickhan (1993) suggests teachers review reports with each student to discuss strengths and weaknesses, to assist the students in accomplishing their goals. Teachers must praise students for their efforts, as the computers' praise is not very warm or nearly as effective as a pat on the back by the teacher (Blickhan, 1993).

Teachers' evaluation of the task performance is essential when using an ILS. Teachers must monitor and adjust programs on a regular basis in order for the instruction to be effective. Working through lessons with students to discover if the difficulty is due to procedure or concept misunderstanding is effective. The amount of student learning which takes place with an ILS depends on how teachers manage students' information; the variety of instructional strategies employed; how well-motivated students are; the amount of time scheduled for individual students to work on the system; and the balance between using an ILS and other teaching tools (Blickhan, 1993).

Teachers' roles are to provide support and gradually build children's independence (Clements, 1993) for problem solving. Scaffolding connotes a collaboration and support of teachers guiding children as they approach problems, thereby facilitating growth (Underwood & Underwood, 1990). Vygotsky (1978) defined the zone of proximal development as "the distance between the actual developmental level as determined through independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (p. 86). Vygotsky's (1978, 1986) zone of proximal development posits that students can, with the help of adults or children who are more advanced, master concepts and ideas that they cannot understand on their own. Vygotsky proposed that all cognitive functions are first experienced socially among people and then transferred to the individual psychological plane of functioning (Berk & Winsler, 1995). The role of computers in fostering social relationships within peer interactions may be an important step in cognitive development (Crook, 1987; Wartella & Jennings, 2000).

Summary.

Much of the literature presented has focused on the effectiveness of an ILS on primary students' gains in mathematics. The research indicated that many factors have an effect on students' gains. Several studies compared the gains of students who used an ILS and those who did not. Other studies cited students' characteristics; ability levels, gender, and motivation as influencing students gains. Further, theoretical framework, including development of computational skills, early exposure to computers, a constructivist approach, a behaviorist approach, and social context, has been investigated.

Teachers' attitudes, collaboration and leadership, judgment of students' ability levels, expertise, professional development, and their roles regarding integration and implementation of the technology have also been examined as to their impact on primary students' gains in mathematics.

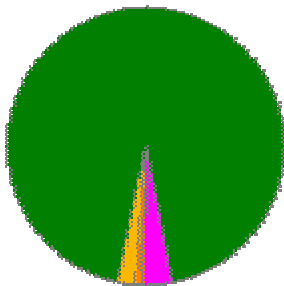
Although much research exists regarding students' achievement, no consensus has been reached concerning those factors most predictive of increasing the achievement gains made by primary students in mathematics using an ILS. By using a mixed model study, this investigator hopes to develop a more thorough understanding of the factors influencing primary students' gains in mathematics using an ILS. Moreover, existing literature is primarily quantitative or qualitative in methodology, rather than mixed model. Therefore, the researcher hopes that the present study will add to the existing body of knowledge by concentrating on teachers' experience, attitudes, and implementation practices and by exploring other factors that are predictive of primary students' gain in mathematics using an ILS.

Chapter 3

Methodology

Participants

The school where the study was conducted had a population of 844 students and received an A-rating from the state, as well as achieving a recognition of *No Child Left Behind* criteria, established by the Florida Department of Education (2003b). The student population is 94% White, 3% Multi-Racial, 2% Hispanic, and less than 1% African American, American Indian, and Asian, as shown in Figure 1. This school was selected because it was the site where the researcher taught. The school had a teaching staff of 62 full-time teachers at the time of the study.



Ethnicity	This School	State Average
African American	<1%	25%
American Indian	<1%	<1%
Asian	1%	2%
Hispanic	2%	22%
White	94%	49%
Multi-Racial	3%	3%

Figure 1. Student ethnicity

Participants in this study represented a homogeneous sample, as defined by Creswell (1994), taken from the population of 21 men and women who were kindergarten, first- and second-grade teachers at an elementary school located in a small

town in Southwest Florida. According to the Florida Department of Education’s School Advisory Council Report and Florida School Indicators Report (2002-2003), years of experience for the primary teachers range from beginning teachers to 23 years of experience. The average years of experience for this entire school faculty was 10.5 years, while the district average was 13.6 years, and the state of Florida average was 13 years, as shown in Figure 2. Two-thirds of the 21 primary teachers held bachelor’s degrees only, while one-third held master’s degrees. Figure 3 provides teachers’ advanced degrees. Forty-eight percent of the faculty held advance degrees at the school, while the district average was 46.8% and the state average for master’s degree was 32.7%. No one at the school had either a specialist degree or doctorate degree.

	This School	District	State Average
Average years of experience	9.9	13.6	13

Figure 2. Teacher experience

	This School	District	State Average
Bachelor's degree only	56.4%	53.2%	70.1%
Master's degree	43.6%	45.9%	28.7%
Specialist degree	0%	0.1%	0.8%
Doctorate	0%	0.8%	0.4%

Figure 3. Teachers’ advanced degrees

For both the quantitative and qualitative portions of this study, participants were volunteers from the primary teacher population at the research school site. At the time of the study, the population of primary teachers was 21. Participant involvement was voluntary.

Selection of Participants

Purposive sampling (Kemper, Stringfield, & Teddlie, 2003) was utilized to select the participants because primary school teachers were the focus of this study. All primary teachers were invited to an orientation and presentation explaining the purpose of the study as an exploratory investigation of teachers using computer-assisted instruction. Methods of data collection also were explained. After the presentation and explanation of the study, the teachers were asked to participate. All participants were required to sign a consent form (See Appendix A).

For the quantitative portion of the study, a homogeneous sampling (Kemper et al., 2003) was utilized. All participants were primary teachers at the research site who had agreed to participate in the study. Years of experience of all participants was reported by the participants and verified by the Human Resource Office.

For the qualitative portion of the study, the interview participants were selected from a stratified purposive sampling (Kemper et al., 2003). This stratified purposive sampling was utilized to interview three teachers who had higher-than-average gains of students in the mathematics session of the Successmaker lab and three teachers who had students who are making lower-than-average gains in the mathematics session of the Successmaker lab. The purpose of this stratified purposeful sampling was to capture major variations in the teachers' methods and styles rather than identifying a common core (Patton, 1990). According to Creswell (1998), the sample size of six is adequate for a phenomenological study. Informal observations were conducted to confirm teachers' methods and styles reported during the interview process.

The focus group sampling involved homogeneous sampling (Kemper et al., 2003). All primary teacher participants at the research site were invited to participate in the focus group. Although only a purposive stratified group was selected for the interview, the focus groups allowed all primary teacher participants to contribute by offering them the opportunity to respond to open-ended questions and share their experiences and perceptions about the Successmaker lab.

Because the researcher was already a faculty member, rapport would have been established before this orientation. The role of the researcher was to report accurately the voice of the participants (Onwuegbuzie & Teddlie, 2003), describing the experiences and meanings of the participants, while remaining neutral (Creswell, 1998). All data was reported with as little bias as possible. Because the researcher was a member of the faculty, a primary teacher, familiar with the other faculty members and environment, and a teacher who uses the Successmaker lab, vocabulary needed to discuss the Successmaker lab was not be an issue. Throughout all interviews and focus groups, the researcher attempted to remain unbiased, neutral, and objective. Confidentiality was emphasized throughout the study to allow participants to speak freely and dispel any notion that the researcher would report possible negative personal feelings or responses back to the principal. Maintaining confidentiality and anonymity of the participants was paramount.

Ethical Considerations

The principal at the research site granted permission for this research to be conducted and access to needed information for this study. The school district county board office provided documentation of necessary information pertaining to the teachers'

prior work experience. In addition, the researcher applied for the University of South Florida Institutional Review Board's approval to conduct this research.

For the quantitative portion of the study, the principal provided the background data. Only information on the volunteer participants was relayed to the researcher. The principal agreed to provide this information on the reported gains in the mathematics session of the Successmaker for the year being studied and two previous years. This information was the source of the selection for the interviews. This information provided was confidential and remained so throughout the study. The interviews were the same for both targeted groups of teachers. Confidentiality also was maintained and anonymity was controlled, as no names were reported in the study.

No teacher knew their students' gains relative to other teachers' student gains. All interviews were audiotaped except one at the participant's request, and the researcher destroyed the contents of the tape at the conclusion of the study. Informal observations were not taped and the researcher kept all notes. The researcher was the interviewer and transcriber of all data.

Additionally, because the teachers were deciding independently to participate in the study, there was the possibility of teachers deciding together to participate or not. To control for this possibility, the researcher explained clearly the expectations, rationale, and anticipated benefits to the participants of the study. It was a goal of the researcher that all members of the population understood the value of this research and volunteered to participate.

Delimitations of Study

The proposed research study incorporated deliberate limitations as defined by Creswell (1994). For the quantitative portion of the study, the study was limited to students who had been using the Successmaker lab for a specific amount of time, determined at the commencement of the study. Students who had been enrolled in the course for a length of time not commensurate to the number of total school days at the time of data collection were eliminated. Another deliberate limitation to this study was the assessment of gains solely by the reports of the Successmaker lab. For the qualitative portion of this study, participants were deliberately limited to teachers in first through third grade.

Threats to Internal/External Validity for Quantitative Component of Study

This study was investigating the extent to which years of experience of primary teachers were related to primary students' gains in mathematics using an ILS. The internal validity of the findings may have been threatened via history (Onwuegbuzie, 2003) if the years of teaching experience span many grades, thereby affecting the knowledge base of a specific grade and subject matter. When examining the data, the years of experience were calculated and recorded as years in each grade. Additionally, teachers may have come to the school with prior years of experience in the same grade, but not having had experience with the Successmaker Management System. An internal threat of differential selection of participants (Onwuegbuzie, 2003) existed because the sample is non-randomized. The researcher strived to assess the equivalency of groups by controlling as many variables as possible. The researcher of this study examined the possible influences of these variables when analyzing the data.

Additionally, the internal validity of the quantitative portion of this study could have been threatened during the data collection stage due to instrumentation (Onwuegbuzie, 2003). Despite the researcher's concerted efforts to contact Pearson Educational Technologies, no data were available regarding the reliability coefficient of scores. The qualitative validity also could have been threatened during the data analysis due to mortality because students enroll and transfer throughout the year (Onwuegbuzie, 2003).

The external validity of the findings could have been threatened by population validity due to the small sample size, which would limit generalizability (Onwuegbuzie, 2003). To address this, the researcher examined the years of experience for all of the classroom teachers at the school and compared those to the obtained data that show students' gains. Additionally, the total average years of teaching experience at the research site was lower than either the district average or the state average. Specifically, the average years of experience for this school was 9.9 years, compared to 13.6 years in the school district, and 13 years in the state of Florida (Florida Department of Education's School Advisory Council, 2003). The participants' experience was examined before generalizing about the relationship between experience of primary teachers and primary students' gains in mathematics using an ILS. The researcher was cautious about inferring or generalizing across different types of settings. A second threat to external validity was the result of the study being conducted at only one school site. This ecological threat to validity prevents generalizability across settings to other regions (Onwuegbuzie, 2003). A third threat to external validity was temporal validity. Because this study was conducted over a short period, it is difficult to generalize over time

(Onwuegbuzie, 2003). A final external threat to validity was specificity of variables (Onwuegbuzie, 2003). Due to the specific instrument used to measure the variables and the specific inquiry undertaken, the researcher took extreme caution in generalizing the findings.

Threat of Verification/Trustworthiness, Legitimation, Authenticity, Credibility

The qualitative study addressed trustworthiness and verification by controlling for observational bias (Onwuegbuzie, 2002), by audiotaping and transcribing each in-depth interview. An audit trail was left by maintaining extensive documentation of all interviews, focus groups, informal observations and data stemming from this study (Onwuegbuzie, 2002). To control for researcher bias, the researcher attempted to remain neutral during the interviews (Onwuegbuzie, 2002), and ask open-ended questions. It was not expected that the researcher's prior knowledge of the participants would influence interpretation of data collection. Emergent themes were identified during data analyses and frequency of occurrence was determined (Onwuegbuzie, 2002). Each theme was quantified (Tashakkori & Teddlie, 1998) and the effect size reported (Onwuegbuzie, 2002). Additionally, the researcher utilized a between-method triangulation.

Quantitative Instruments

Teachers' years of experience were reported by the teacher in writing to the researcher and supported by documentation in the teachers' personnel files located in the Human Resource Office at the school board county office. The personnel files were an appropriate instrument for reporting teachers' years of experience for the participants involved in the study as threats to both construct-related validity and criterion-related validity (Onwuegbuzie, 2003) were controlled for because personnel files are business

records and admissible in court (W. H. Meub, Esq. personal conversation, September 4, 2003). Content-related validity (Onwuegbuzie, 2003) was controlled because the personnel files contain all pertinent information regarding prior teaching experience. The years of experience was categorized into years of experience at each grade level and years of experience in different school districts. Partial years were translated into decimals. For example, 3 months would be written as 0.30 years of experience. The current year of teaching was reported as one year of teaching.

Student gains were reported by a Gains Report, which was generated by the Successmaker Management System. Gains are reported once the child has attained Initial Placement Motion (IPM) at the beginning of each academic year. A report generated by the Successmaker Management systems provided the total time on mathematics, specifically Math Concepts and Skill (MCS) course. The gains are reported as decimals such as 1.0 represents one year's growth and 0.5 represents a half-year's growth.

Content-related and criterion-related validity were maintained because the coursework for the Math Concept and Skill program was designed by curriculum experts to align with the standards defined by the National Council for Teachers of Mathematics (NCTM), as reported in a Successmaker Research Summary (Thrall & Tingey, 2003). Therefore, it was deemed as current and appropriate to report gains related to the Florida Sunshine State Standards and national mathematics curriculum, which addresses the content-related validity (Pearson Education Technologies, 2003). No information about construct-related validity was found. Information on score reliability also has not been reported by Pearson Education Technologies; however, the researcher had contacted Pearson Education Technologies to attain this information. The researcher computed a

coefficient alpha for the study sample. The gains report was an appropriate instrument for reporting student gains of those participating teachers involved in the study because this report was continually updated after each math session. The researcher interpreting the data had attended training in the interpretation of Successmaker Management System reports.

Qualitative Instruments

Interviews, informal observations, and focus groups were utilized to collect data for the qualitative portion of this study. An interview guide approach (Johnson & Turner, 2003) was utilized for the six personal interviews. The researcher selected three teachers with above-average class gains on the math session of the Successmaker Lab and three teachers with below-average class gains. If the sample had not included this configuration for interviews, the researcher would have adjusted the criteria for interviewing with the intent of having an equal number of interviews with both defined sets of teachers. This type of semi-structured interview format was selected because it allowed the interviewer to have prespecified topics listed on a protocol, but allowed the interviewer to reword the questions as needed and change the order of questioning. (See Appendix B for sample questions of interview.) Interview questions, developed by the researcher, were designed to elicit information from the participants about their procedures during the Successmaker lab and how they philosophically saw the Successmaker as part of curriculum development. One example of the interview questions is: Can you tell me the role that Successmaker lab plays in the grade level curriculum? Each interview lasted approximately one hour and remained informal. Each interview took place in the teacher's classroom at a time that was convenient for the teacher being interviewed. The

location provided a comfortable environment for the teacher and fewer interruptions to improve confidentiality. Each interview was audiotaped, if permission is granted by the interviewee.

Informal observations of interviewed participants were conducted in the Successmaker Lab to confirm teachers' reported styles and methods. The researcher was the head mentor and team leader, and thus had regular access to informally observe the teachers at work in the Lab without being obtrusive.

Two focus groups were used after the personal interviews to help the researcher better understand and interpret information and findings from the interview (Johnson & Turner, 2003). Discussions were directed toward the Successmaker lab and students gains. One example of a focus group question is: Has Successmaker lab changed your math teaching or grouping in your classroom? (See Appendix C for focus group questions). Each focus group had 6-10 participants as recommended by Langford, Schoenfeld, and Izzo (2002) and lasted approximately one hour. Each focus group took place in the researcher's classroom. Space was available and interruptions were kept to a minimum. It was also conducive to audiotaping. In addition to audiotaping, the researcher took notes during the discussion.

Pragmatist Procedure

This research represented a modified version of Creswell's (2002) sequential explanatory design, whereby the quantitative data collection and analysis preceded the qualitative data collection and analysis; however, this research study gave equivalent priority to both parts of the design. This method was selected because the researcher was interested in triangulation. Both types of data were collected at the same time and

independently. This type of concurrent model design approach is used to corroborate findings in a single study (Creswell et al., 2003). Both quantitative and qualitative data had equal priority and were integrated at the analysis phase (Creswell et al., 2003). By using separate methods for qualitative and quantitative methods, weaknesses in each method were strengthened by the other method (Creswell et al., 2003). This mixed methods study integrated diverse data sources, including years of experience and current teacher interaction to address the research questions. Combining the two paradigms allowed the researcher to examine a phenomenon from different contextual factors. Greene and Caracelli (2003) purport that social reality is both causal and contextual. Mixed methods utilize both these realities to examine and explore a social question.

Quantitative Procedure

For the quantitative portion of this study, the researcher used a post-positivist paradigm for this correlational research design (Gay & Airasian, 2003). This approach tried to confirm the hypothesis by determining whether and to what degree a statistical relationship existed between the variables as measured via a correlation coefficient (Creswell et al., 2003; Gay & Airasian, 2003). The years of teaching experience as documented by the Human Resources Office, was correlated with the Student Gains Report provided by the Successmaker Management System, which reported student gains in the mathematics session of the Successmaker lab. The report of gains for each classroom was taken on the same day to control for variability of data results. The researcher, having been trained on data report interpretation, examined relationships between teachers' experience and average class gains. Gains also were disaggregated by

below-, on-, and above-grade level performance to determine if teacher experience predicts gain clarification.

All teachers had access to run student gains reports on their class at any time. In fact, the administration encouraged teachers to do so to keep track of their students' progress. Therefore, the ethical nature of collection is addressed because all teachers had the access to retrieve this information daily.

A threat to the internal validity to be considered in this study was the size of the classroom, as well as the number of Successmaker lab adults present to assist during the Mathematics Concepts and Skills (MCS), course sessions. Additionally, children's length of time in the computer lab was affected by the number of days in attendance. New students and those students with frequent absences were examined and discarded from the data collection and analyses.

Because children enter this school throughout the year, and may be absent for extended periods, the researcher examined the total time on mathematics sessions. The researcher only included students who had a total time commensurate with the time of year for this study.

External validity was threatened by the small sample size. The research site was an A-rated school, as defined by the Florida Department of Education, and the student population drawn predominantly from a White middle class district. Generalizing may not be appropriate, however, the information provided from this research could yield baseline data for larger researcher projects addressing these questions in the future. Transferring the results of this study to other situations that are dissimilar may be inappropriate, however the results could illuminate constructs to be modified (Maxwell &

Loomis, 2003). These findings were shared with both teachers and administrators at the research site, as well as interested county personnel involved in the use of Successmaker Management System.

Qualitative Procedure

In the qualitative portion of this research, the researcher used the exploratory design consistent with inductive model of thinking (Creswell, 1994). The researcher selected this design because all themes emerged during the interpretive phase. The analytic induction approach (Bogdan & Biklen, 2003) was selected because the research procedure allows for a variety of types of participants through purposeful sampling (Bogdan & Biklen, 2003).

The interview instrument used an interview guide approach. The interview guide approach permitted the researcher/interviewer to use topics that are prespecified and listed on the interview protocol but could be reworded or covered in a different sequence (Patton, 1990). This gave the researcher latitude to probe the interviewee for clarification and more detail as needed during the interview (Johnson & Turner, 2003; Patton, 1990). Follow-up questions to obtain further clarification of the scripted questions evolved during the interview.

The researcher followed the data collection activities for phenomenological studies, as described by Creswell (1998). The purposeful sampling scheme was stratified purposefully as described in Miles and Huberman (1994), because the researcher was specifically interviewing participants with higher-than-average student gains on mathematics sessions on the Successmaker lab versus participants with lower-than-average students gains on the Successmaker lab. Data collection was obtained through

interviews exploring categories and patterns to emerge from the interviews with which to create a theory (Auerbach & Silverstein, 2003). Creswell (1998) suggests that researchers use up to 10 interviews for phenomenological study; this study interviewed six participants.

The interviews took place in the teachers' classrooms. This increased confidentiality and a willingness to express ideas freely and thoughts on the questions posed during the interview. All interviews audiotaped, with the exception of one at the request of the participant, as well as handwritten in the event that the taping did not work. Further, all interviews took place over a two-week period. A copy of the interview is found in Appendix B.

After all interviews had been completed, the researcher conducted informal observations in the Successmaker lab of all interviewees. This observation allowed the researcher the ability to confirm and clarify the teachers' explanations of their style and methods reported during the interview process.

A second set of data was collected at the completion of the personal interview and observation. The researcher also conducted focus groups after completing the interviews to understand and interpret better the information obtained earlier in the interviews (Johnson & Turner, 2003). Focus group discussions were based on the protocol questions in Appendix C; however, the informal format allowed for spontaneous discussion on the topic. Ideas and impressions generated in this unstructured situation from these discussions assisted the researcher to understand the participants' perceptions (Johnson & Turner, 2003).

Focus groups included both interviewees and at least one representative from each grade level to confirm, extend, and broaden the themes and categories discovered during the interview process. This allowed the researcher to check for representativeness of sources of data, to obtain feedback from the participants, and allow all participants to provide valuable information to the questions posed during the focus group. Focus groups allowed the researcher to observe interactions among teachers and observe responses to each other. Both focus group sessions had the same open-ended questions and took place within one week of each other. The sessions were very spontaneous. The role of the researcher was to monitor the discussion and keep it focused (Johnson & Turner, 2003). Responses from the focus group members were used as a member check to validate ideas generated during the in-depth interviews. Focus groups allowed for probing of each other's experiences in the Successmaker lab. The focus group sessions were audiotaped, and included note taking by the researcher during the focus group sessions. Sessions were transcribed by the researcher (Berg, 2001). All data collected during both interviews and focus groups were reduced to themes that emerged via the method of constant comparison (Gay & Airasian, 2003) during analysis. The information from the focus group was examined for themes and patterns (Berg, 2001), and then compared to the themes emerging from the interview data. Maintaining all records of data analysis and quantizing category frequency produced a detailed audit trail of both interviews and focus groups.

Quantitative Analysis

The researcher conducted a partial correlation analysis to determine the relationship between teachers' experience (number of years in teaching) and student

gains, after adjusting for the time on computer, number of adults in lab, and class size variables. These latter variables were treated as covariates (Glass & Hopkins, 1996). The researcher used the Statistical Analysis System (SAS) computer program to analyze the data (Cody & Smith, 1997). A 5% alpha level was used. An effect size was reported if the relationship was statistically significant

Qualitative Analysis

Once the interviews and observations were completed, the researcher transcribed each interview from the audiotape and, in a systematic manner, analyzed the textual data (Creswell, 1994). Categories were verified through an empirical approach. Audiotapes had reliability checks by repeated coding procedures (Constas, 1992). Because this is an exploratory study, categories evolved *a posteriori* during the analyses; the first level of analyses was for the researcher to code select relevant text. The second level was to organize repeating ideas into more general themes. The final phase was to develop a theory by putting the themes into general categories. The focus groups' transcription was analyzed the same way as the interviews.

Verification of categories was provided because the researcher asked to receive feedback from the interviewed participants to see if the categories and conclusions were accurate. This is also called member check validity (Creswell, 1994), which provided a chance to return to the informants and ask them if the conclusions were accurate. Finally, the researcher used the theoretical constructs to create a theoretical narrative. This same analytical procedure was utilized for the focus groups as well.

Combined Qualitative and Quantitative Data Analysis

This study utilized a between-methods triangulation because the researcher was measuring the same phenomenon through both qualitative and quantitative data collection. A parallel mixed analysis was utilized (Onwuegbuzie & Teddlie, 2003). Both qualitative and quantitative data were analyzed. The data was qualified and quantified, with both data collections being given equal status. Triangulation was utilized to corroborate different kinds of data as they pertained to the research question (Esterberg, 2002).

The qualitative data was reduced to categories to identify patterns. Themes were counted and quantified to maintain analytical integrity (Onwuegbuzie & Teddlie, 2003). The quantitative data also was qualified, with both sets of data being analyzed approximately equally. The mixed analysis was concurrent (Onwuegbuzie & Teddlie, 2003). This mixed analysis included data reduction to reduce the data into themes and categories, data display to organize the themes into tables and charts, data transformation to identify the interrelationship between themes, and data comparison which involved comparing the quantitative and qualitative data types (Onwuegbuzie & Teddlie, 2003).

The purpose of this study was exploratory. The themes and patterns of teachers with higher-than-average gains in the Successmaker lab were then compared with the data of years of experience to see if there is any correlation to teaching methods and styles, and students' gains.

Chapter 4

Results

This chapter presents results related to the following research questions: (a) Are years of teaching experience of primary teachers related to primary students' gains in mathematics using the Successmaker Integrated Learning System and (b) What are the differences in teaching styles and methods between primary teachers with students showing higher-than-average gains in mathematics versus primary teachers with students showing lower-than-average gains using an Integrated Learning System. Of twenty primary teachers at an elementary school in southwest Florida, nineteen teachers participated in this study. One first grade teacher was unable to participate due to an accident, which resulted in a six-week absence. The sample included five first grade teachers, seven second grade teachers, and seven third grade teachers. Each classroom had an average of 22 students in the Successmaker lab every session. Each class was heterogeneously grouped with the exception of one class per grade level. This class was named the Advanced Work Class and was composed of all identified gifted students and the highest achieving students as defined by standardized test scores at that grade level.

In the quantitative portion of this research, all participants signed the consent form and completed the Years of Teaching Experience survey. The survey included total years of teaching experience, years of experience in Florida schools, and years of experience at each grade. Both the total years of teaching and the years of teaching at the

research site were then correlated to student gains in mathematics. During the qualitative portion, the two teachers with the highest and the lowest average student gains from each grade level were interviewed. Informal observations followed. An additional interview was conducted with the Instructional Technology Facilitator (ITF). Two focus groups, in which all participants were invited to attend, were held after the interviews and observations to confirm and clarify information reported during the interviews.

The first section contains the demographics of the research sample. The second section includes findings from the quantitative analysis of the Years of Teaching Experience survey correlated to student gains in the Successmaker program. The third section consists of a qualitative analysis of the seven interviews, observations, and focus groups, which were analyzed for recurring themes and patterns regarding teachers' styles and methods concerning the Successmaker program. A summary of the findings concludes the chapter.

Demographics

Teachers' total years of teaching experience ranged from 40 years to beginning teachers, who had recently graduated from college in 2004. More than one fourth of the teachers were both new to the school site and new to the teaching profession, while more than 60% had ten years or less of teaching experience. The research site opened fifteen years ago and the Successmaker program has been in use for the past five years, which means more than half of the teachers in the study have been a part of the Successmaker program since its inception. Table 1 shows each teacher's total years of teaching experience, years of teaching at the research site, and average student gains reported by the Successmaker Management System.

Table 1

Years of Teaching Experience and Average Student Gains

Teacher	Total years of experience	Years at research site	Average student gains
3b	1	1	0.37
2b	1	1	0.5
3f	1	1	0.4
2f	1	1	0.36
2e	1	1	0.5
1d	2	1	0.5
1c	2 ½	2 ½	0.67
3a	4	3	0.46
2d	4	4	0.42
2g	7	7	0.34
2c	9	8	0.65
1b	10	9	0.6
3c	15	14	0.38
3g	15	15	0.62
1e	23	15	0.4
3d	24	10	0.32
2a	26	15	0.43
3h	29	14	0.51
1a	40	9	0.45

Table 2 examines teachers by grade level. It shows each teacher's average Initial Placement Motion (IPM) level, which is the initial placement level for each student based on a computer generated pretest that determines the level of mathematical development within the fifteen strands, followed by the ranking within the grade level. The table also shows the average gains for each teacher and that ranking within the grade level. For example, teacher 1c had an average IPM level of 1.91, which was the third highest

ranking among the other first grade teachers. However, teacher 1c ranked first in gains because she had the highest average gains for first grade.

Table 2

Teacher	Grade	Average IPM Level	Ranking in grade	Average gains	Ranking in grade
1c	1	1.91	3	0.665	1
1b	1	1.55	5	0.603	2
1d	1	1.74	4	0.5084	3
1a	1	2.71	1	0.4542	4
1e	1	1.93	2	0.3985	5
2c	2	2.80	4	0.6526	1
2e	2	2.74	5	0.5011	2
2b	2	2.43	7	0.5006	3
2a	2	3.60	1	0.4265	4
2d	2	2.63	6	0.4221	5
2f	2	2.87	3	0.3567	6
2g	2	3.01	2	0.3400	7
3f	3	4.24	1	0.6200	1
3g	3	3.58	5	0.5120	2
3a	3	3.57	6	0.4600	3
3e	3	3.57	6	0.4047	4
3c	3	3.61	4	0.3772	5
3b	3	3.80	2	0.3686	6
3d	3	3.81	3	0.3213	7

Quantitative Results

A correlational research design (Gay & Airasian, 2003) was used to determine whether and to what degree a statistical relationship existed between the variables of years of teaching experience and student gains. A Pearson Product Moment correlation coefficient (Creswell et al., 2003; Gay & Airasian, 2003) was computed. The number of years of teaching experience, which was documented by the Human Resources Office, was correlated to the Student Gains Reports provided by the Successmaker Management

System. Student gains in the mathematics session of the Successmaker program were taken for each class at the same time prior to the school day on February 7, 2005.

In the initial methodology, the researcher proposed to examine each teacher's yearly gain over the last five years. However, due to growth, transfers, and retirement, only five teachers have remained at the same grade level since the inception of the Successmaker program. Therefore, the sample became too small to formulate any adequate generalizations. Interestingly, the teachers with the highest gains in second and third grade have remained the same for three years. The first grade teacher has maintained the highest gains at her grade level for two years. Teachers with the lowest gains have varied every year at each grade level. Additionally, a first year teacher has never had the lowest gains in any year.

To control for the threat to the internal validity, students who had less than ten hours of program time were excluded from the sample. This exclusion discarded the data of those with frequent absences, late enrollment in the year, or withdrawal from the school. Some teachers had adult assistance in the lab periodically. However, because the assistance was inconsistent and untrained, teachers were unable to plan or use the assistance effectively. Therefore, it was not expected to affect the student-teacher ratio. However, it should be noted that some teachers did have more student data excluded due to the criterion that was established that no students having fewer than ten hours of total time be included in the sample. The total number of students in the lab each day was similar across classes.

All statistical correlations were computed using the Statistical Package for Social Sciences (SPSS) software. The first correlation computed was between total years of

teaching experience and total years at the research site. The significant correlation was 0.77 ($p < 0.001$). The correlation between total years of teaching experience and average student gains was not significant ($r = -0.10, p = 0.674$). The third correlation was computed between years of teaching experience at the research site and student gains. This also was not significant ($r = 0.03, p = 0.897$). Therefore, years of teaching experience did not predict total gains. The scatter plot also depicted no relation between years of teaching experience at the research site and average student gains. The non-significant relation was not due to a nonlinear relationship between years of teaching experience and student gains as shown in Figure 4 and Figure 5.

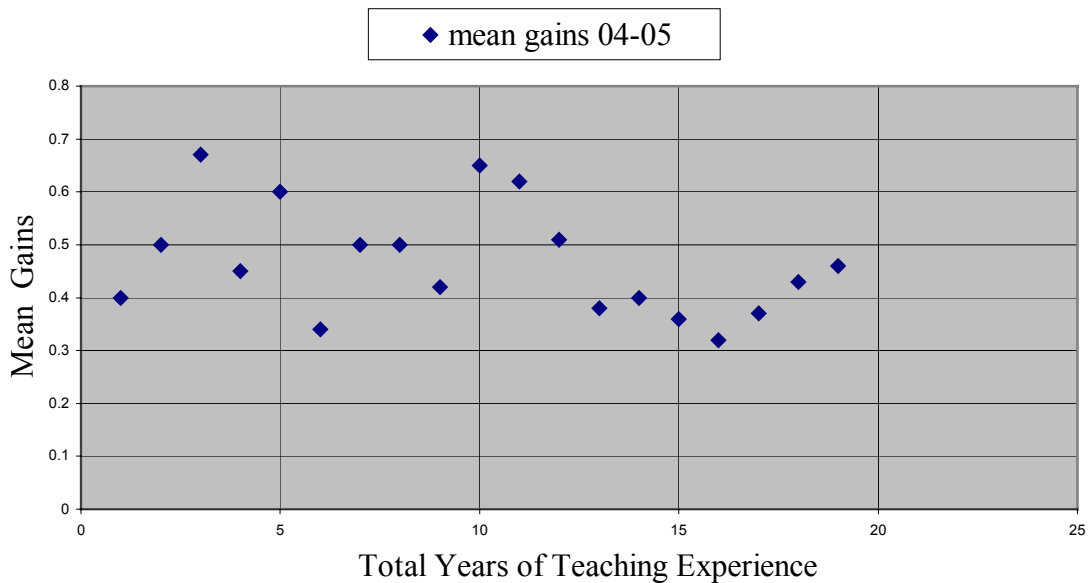


Figure 4. Total years of teaching experience – mean gains 2004-2005

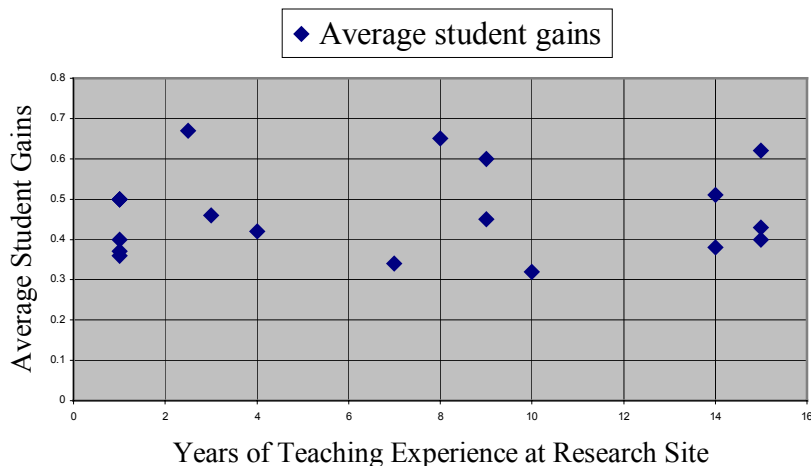


Figure 5. Years of teaching experience at research site - average student gains.

Qualitative Results

Based on student gains reported on the February 7, 2005 Course Report, the teacher with the highest average student gains in mathematics and the teacher with the lowest average student gains in mathematics were selected from each grade level, resulting in six interviews. Qualitative data were collected through these interviews, followed by informal observations in the Successmaker lab to confirm teachers’ styles and methods reported during the interviews. The ITF, who had overseen the Successmaker program since its inception, was also interviewed to provide insight and data background to this study. Each interview was approximately 45 minutes in length. Two focus groups of ten and eight teachers, which consisted of representation from each grade level, were held after all interviews and observations to validate ideas generated during the in-depth interviews. Focus groups, each lasting approximately one hour and fifteen minutes, were held within three days of each other and consisted of the same open-ended questions. The sessions were spontaneous and allowed the researcher to

observe interactions and responses among teachers. Each focus group was audiotaped and transcribed by the researcher.

The highest gains at each grade level varied slightly. The highest gain for first grade was 0.67, while second grade's highest gain was 0.65, and third grade's highest gain was 0.62. The lowest gains by each grade included first grade at 0.40, second grade at 0.34, and third grade at 0.32. When interpreting these gain scores, 1.00 is equivalent to one year's gain. Based on one full year's gain by the end of May, it would be anticipated that all students show approximately 0.60 gains by February.

Each interview was conducted in the interviewer's classroom or interviewees' classrooms. The teachers appeared comfortable with the interview process and talked freely about their views related to the Successmaker program, and their teaching styles and methods. No respondent seemed concerned about the reporting of the findings from the interview, but one did request the interview not be audiotaped. This request was upheld and handwritten notes were taken to document the information obtained. All questions from the Interview Protocol (Appendix B) were used, but the order varied depending on the flow of the conversation. Additional questions were asked to clarify responses or to obtain additional information. A different set of questions (Appendix D) was used for the ITF.

Analysis of the interview data revealed that all respondents shared some specific beliefs about the Successmaker program. In particular, when asked about the importance of Successmaker, all teachers, regardless of student gains, mentioned the benefits of the Successmaker lab, however, the nature of that value differed. Additional areas of

agreement included the positive value of motivation and presence of barriers that inhibited maximum effectiveness.

Although areas of agreement were found, analysis revealed numerous differences among participants, and profiles emerged based on these differences. These included time in the Successmaker lab, use of Successmaker Management System reports, integration of Successmaker into curriculum, motivational strategies, newness to the Successmaker program, influence of administration, and specific barriers that inhibited maximum effectiveness. These disparities of opinions were somewhat correlated to student gains.

As previously noted, two participants from each grade level with the highest and the lowest average student gains in mathematics in the Successmaker program were selected. In order to examine factors that may have contributed to student gains, findings were discussed within these profiles regarding participants' styles, methods, and interactions with primary students using the Successmaker Integrated Learning System.

Time in the Successmaker lab. While all teachers reported that total time in the Successmaker program had an effect on student gains, numerous differences between teachers with the highest and the lowest gains emerged regarding assigned Successmaker lab times. The three teachers with the highest gains stated they attended the Successmaker lab everyday at their assigned times because "it is a priority." These teachers stated that their scheduled times of day did not negatively affect student gains. One teacher, who was assigned to the lab following the morning bell, noted the students "come in a bit sluggish...but we have set some goals." One teacher, who had attended the lab in the morning in previous years, was assigned the lab at the end of the day. When

asked if there was a difference in the scores this year, she stated she had not noticed a decline this year, which she had anticipated.

The three teachers with the lowest gains mentioned that fire drills, school performances, and state and district testing all adversely interfered with their lab times. One teacher provided a copy of a calendar with circles around the dates that had some sort of interruption during the day. She felt there were too many interruptions affecting the continuity of her Successmaker attendance. When asked if she would have preferred an afternoon lab time when there were fewer interruptions, she stated, “there is not a perfect time to go to the lab.” Another teacher with the lowest gains in her grade felt her morning was too broken up by her Successmaker lab time and special classes, resulting in a loss of instructional time in the classroom.

The focus groups validated that teachers with higher-than-average gains worked with their assigned times without complaint, while teachers with lower-than-average gains with similar times claimed their lab times would be better at a different time of the day. Two teachers, one with higher-than-average gains and one with lower-than-average gains reacted differently to the same lab time. The teacher with the higher gains used the fifteen minutes between her Successmaker lab time and special classes to discuss strategies for the lab and review students’ scores. The other teacher felt that those same fifteen minutes were a loss of instructional time. One teacher stated students were “watching the clock” at the end of the day. Another teacher explained, “I go right after lunch and they don’t even have time to use the bathroom between lunch and having to be at the Successmaker lab... so that is a problem because it seems a lot of students need to use the bathroom after lunch.”

Another issue related to time was students' total time on the computer. Each teacher's assigned lab time was 30 minutes per day. A complete session included a reading and math session, each fourteen minutes. Due to a late entrance into the lab, another teacher's late departure from the lab, computers not working, or students putting in the wrong number and having to restart the session, it was likely that students would not complete the second session. The ways in which these issues were handled depended on teachers. Those with the greatest gains made a game out of cheering for the first students to log into the program and start working. Teachers with the lowest gains stated, "students are slow getting started" or "they forget their remediation numbers." Remediation numbers are different numbers than the daily student numbers. These numbers are assigned to students having difficulty in particular strands as documented by the Successmaker Management System reports. Once students have mastered the remediated skills, they no longer use the remediation numbers. Students use remediation numbers throughout the year for short periods of time.

In the focus groups, teachers spoke about the possibility of increasing the amount of total time in the lab to accommodate for the coming and leaving of teachers, or decreasing each session to thirteen minutes to allow time for students to complete each session in its entirety. Third grade teachers in both focus groups mentioned their classes always completed the reading session first because of the emphasis on the reading portion of the FCAT.

More than three-fourths of the teachers, including those teachers with the highest gains and the lowest gains, felt there was too much time in the lab for just Successmaker. Two-thirds of all participants suggested using the Successmaker program only three days

a week, leaving two days for other computer-based activities, including Internet research. It was suggested that the required amount of weekly time be completed in three days instead of five, “allowing for the same amount of time but fewer interruptions.” One rationale given for attending three days was that it provided the challenge and remediation students needed, without “doing it everyday, which becomes boring.” Another teacher suggested having half of the class work on the computers and the other half work on something else, with at least one other person in the room. This would give the teacher a chance to provide more individualized help to students who were working on the Successmaker program at the time. One teacher remarked, “I think it would also give the students a bit of a break.”

During the interviews, the three teachers with the highest gains mentioned concerns about the time that was required to make adjustments in the program once the teacher requested a change. The three teachers with the lowest gains made no comments concerning the turn-around time for adjustments to be made once a request was sent to the Instructional Technology aide.

Use of Successmaker Management System reports. All participants reported running a Daily Report at the end of their sessions. This report showed students’ scores in each session. Additionally, it reported the number of problems attempted, the number correct, the amount of time in that session, and the number of audio repeats. Teachers used this report to decide with whom they would work the following day. Two of the three teachers interviewed with the highest gains sent home Parent Reports each grading period with a letter explaining the report. One teacher sent it home at each mid-term as well as with report cards.

I specifically look at the gains because I teach the Advanced Work Class. It is my goal to assist them in making a year's growth. So, if it is 0.25 each quarter, by the second quarter it should be 0.50, by the third quarter it should be 0.75. I write on the report what the goal should be. It isn't part of their grade, but there is a goal that students should be showing 0.25 growth each quarter.

In terms of motivating those students who did not meet their quarterly goals, the teacher explained that she included in the parent letter the student's off task behavior in Successmaker lab. This alerted the parents as to why their child was not making the proper growth. One teacher with the lowest gains also reported sending home Parent Reports every grading period, but in reading only.

The Successmaker program was capable of generating worksheets for each student by strand and level. Teachers were able to request a student's lowest level or current levels in all strands or enter a specific strand and level, including the number of problems. However, a few strands at certain levels did not have worksheet items. Almost half of the teachers in the focus groups used the worksheets for homework. One teacher reported that she rotated between math and reading worksheets for homework each week. Teachers with the highest gains reported also using these worksheets for remediation later in the day. One teacher had students complete a worksheet of ten problems during recess if they "weren't giving their best efforts" that day or were "truly struggling on a certain strand."

All of the teachers reported using data from the Today's Session Report for their motivational strategies. More than half of the teachers stated that they used this report to identify those students who needed the most help and placed them in a specific area of the lab so they could be in close proximity to provide help.

When the teachers were asked if they ever felt there was too much information from the available reports, two teachers who had used Successmaker since its inception

felt there was “a lot about Successmaker to still learn” and that the reports “provided too much information” and it became confusing. They both stated that they often sought assistance from the ITF and Instructional Technology aide. Another teacher with one of the highest gains responded, “It is like doing blood work on children. I know exactly where they are in different areas. I know a lot more about students in math and reading, but math gives me more information.” Another teacher with lower-than-average gains stated, “the Delayed Presentation Report helps me analyze data by identifying who is struggling in certain areas and with which students I need to focus.”

Integration of Successmaker into the curriculum. The perceived role that Successmaker played in the math curriculum affected the teachers’ styles and methods while using the Successmaker program. Teachers with the highest gains purported the Successmaker program revisited skills constantly, helped extend lessons, covered the curriculum, and introduced students to several new concepts before being covered in the classroom. One teacher commented, “It is aligned with our curriculum and our expectations for them.”

One teacher with the lowest gains stated, “There seems to be a lot more the Successmaker program is teaching students that we haven’t covered in the curriculum; things that are really not part of the grade level curriculum.” Another teacher with the lowest gains felt the Successmaker program made certain that “students who need that remediation can get that remediation. Those who need the challenge can get the challenge that I can’t always do throughout the day, everyday.” A third teacher with the lowest gains believed “Successmaker is a good tool for individualized instruction. It is obviously an important part of what we do here.”

During the focus groups, teachers reiterated both the enrichment and remediation aspects of the Successmaker program. However, additional statements were added as to the ways in which the Successmaker program aligned with the math curriculum. More than three-fourths of the teachers believed Successmaker “allowed the students to go as far and fast as they can go.” Three teachers mentioned that when students saw a connection to content that was being taught in the classroom, they become more excited in the lab. One teacher elaborated, “If there is a connection to the classroom, then it is more effective in the Successmaker lab.”

Whether there was a connection to the classroom was again dependent on the teachers. Many teachers allocated a separate time to review Successmaker math from their grade level math lessons. While teachers with both the highest and the lowest gains reported using Successmaker data as a basis for grouping within the classroom math lessons, only the teachers with the highest gains explained specifically how lessons were integrated from the Successmaker lab into the classroom. One teacher stated that “sometimes things come up in the Successmaker lab that I haven’t done in the classroom, so that may dictate me doing some lesson in the classroom I wouldn’t have done yet.” One third grade teacher discussed how it took the whole year to master multiplication facts. She believed students were intimidated by multiplication in the Successmaker lab at the beginning of the year and often became scared and performed poorly. To combat this, the teacher had students bring a multiplication chart to the Successmaker lab to establish success at the beginning of the year. Another teacher felt Successmaker allowed her to “know where each student is a little more...than if I were just in the classroom ...to meet each student’s needs better than just by pretests and observations to find out

more of who is really good and maybe not in a certain strand.” One teacher with the highest gains noticed “students move more quickly because of Successmaker, so I can move curriculum to a higher level.” Teachers with the highest gains affirmed that they also pulled together small groups or worked one-on-one in specific skill areas based on Successmaker data.

One teacher with the lowest gains reported “if a lot of students are having difficulty, I may address it in the classroom even if it is not part of the curriculum.” The three teachers with the lowest gains believed that the Successmaker program was “drill and kill.” One teacher stated that the Successmaker program has “shown me that drill and kill isn’t always the way to go. There are different ways to go about teaching a skill, especially when students do not pay attention because the activity itself becomes boring.” During the interviews with the teachers who had the lowest gains, there was no mention of incorporating the Successmaker program into the classroom math curriculum.

These differing views toward incorporating the Successmaker program into the classroom math curriculum became pronounced during the focus group discussions. The vast majority of participants explained that Successmaker math was dealt with in isolation. It was part of the morning message or discussed upon returning to the classroom from the lab. One teacher used the Successmaker worksheets as morning work and then pulled together small groups during that time. When asked if anyone incorporated it as part of the math lesson, a response was “Successmaker has fifteen strands, so you can pick one piece and talk about it.”

The teachers with higher-than-average gains felt students learned concepts better, particularly in the area of geometry, as a result of the Successmaker program. The topic

of taking students farther than they would have previously gone was again brought up. One teacher stated the Successmaker program introduced students to new concepts and then remediated them, or “coached them along” when necessary.

Motivational strategies. Students are motivated to perform when teachers give attention to and show interest in their work. In addition to offering rewards, this includes demonstrating the value of the work in which students partake, so that students see it as meaningful, resulting in engaged, independent, and successful efforts. Throughout each interview, every teacher spoke about some form of motivation they provided for their students. Reported motivators were similar among the teachers with the highest gains and those with the lowest gains. They included both verbal recognition, such as “Great job!” and tangible rewards, such as monthly pizza parties for the top students. Most teachers provided some type of daily acknowledgement of scores. Many had a “Seventy Percent and Above” club in which students earned their names on the board, stickers, tokens, or ‘classroom’ money. The consensus was that “students get excited to see their names on the board.”

Teachers reported that scores had improved consistently when using effective motivators. One explained that when the motivation was appealing, they “are much more likely to tell me they need help. But if they are not, they don’t really care and they won’t say they are having a problem.” Another teacher added, “Students are coming to me more often and stating they are having a problem.” One teacher stated that “students graph where they are...we have snack and celebrate their scores.” Another teacher used four minutes of recess before the lab as an incentive for students to do their best. She remarked that the four minutes “allowed students to get the wiggles out,” which resulted

in improved focus while in the lab. Examining the use of motivators revealed more of a pattern across grades than by levels of gains. First grade teachers found that going around the lab saying, “You’re doing a great job,” “That’s terrific,” talking in a silly voice while saying students’ names, using a thank you jar, or giving students a high five were effective motivators and influenced the scores of the students. Second grade teachers felt they had to change the motivation strategy every month. They needed to “keep it novel.” In the beginning of the year, the rewards were simple, such as a chart with a student’s name on it. But by Christmas, many teachers reported more tangible rewards were needed to motivate the students. By third grade, teachers told students that “it is required,” but admitted that motivational rewards were effective, depending on whether students liked the rewards.

Teachers of the Advanced Work Classes looked at motivation differently. One teacher felt tangible rewards worked only for a short period, but then students ultimately shut down. Another teacher incorporated classroom group behavior with computer rewards. Each week, she allowed one group to use the Internet during one session. She also allowed partner math on Fridays. This involved two students working together to complete their math sessions, allowing for dialogue. This teacher had one of the highest student gains in the school.

Teachers at all grade levels admitted to periodically using their lab time for Internet exploring. This usage was directed by classroom projects, which required online research. The majority of the teachers also stated they used another reading program within the Successmaker program once a week for variety, but there was not an alternative math program available for students to select.

Newness to the Successmaker program. As stated at the beginning of this section, this school site had many new teachers to the campus this year. During the focus group discussions, the new teachers offered a different perspective on Successmaker and the process they went through to comprehend and better understand the program and reports. At the beginning of the school year, the ITF offered inservice training to new teachers to give them an overview as well as instruction on how to retrieve reports and interpret them. At the conclusion of this training, the ITF encouraged these teachers to visit her throughout the year to ask questions about the program and reports.

During the focus groups, it was revealed that although the new teachers went to the training orientation, several felt the importance of the Successmaker lab was not conveyed to them. One commented, “I didn’t know what I was doing.” Another stated, “I didn’t get it.” However, after the six sessions of training, they felt they understood the basic mechanics of the program, but they did not know “the strategies that other teachers used.” One new teacher commented, “I barely knew what I was doing. Then I sat down with the ITF a couple of times and now I think I have got it.” The majority of the new teachers referred to this year as two years because they did not “get it until halfway through the year.” One teacher, who returned after staying home for five years with her children, was very reflective about the process of becoming immersed in the Successmaker program.

This year has almost felt like two years. If I were thinking August to December and January to now, I would say teacher knowledge, interventions in the classroom, and incentives have made this second part of the year a huge difference from August to December. It almost felt like two separate years. My knowledge of the Successmaker program has taught me not to keep Successmaker isolated from the classroom. I have learned and brought strategies for working with the students into the classroom and this has made a difference. Looking around the lab, I’d say to myself, “Oh Roman numerals. We didn’t have that in

math or maybe they had it last year and forgot it.” So, we do a little mini-unit on Roman numerals. The whole class might not be at that level, but there are those few that could really benefit from it. Those few things have made a difference and it changed the way I look at Successmaker and how students achieve in it.

Influence of administration. In addition to almost 40% of the participants being new to the school or in different grade levels this year, the school’s assistant principal had become the acting principal of the school. She had been at the school since its opening in 1990, beginning as a teacher. She moved to administration six years ago. In January, she sent an email to the teaching staff reminding them of the characteristics that make Successmaker a vital component of our instructional program:

First and foremost is teacher involvement. The number one indicator of successful implementation is a teacher actively involved with student interaction in the lab. Second is the regular use of the reports from Successmaker. Therefore, I expect to see teachers involved with students in the lab as opposed to grading papers or completing some other teacher duty. Also, I want to periodically review the progress of the students, so later in this memo, I will list a schedule; of when I want specific reports turned into me. . . . Please highlight any students with an average percent below 70%. Then note what interventions are taking place to help that student. Do not make comments telling me that the student is on an AIP or is an ESE student. I am specifically interested in the strategies you are using to help improve the scores. . . .”

Participants were somewhat divided as to their reactions to this email. Teachers with higher-than-average gains did not feel threatened by this administrative involvement. Most felt that the administrator was simply sharing ideas with the staff and trying to keep a handle on successful implementation of the program. A veteran teacher added, “I don’t think it is any different than it was before, we are used to running these reports.”

Teachers with lower-than-average student gains reacted quite differently. One teacher was not certain as to the purpose of giving the principal the reports and added, “I am doing my best.” Another teacher wondered why she had not received feedback. One

teacher with the lowest gains responded by saying, “I used to skip Fridays, but once the principal came in, I stopped. My students realized they had to go because I got yelled at.” Three veteran teachers commented that they did not realize that there was going to be “so much emphasis on Successmaker” until the principal came to their team meeting with data. Another teacher was aware of the emphasis for third, fourth, and fifth grade, but did not think it “was forced.” A teacher who had used the program for the entire five years it had been at the school site reacted by saying, “I loved Successmaker until it was mandated; now it is something I have to do. I try hard not to show that to students, but you know. It is required.”

One teacher with the lowest gains had the strongest reaction to the principal’s email.

We are all professionals. Don’t tell me not to check papers because that thought hasn’t even crossed my mind. Tell me what I can do and give me help. I need to help these students progress. Help me be an effective teacher. Getting emails that say, “Don’t correct papers, please help your students”... We are not saying let me go to work and just do the minimum amount to get by... I am upset when I give my report to the administration and can’t write ESE or 504 plan beside a student’s name. I would have to help my ESE students the whole time. What do I say to the others, “Sorry I can’t help you?”... We, as professional educators, know things affect a student’s performance...it’s a little frustrating that some factors that we have to take into account in our planning and our day-to-day interaction with our students, all of a sudden in Successmaker it doesn’t matter... Some of these factors are not taken into account when looking for gains. You just can’t say, “Teacher do this.”

Barriers that inhibit maximum effectiveness. Both teachers with the highest and the lowest gains expressed the existence of barriers that inhibited the maximum effectiveness of the Successmaker program. Both spoke of “the drudgery of doing it everyday,” and frustration when computers were down, resulting in a loss of time. Teachers with the highest gains also added factors such as the turn-around time for the

Instructional Technology aide to register students in new courses or turn on or off remediation numbers, noise in the lab, and students' moods for that day.

Teachers with the lowest gains both expressed and implied frustration with many aspects of the Successmaker program. The majority of the frustration stemmed from the inability to reach all students in that there was "not enough of me to go around. I can't get to them fast enough." One teacher stated her frustration level as well as students' frustration levels.

When the Successmaker is teaching students material that we haven't covered and that student is struggling in Successmaker, I can't run over and teach that to them because I have other students to teach as well. I just ask them to raise their hands. The first one that raises his hand and I am not busy I go over there and see if I can help him in a couple of minutes."

Another teacher made several comments about the repetitiveness of having to do it every single day and its transformation into a "task, more like a chore. We all know children hate chores." One teacher did not like remediation numbers because students forgot their special numbers, and it was difficult to keep track of when students were ready to be taken off their remediation numbers.

During the focus groups, similar topics were discussed, while additional barriers were expressed. More than three-fourths of the teachers shared the frustration of not being able to meet every student's needs when they asked for help, because "it's not their fault we can't reach them all, they ask for help but it is just myself in the lab." In addition to the frustration of not being able to sit with each student because "the rest [of the students] suffer," three teachers reported that some students might have been far ahead of the class and learning a concept beyond that grade level's curriculum. Another teacher

added that students working at the highest levels were often making the least amount of gains.

Other barriers included mechanical difficulties with the technology, students learning the game but not the concept, insufficient supervision in the before school and after school lab, and entering into a messy lab. An Advanced Work Class teacher purported that students in primary grades were very social and the Successmaker program did not allow them the opportunity to discuss what they were doing during the session. She continued,

I don't think Successmaker is giving us valid input. I don't think it is giving us where students truly are. It is a quick fix. You are not applying anything. There is the problem and blip there is the answer... I think it is wrong. I think Successmaker has led us astray.

The newest teacher in the study, hired in September due to high numbers at one grade, was forced to have her students in three different labs at one time. She was able to walk between two of the labs, but the third lab was located in another building, thus making it impossible to help all her students in the lab. This was a large barrier for her to meet each student's needs. Despite this significant barrier, her students showed considerable gains. This new teacher set high expectations for her students which were upheld even though she was not present in each of the rooms at all times.

Factors leading to maximum effectiveness. Teachers with higher-than-average student gains generated most of the views about the contributing factors that lead to the highest student gains. As stated earlier, time was purported by most of the teachers as the most important factor. Staying on top of the students was the second most frequent response. Teachers felt they needed to communicate to the students that they knew their students' scores and were aware of "what you are doing." Keeping students on task,

letting them know this was important, and that they were held accountable for their work and scores were also considered important factors that contributed to student gains in the Successmaker lab. The teachers with below-average-gains felt the gains were dependent on the way in which students in their classroom responded to the curriculum for that year and not the program. Another teacher cited there were “too many variables to rely on one thing.”

Each participant, regardless of her student gains, felt additional trained adults in the lab would increase maximum effectiveness. One teacher cited, “No child ever failed when someone was standing by them.” Two thirds of the teachers interviewed mentioned the advantage of having another adult in the lab. College interns and aides, when present, have had a positive impact on the effectiveness of the program.

Furthermore, it was suggested that additional programs, including writing or science, could be added for variety. One teacher with the highest gains believed the Successmaker program was great because “you can get data and see change, growth and gains, but...” felt that three days a week was sufficient. She continued, “The other two days students need opportunities to learn how to think, higher level...and if you don’t provide opportunities...you are not going to get a lot of results.” Two other teachers, one with the lowest gains and one with average gains, reiterated the concept of needing to provide additional opportunities on the computer to encourage and support critical thinking.

More than 75% of the participants suggested that the school provide an incentive for students. Suggestions included putting names on a wall for the month, displaying the “Stars of Tomorrow” each month, having a list of top time, gains, level, etc., supplying

teachers with rewards they could use in the classroom, and holding a school-wide celebration. All of the teachers agreed that if this was something students needed to do for five or six years, the school should show support to inspire them.

One teacher with the lowest gains believed,

It all comes back to the teacher. To me, everything plays a part. There are five parts that affect the child's growth at a school: the teacher, child, parent, community, and school. They all play a part in creating the child's developmental growth.... Successmaker plays a part, but only a part, not the whole.

Professional Development. Professional development attainments and goals varied greatly between teachers with the highest student gains and teachers with the lowest student gains. Of the three teachers with the highest gains, two had Masters degrees, with one working on her Masters degree + 45 additional credits and one National Board Certified. The third teacher graduated two years ago with a Bachelors degree and plans to begin her Masters in Leadership this summer.

The teachers with the lowest student gains indicated no interest in furthering their professional development, in the near future, beyond the required inservice for recertification. One teacher had her Masters, and the other two teachers had their Bachelors degrees. One teacher did say she would like to pursue a Masters degree when her child is older.

Table 3 is a compilation of the themes that emerged from the interviews and focus groups. Responses of the teachers with the highest gains interviewed, teachers with the lowest gains interviewed, and the teachers that attended the focus groups were divided into themes. Patterns were revealed and reported.

Table 3

Developing Themes Reported by Teachers with Highest Gains, Teachers with Lowest Gains, and Focus Groups

Themes	Teachers interviewed with highest gains	Teachers interviewed with lowest gains	Focus groups
Time in Successmaker lab	Play game to start immediately	Slow getting started. Forgot materials, numbers	Many completed reading first due to FCAT, often cutting short the math session
Alternative models	Three days a week, critical thinking programs two days a week	½ time on computers, ½ time at centers while in lab Three days a week for longer periods of time Three days a week, Internet and other programs two days a week	Internet explorer or other computer-based activities two days a week
Use of Successmaker Management System reports	Today's Session Report targets students and motivation Parent Report with report cards Course Report Worksheets to use during recess for remediation/off task behavior Worksheets for homework	Runs reports for grouping Gives reports to ITF Many reports are too complicated to interpret easily	Today's Session for motivational clubs Worksheets for homework Delayed Presentation Report to analyze data
Integration of Successmaker into the curriculum	Revisits skills constantly Helps extend lessons Introduces new concepts Integrate lessons from Successmaker to classroom Guideline for grouping in classroom Pull together small groups or one on one	Not part of grade level curriculum Supports remediation Material presented in lab may necessitate additional classroom lessons	Enrichment and remediation Allows students to go as far and as fast as they can When we get back from lab for a few minutes Utilized in isolation Lab more effective if connection to classroom is made Pull together small groups

Table 3 (Continued)

Themes	Teachers interviewed with highest gains	Teachers interviewed with lowest gains	Focus groups
Motivational strategies	Verbal, Tangible Daily, weekly, monthly Varied	Verbal, Tangible Daily, weekly, monthly Varied	More effective if students buy into motivation Students express need for help more often if motivated Scores improve with motivation
Barriers that inhibit maximum effectiveness	Drudgery of going everyday Turn around-time to register students for new course or remediation Mechanical difficulties	Drudgery of going everyday Inability to reach each student Teacher and student frustration Mechanical difficulties	Drudgery of going everyday Not able to meet each student's needs Mechanical difficulties Lack of socialization or students able to discuss what they are doing
Factors leading to Maximum effectiveness	Additional adults in lab Provide additional opportunities for critical thinking Both total time and focus while in the lab Communicate to student the value of Successmaker	Additional adults in lab Scores are dependent on students, not Successmaker	Additional adults in lab Too many variables
Professional Development	Two with Masters degrees National Board Certified One teacher Beginning Masters degree Constantly taking courses	No immediate future for further professional development One teacher has masters	

Interview with Instructional Technology Facilitator (ITF). Although this interview was not part of the original proposal, the researcher felt strongly that the ITF could provide insight and corroborate data patterns. This interview took place prior to the focus group discussions to obtain the ITF's perspective of the strengths and inhibiting factors to maximum effectiveness of the Successmaker program, and to postulate additional questions for the focus groups.

The school's ITF had been in this position for the five years since the Successmaker program was installed at the school site. Prior to this position, she taught kindergarten, first and second grades for seven years. A representative of Pearson Technologies provided Successmaker training for the participating schools in the school district on a monthly basis. At the time of this study, there were fourteen schools, thirteen elementary and one middle school utilizing the Successmaker program. The research site was in its fifth year.

The ITF spoke about the training for new teachers.

We started with intense training at the beginning of the year. I believe it was six weeks. We went over all of the basics of going into the course, looking at the course, reviewing all the basic reports that they need to be familiar with and how to understand them...generally, how to work in the lab with your students, explaining those procedures. Then after that initial period was up, I offered to meet with anybody who needed that support.

The ITF explained that she also provided support for the entire faculty by looking at reports given to her and setting up remediation numbers and new programs. Sometimes the ITF came across reports where she flagged items, contacted those teachers, and spoke with them individually.

When asked about the strengths of the Successmaker program, the ITF stated that it gave information about students to teachers, allowing them to "zero in" on both the strengths and weaknesses of students. Along with that, teachers could access both student information and class information to guide instruction. She continued by stating the program was designed to meet "every students' needs at their individual levels." If a student worked at his instructional level, he should be successful. It did not matter if he was ESE because he was at his instructional level. The gains might not occur as quickly because of that disability but if he was at an instructional level that was appropriate, he should make gains. A weakness, as noted by the ITF, was that the

information you get out is only as good as the information you put into it. So, if you have a student in the lab that is not putting forth her best effort, then the information we get out isn't appropriate or true information. So, we can't use that information to make those guiding decisions the way we should.

Because the ITF had been in her position since the inception of the program, she has had the opportunity to observe patterns emerging year after year as she analyzed the data. She noted the biggest pattern was teacher involvement in the lab.

If the teachers are involved with the students in the lab, if teachers are running their reports regularly, making sure the students receive the remediation they need, receive that individual attention they need, the program works great for them. If they don't buy into the usefulness of the program or the reports, the program isn't that successful. I think that creates a cycle. They see it not being successful, so they don't put involvement back into it. Trying to break that cycle to show them by saying if you put this into it you will get this back out has been hard.

When asked whether she felt gains followed students or followed the teachers, the ITF purported it was more related to teachers. Typically, she saw teachers with the highest gains being repeated year after year. Additionally, she did not see any correlation between teachers' years of experience using the Successmaker program and increased student gains.

Summary

The quantitative statistical analysis of years of teaching experience and student gains in mathematics using the Successmaker Integrated Learning System resulted in findings based on (a) total years of teaching experience, (b) total years of teaching at the research site, (c) average student gains in mathematics reported by the Successmaker Management System, and (d) the correlation between years of teaching experience and student gains. With respect to the correlation between total years of teaching experience and student gains, no statistically significant difference was found regarding the effect of

total years of teaching experience and student gains. Additionally, no statistically significant difference was found between years of teaching experience at the research site and student gains in mathematics.

The qualitative analysis of data collected through interviews with teachers who had the highest and the lowest student gains in mathematics at each grade, informal observations, the interview with the ITF, and focus groups with all participants revealed factors that appeared to contribute to teachers' styles and methods which affected student gains. All informal observations confirmed information imparted by teachers during the interview process. Several factors influenced the styles and methods of the implementation of the Successmaker program. They included: (a) time in the Successmaker lab, (b) use of Successmaker Management System reports, (c) integration of Successmaker into the curriculum, (d) motivational strategies, (e) newness to the Successmaker program, (f) influence of administration, (g) specific barriers that inhibit maximum effectiveness, and (g) professional development. Furthermore, these factors can be categorized into four general themes: (a) teachers' role, (b) teachers' expertise, (c) teachers' collaboration, and (d) teachers' attitude.

Chapter 5

Implications

Introduction

The purpose of this dissertation was to assess the effect of years of teaching experience and teachers' styles and methods on primary students' gains in mathematics using the Successmaker Integrated Learning System. Simply placing learners on computers does not ensure that they will grasp the underlying structure of important ideas and concepts. The U.S. Department of Education, NCATE, and NAEYC believe teachers' roles influence the way in which students experience computers (Becker, 1993, 2000; Shade, 1996; Solomon, 1986). The lack of proper teacher training in the area of mathematics stated in the *No Child Left Behind Act (2001)* was reported as one of the leading causes for the poor performance of U.S. students. Equally important are follow-up opportunities for teachers to collaborate and share effective strategies (Becker, 2000). Perhaps the most important factor in the way students experience the computer lies in teachers' attitudes (Solomon 1986). Therefore, successful implementation of an ILS program depends on: (1) teachers' role, (2) teachers' expertise, (3) teachers' collaboration, and (4) teachers' attitude.

Statistical analysis of years of teaching experience and student gains in mathematics using the Successmaker program revealed no significant correlation between total years of teaching experience and average student gains. The second correlation between years of experience at the research site and student gains also was not significant. Teachers did not improve their techniques and increase student gains merely

by having more years of teaching experience or having experience with the Successmaker program for a longer period of time. Teachers who were new to the program did require time to develop a knowledge base to effectively implement the Successmaker program. However, some teachers who had several years of teaching experience and had been at the research site since the inception of the program showed smaller gains than those with fewer years of teaching experience and less experience with the Successmaker program. It must be pointed out that no first year teacher had the lowest student gains. In fact, a teacher with one of the longest teaching careers had the lowest gains at her grade level. This result confirms that factors other than total years of teaching experience are essential to student gains.

With respect to the differing teacher styles and methods, this chapter is devoted to an examination of the findings as they relate to the research questions put forth in Chapter I. The practical significance of the findings is presented, and the relationship between the findings of existing research and the study's theoretical framework is discussed. Also included are examinations of the congruence of the quantitative and qualitative findings and of the study's limitations. This chapter concludes with the implications of the findings for future research and for future practice.

Contributing Factors Affecting Student Gains

Contributing factors which affect student performance on the computers according to Becker (2000), Ginsberg and Zelman (1983), Rogers and Newton (2001) and Solomon (1986) include teachers' attitudes, the role and integration of technology within the curriculum, and teachers' expertise. Mills and Ragan's 2000 study reported integration into the classroom curriculum, training in the use of the ILS, and the use of motivational

strategies as being indicative of the best ILS implementation practices. This research study identified teachers' roles, teachers' expertise, teachers' collaboration, and teachers' attitudes as contributing factors that affect student gains.

Teachers' role. One of the key features of an ILS is that students have an individualized and personalized program (Bailey, 1992). In addition, the statistical data reports of students' accomplishments generated by an ILS are presumed to be useful for guiding instruction, remediation, and placement (Becker, 1993). The data reports become even more valuable when the ILS aligns with both state and local standards, as does the Successmaker program, according to Pearson Education Technologies (2003). However, reports generated by the Successmaker Management System are only as effective as the teacher who interprets and responds to them. Ways in which teachers at the research site stated using these reports varied, including the basis of rewards, the origination of remediation numbers, and the direction of guided instruction in small focus groups. Many teachers reported running these reports, however, the researcher repeatedly found a number of teachers' reports left near the Successmaker lab printer. The data obtained from the Successmaker lab reports were not being utilized in the classroom by many of the teachers with below average gains, which translated to a lack of integration into the classroom curriculum.

Slavin (1983) suggests that the most difficult problem of school and classroom organization is accommodating instruction to the needs of students with different levels of prior knowledge and different learning rates. An ILS addresses the problem of accommodating appropriate levels of instruction for students, thereby relieving teachers of the mechanics of handling individualized assignments. Further, it increases the

proportion of teachers' time available for direct instruction, personal tutorial, or remedial assistance. Teachers at the research site did not mention those aforementioned benefits. On the contrary, over 80% of the participants commented on the frustration of not being able to meet each student's needs in the Successmaker lab. This has not been mentioned in other studies. The frustration increased among teachers with lower-than-average gains, as opposed to teachers with less teaching experience. The challenge of not being able to help each student would be the same in the classroom, however, the frustration in the classroom was not articulated during any interview or focus groups.

Teachers' roles go beyond providing assistance in the labs to providing motivation to students. Both Blickhan (1993) and Mills and Ragan (2000) report motivation as a critical factor in increasing student gains using an ILS. Many students at this school site had used the Successmaker everyday for their entire time at the school. Fifth graders used this program since they were in first grade. The computer graphics were no longer an effective motivator for them. Motivation is vital to learning, and perhaps the teachers' most essential job is to see that students are motivated to work on instructional tasks until they can accomplish the desired outcomes. All of the teachers in this research study acknowledged that every students' scores and gains improved, regardless of their levels, with motivation. The results also suggested that extrinsic motivators were appealing to students for a short time, but they had to be varied throughout the year. During the focus groups, participants suggested the school provide support through school-wide recognition of students who showed gains relative to the time of year. When this idea was presented to the ITF, she acknowledged that other schools had tried a school-wide recognition program. However, she reported the schools

had not seen any significant changes. One can only speculate that teacher buy-in to the program is a bigger factor to the effectiveness of the motivation, than who is supplying the motivation for the students.

Kohn (1993) believes it is important “ to avoid rewarding people for engaging in an activity or behavior that we would like them to find intrinsically motivating” (p.87) He further states that intrinsic rewards foster an increase in performance, encourage risk-taking and develop a sense of autonomy. It was evident in this study that if teachers were aware and concerned with students’ work in the Successmaker lab, not only in terms of rewards - but also in terms of meaning, then students believed the work had value. As a result, students saw the Successmaker program as meaningful too, and they became engaged, worked independently, and felt successful. Those teachers who extended the lessons from the Successmaker program to the classroom, promoted the continuation of the concepts presented in the lab thus further nurturing intrinsic motivation.

A collection of studies has shown that participation in well-functioning cooperative groups leads students to feel more positive about themselves, about each other, and about the subject they are studying (Kohn, 1993). Vygotsky considered developmental accomplishments as outgrowths of the social situation (Bodrova & Leong, 1996), in which social contexts give students the opportunity to successfully carry out higher forms of mental ability than they could accomplish alone (Roschelle, Pea, Hoadley, Gordin, Means, 2000). A few teachers at the research site spoke of the value of allowing students to interact with each other occasionally while using the Successmaker program. Generally, this type of collaboration was not encouraged because the program was set up as individualized learning. The teacher who acknowledged doing partner math

every Friday, purported that the interaction among students facilitated the development of critical thinking and problem solving. This teacher had one of the highest gains in the school. One teacher felt it was a shortcoming of the program not to allow primary students to interact and discuss problems with each other. Learning research has shown that students learn best by actively constructing knowledge from a combination of experience, interpretation, and structured interactions with peers and teachers. However, the confirmation of this theory is outside the scope of this research study.

Teachers' expertise. Shade and Davis (1997) purport all that stands in the way of teachers maximizing the potential of computers in education is the lack of training. According to Blickhan (1993), the amount of inservice training teachers receive before implementation, as well as during its use, is vital to the effectiveness of the ILS. Teachers, who were new to the Successmaker program and received inservice training, acknowledged that as their proficiency and understanding of the program increased, so did their strategies to increase student gains. Two teachers with the lowest gains at their respective grade levels who commented that there was so much for them to understand and that the reports were too complicated, would have benefited from additional inservice training. Training and support were available to all teachers, but not all teachers took advantage of the support.

A review of the participants' professional development history also revealed a connection to student gains. The three teachers with the highest student gains had amassed a broad spectrum of professional development subject areas. In addition to having participated in professional development in the recent past, these teachers were continually increasing their academic development. They were constantly looking for

new ways to think and teach. The three teachers with the lowest gains generally had no interest in professional development, other than that required by the state for recertification.

Teachers' expertise in implementing ILS instruction and integrating ILS activities with classroom activities is another essential factor in determining the effectiveness of an ILS program with regard to student achievement (Bush, Armstrong, Barbrow & Ulintz, 1999). Blickhan (1993) documented that those teachers who integrated ILS activities into classroom activities tended to be more effective users of ILS instruction. Coordination between classroom activities and ILS activities has a positive effect on both student achievement and student attitude (Becker, 1992; Mills & Ragan, 1998). Becker's finding (1994) revealed that exemplary computer-using teachers prepared themselves better by allowing technology to have an impact on the manner in which they taught. The teachers with the highest gains integrated the materials introduced in the Successmaker lab back into the classroom as part of their math lessons. They did not keep it as an isolated fifteen-minute period during the day. The results of this study indicated ongoing training and support were needed to instruct teachers how to incorporate the Successmaker into their math curriculum.

Teachers' collaboration. Becker (2000) reports that teachers who professionally interact with their peers on instruction, subject matter, mentoring, and teaching workshops are more likely to have their students use computers regularly during lessons with more types of software than teachers whose sole focus is on the classroom. Haughland (1999) proposes that opportunities must be given to mentor other teachers who are having difficulty with a program they have already explored. Mentors provide

teachers with affirmation, support, and new possibilities for maximizing the effective use of computers. During the focus groups, participants reiterated the value of having this time to share effective strategies with each other. Teachers commented that they had not had an opportunity before this to collaborate ideas, raise questions, and discuss concerns and problems related to the Successmaker program. They welcomed the opportunity and time to learn strategies that other teachers were using to improve student gains.

Additionally, while the initial training provided by the ITF was helpful, the new teachers wanted others with whom they could share their daily questions and collaborate to enhance the value of the Successmaker program.

Teachers' attitudes. The way teachers utilize the computer is influenced by teachers' attitudes toward the educational purpose and appropriateness of the computer. Becker (2000b) purports that it is becoming increasingly obvious that all the staff development and technology support in the world might not be effective if teachers have beliefs about teaching and learning that contradict the assumption of the training and support.

Additionally, Mann, Shakeshaft, Becker and Kottkamp (1999) report positive attitudes toward technology by both teachers and students, as well as teacher training in technology lead to the greatest student achievement gains. The results of this research study indicated that teachers' attitudes were perhaps the greatest factor in contributing to student gains. Teachers who did not see the value of the Successmaker program criticized their scheduled time of day at the Successmaker lab, the confusing reports, the interruption of classroom instruction, the consideration of the special needs children, and the overwhelming number of children to attend to at one time. Teachers who valued the Successmaker program looked at the same challenges in a more positive light as issues that needed to be resolved and were

willing to put forth the effort because they believed the program improved student achievement. Teachers who saw value in the relationship between the Successmaker program and the classroom math curriculum had the highest gains. Teachers who relegated Successmaker to fifteen minutes a day with no incorporation into the classroom had the lowest gains.

Kohn (1993) points out that teachers who feel that administrators do not listen to their views, and who have little influence over the educational program, are particularly likely to report feelings of psychological distress. When teachers feel powerless, they are more likely to become more controlling with students for whom their performance they will have to answer, thus diminishing any opportunity for autonomous learning (Kohn, 1993). Many teachers' frustration and powerlessness regarding the administration's mandate to implement the Successmaker program without an open discussion was evident during the informal observations of the teachers in the Successmaker labs. The teachers who reacted most strongly against the administration's requirement of monthly reports, exhibited the largest amount of stress and frustration with their students in the lab. These students did not attempt problems independently, but rather followed the teacher around the room, which resulted in lost time on the program. However, the students of those teachers who valued the program and relayed that value to the students, exhibited autonomy and self-confidence by attempting problems alone.

Combined Quantitative and Qualitative Data Analysis

In this study, no significance between years of teaching experience and student gains was indicated. Rather, the implementation of the Successmaker program appeared to be the critical factor. The way in which the program was implemented was dependent

on teachers' attitudes toward the program more than any other one factor. Years of teaching experience were not indicative of attitude. Therefore, it appeared attitude and experience were independent of each other as far as predicting student gains.

The data collected in this study also examined the relationship between the Initial Placement Motion (IPM), and the amount of student gains. As shown in Table 2 gains were not related to students' IPM scores. Teachers who had students with a mean IMP which was lower or higher than the mean for the grade, i.e., students beginning with below-grade level scores and students beginning with above-grade level scores, showed gains independent of the IPM score. Whether a teacher worked better within her class with students who had lower or higher IPM levels is beyond the scope of this study. Therefore, the initial IPM level of a student using the Successmaker is not related to the gains students produce. Teacher involvement is a decisive factor.

Limitations of Study

In revisiting the limitations of this study that were presented in Chapter III, caution should be exercised in interpreting the practical significance of the findings. Because the study was limited to 19 teachers from an elementary school in southwest Florida, both ecological and population validity might be threats to external validity. Likewise, teachers' experiences did span more than one grade level, which may have affected the teachers' knowledge bases of a specific grade and subject matter. The average years of teaching experience among the participants was 11.3, while the average for the entire school was 9.9 years, compared to 13.6 in the school district and 13 years in the state of Florida. A non-randomized sample might have affected the internal validity of this study. However, it should be noted that the entire available population of primary

teachers at the research site agreed to participate in the study. Therefore, the sample was representative of those grade levels at the research site but not necessarily representative of the entire staff. It must be noted that despite attempts at heterogeneity in all classrooms except the Advanced Work Classes, and equal opportunities for children to make gains, the teaching variable is not isolated. Students' family background, and students' potential within each classroom are other factors that influence student gains. Classroom sizes were relatively constant and no teachers had additional adults in the lab consistently. Any students with less than ten hours on the program were dismissed from the study. In addition, the data extracted from the interviews and focus groups may not have been representative of the views of all the teachers at the research site.

Implications for Future Practice

The current research study had implications for teachers' role, teachers' expertise, teachers' collaboration and teachers' attitude as it related to student gains using the Successmaker Integrated Learning System.

Teachers' role. The role of teachers includes analyzing data and responding to meet individual student's needs while providing effective motivation for students to become self directed to perform at their highest levels each day. Teachers are trained to interpret data reports, but it is also the role of teachers to use those reports to guide their delivery of the curriculum. As the examination of effective practices for student gains continues, teachers must attend to the relationship among students in the classroom and consider the importance of collaboration as it facilitates effective learning. Teachers might try allowing students to peer teach during lab time occasionally as a strategy to both increase student understanding of a concept and as a motivational tool.

Teachers' expertise. Proper implementation of an ILS is a developmental process that must be nurtured and sustained. The expectations and operational components must be clearly articulated to teachers so that they understand what the program looks like when it is functioning effectively. When teachers are given just the mechanics of a program, they will implement an ILS to whatever level is consistent with their conceptions about the ILS and that which structurally fits into their existing teaching patterns and practices.

Training should be a continuous process and not a one-time event. Ongoing training reaffirms fundamental practices that focus the user on the intended use of the Successmaker program and the influence of teachers on the increase of student gains. Merely having more years of experience implementing the Successmaker program did not result in larger gains. Educating teachers on a variety of strategies to implement both while in the Successmaker lab and in the classroom could increase student gains. Additionally, training in the interpretation of various reports and execution of effective approaches and techniques that address students' strengths and weaknesses would be beneficial to the effectiveness of the program. Effective teaching practices accommodate effective ILS implementation. Teachers who were the most effective implementers of the Successmaker program incorporated the concepts presented in the Successmaker program into the classroom.

Additionally, teachers need to be encouraged to continue their own professional development in all areas, not just in the area of technology. Teachers who are interested in their professional development are more likely to try new approaches to insure student understanding of new knowledge. Teachers who are bored, distracted and frustrated with

their professional development will also convey this thought of minimum requirements to get by to the students. This key factor of modeling the value of intrinsic motivation to learn, learning just for the satisfaction it provides, has been overlooked in other studies. The importance teachers place on knowledge is transferred to students. They see their knowledge as important which increases student achievement and gains.

Teachers' collaboration. As a result of this study, it is evident that teachers both want and need to collaborate and discuss strategies to maximize ILS effectiveness. At the research site, training was given to new teachers during the first few weeks of school. After the initial training, the ITF was available to work with teachers one-on-one. Perhaps, teachers need the support from other teachers in addition to the one-on-one support from the ITF. Learning communities where educators can converse, collaborate and share best practices should be created. Peer observation and peer tutoring must be available for all teachers. More specifically, teachers need an opportunity to observe best practices of other teachers with the highest gains both in the Successmaker lab and in the classroom. Teachers need to work within each grade level, discussing student expectations, effective techniques to integrate Successmaker into the classroom, and solutions to individual student's struggles. Communicating as a team can provide support and consistency within the grade level. Additionally, communication across grade levels would improve school cohesiveness and continuity of the Successmaker program. This dialogue could provide effective and varied motivational techniques and problem solving for students working in the Successmaker program either above or below their grade levels. Teachers with the highest gains could share how they see Successmaker as an integral part of their curriculum toward increasing student gains. In the future, teacher

mentors assigned to the new hires at this research site must be made aware of the importance of the ongoing support needed for these new teachers, whenever it is requested. Teacher mentors should have the responsibility to assist these new teachers throughout the entire year, not just the first few weeks of the Successmaker program.

Teachers' attitude. Communication between the administration and teachers should be clear. By setting high expectations for teachers and explaining the value in the program as it relates to the school vision, the administrator will set a precedence for teachers to convey high expectations to their students and in turn show them the value of the program. However, the administration must listen to teachers' views. Teachers must feel empowered by the program, not powerless. Otherwise, the anxiety toward the program by teachers will be transferred to students. The students in turn will respond to the program only through extrinsic rewards, which need to become more substantial as time goes on, instead of enjoying the intrinsic value of their work or learning.

Teachers' attitudes about a program may be difficult to change. However, in the future, teachers need to be aware of how critical their roles are to the effectiveness of the Successmaker program. The program is not successful without teachers. Given the proper tools, including teacher observations of best practices both while in the lab and incorporating the Successmaker program into the classroom curriculum, collaboration with other faculty members both at each grade level and across grade levels, increased professional development, and administrators willing to listen to teachers' views may change some teachers' attitudes toward the program. These positive attitudes will be conveyed to students, which will increase their willingness to do well because teachers value their work.

Summary

The results of this study pointed out significant differences and variances in both the implementation of the Successmaker program and attitudes of teachers toward the Successmaker program. High student gains were associated with: (a) teachers' role in regard to time in the Successmaker lab and use of Successmaker Management System, (b) use of motivational techniques and ability to formulate innovative approaches to barriers that affect maximum effectiveness, (c) teachers' expertise in terms of inservice training and professional development, and the integration of the Successmaker program into the math curriculum, (d) teacher collaboration regarding effective strategies to promote student gains and (e) teachers' attitude toward the value of the Successmaker program and their influence within the educational program.

This study also reveals the value of intrinsic motivation and its correlation to professional development. Teachers who value learning for knowledge, including their professional development, conveyed that motivation for learning to their students. The teachers gave value to the Successmaker lab by showing students that their work had value. The students then gave value to learning through knowledge obtained in the Successmaker lab, giving them a sense of independence and autonomy to approach problems.

Teachers with the highest gains were not only actively involved with Successmaker; they had an appreciation of the program. They saw the value of the program as it related to the classroom curriculum and student growth in mathematics. If teachers do not see there is value in the Successmaker program then that perception is relayed to students. Teachers who effectively implement and integrate the Successmaker

program into the classroom curriculum need to share their best practices and collaborate with less effective teachers. We must work together to build motivation for both students and teachers.

Educators need to remember the joy of learning for knowledge and not test scores. When educators verify their natural desire for knowledge, and increase their professional development, they return to the intrinsic reason they entered the education profession. This intrinsic motivation needs to be seen and felt by students in each classroom. When students see teachers value knowledge and value teaching them, they in turn will value their learning and develop pride and self-esteem to become autonomous to gain new knowledge and develop their intrinsic motivation to learn, thus removing the need for extrinsic reinforcers to increase student gains.

Suggestions for Future Research

As more money is spent to update Successmaker, and emphasis on student gains continues to be measured and reported, teachers will need the best practices to ensure students make the greatest possible gains every year. Examining factors that increase student gains using the Successmaker program was more complex than merely creating a how-to list. Therefore, more data are needed on the effect of teachers' attitude, teacher professional development, teachers' collaboration, and integration of the Successmaker program into the curriculum at all grade levels. Furthermore, training has been limited to the ITF at the school. Data should be gathered on the effect of mentors providing support and ongoing assistance to new teachers throughout the school year. In addition, it would be interesting to learn the benefits of providing inservice credit for teachers to have the time to collaborate on strategies that result in the best practices.

Future studies need to examine how teachers work with different levels of students. Are some teachers more effective with the students who begin with the lowest IPM level or students who begin with the highest IPM level? Do students who start with high IPM levels at their grade level make as much gains as students who start with low IPM levels? Do students who are motivated to attempt solving problems independently make more gains than students who wait for teacher assistance? Do students who work cooperatively in math at least once a week show greater gains than students who work independently all the time? Do students with less years of experience on the computer show higher gains? Do beginning teachers have greater gains the second half of their first years due to increased teacher knowledge? Do teachers who continue their professional development have greater student gains than teachers whose professional development is limited to recertification requirements? How do you change teachers' attitudes regarding the value an effective program or how to implement it effectively? Finally, additional research would be beneficial to observe the teacher with the highest gains in her classroom to document which strategies and integration techniques result in the best practices to increase gains for all students.

References

- Alliance for Childhood. (2000). Children and computers: A call for action. Retrieved September 5, 2003, from www.allianceforchildhood.net/projects/computers_articles_call-for_action.htm
- Archer, J. (1998, Oct 1). The link to higher scores [Electronic version]. *Education Week on the Web*. Retrieved September 5, 2003, from www.edweek.org/sreports/tc98/
- Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative data*. New York: New York University Press.
- Bailey, D. C. (1992). Wanted: A road map for understanding Integrated Learning systems. Computer-based integrated learning systems. *Educational Technology*, 39(9), 3-5.
- Becker, H. J. (1990). *Effects of computer use on mathematics achievement: findings from a nationwide field experience in grade five through eight classes. Part I Rationale, study design, and aggregate effect sizes*. Center for research on elementary and middle school, Johns Hopkins University. Report No. 51. Paper presented at 1990 meetings of American Educational Research Association, April 1990.
- Becker, H. J. (1992). Computer-based integrated-learning systems in the elementary and middle grades: A critical review and synthesis of evaluation reports. *Journal of Educational Computer Research*, 8(1), 1-41.

- Becker, H. J. (1993). A model for improving the performance of integrated learning systems: mixed individualized/group/whole class lessons, cooperative learning, and organizing time for teacher-led remediation of small groups. In G. D. Bailey (Ed.), *Computer-based integrated learning systems*. Englewood Cliffs, NJ: Educational Technology.
- Becker, H. J. (1994). How exemplary computing-using teachers differ from other teachers: Implication for realizing the potential of computers in schools. *Journal of Research on Computer in Education*, 26(3), 291-321
- Becker, H. J. (2000). Who's wired and who's not: Children's access to and use of computer technology [electronic version] *The future of children: Computer technology*, 10(2), Retrieved October 4, 2003, from <http://www.futureofchildren.org>
- Becker, H. J. (2000b). The "exemplary teacher" paper- how it arose and how it changed its author's research program. *Contemporary Issues in Technology and Teacher Education*, [online serial], 1(2). Retrieved July 1, 2004 from <http://www.citejournal.org/vol1/iss2/article2.htm>
- Becker, H. J., & Lovitts, B. E. (2000). *A Project-based assessment model for judging the effects of technology use in comparison group studies*. Retrieved July 1, 2004 from www.sri.com/policy/designkt/becker2.pdf
- Becker, H. J., Ravitz, J. L., & Wong, Y. (1998). *Teaching, learning and computing: A national survey of schools and teachers*. Center for Research on Information Technology and Organizations, University of California, Irvine. Irvine CA Retrieved October 4, 2003, from www.crito.uci.edu

- Becker, H. J., Ravitz, J. L., & Wong, Y. (1999). *Teacher and teacher-directed student use of computers and software*. Center for Research on Information Technology and Organizations, University of California, Irvine. Irvine California. Retrieved June 30, 2004 from www.crito.uci.edu
- Becker, H. J., & Riel, M. M. (1999). *Teacher professionalism and the emergence of constructivist-compatible pedagogies*. Teaching, Learning and Computing: a research project of the Center for research on information technology and organizations, University of California, Irvine. Retrieved July 1, 2004 from http://www.crito.uci.edu/tlc/findings/special_report2/
- Berg, B. L. (2001). *Qualitative research methods for the social sciences*. Needham, MA: Allyn & Bacon.
- Berk, L. E., & Winsler, A. (1995). *Scaffolding children's learning: Vygotsky and early childhood education*. Washington D.C.: National Association for the Education of Young Children.
- Blickhan, D.S. (1993). The teacher's role in integrated learning systems. In G. D. Bailey (Ed.), *Computer-based integrated learning systems*. Englewood Cliffs, NJ: Educational Technology.
- Blok, H., Oostdam, R., Otter, M.E., & Overmaat, M. (2002). Computer-assisted instruction in support of beginning reading instruction: a review. *Review of Educational Research*, 72(1), 101-130.
- Bodrova, E., & Leong, D. J. (1996). *Tools of the mind: The Vygotskian approach to early childhood education*. Columbus, Ohio: Prentice Hall.

- Bogdan, R. C., & Biklen, S. K. (2003). *Qualitative research for education: An Introduction to theory and methods* (4th ed.). Boston: Allyn & Bacon.
- Bowman, B.T. (1999). Policy implications for math, science, and technology in early childhood education. Based on papers commissioned for the forum on Early Childhood Science, Mathematics, and Technology Education February 6-8, 1998 American Association for the Advancement of Science Washington D.C. p 40-49
- Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. Spiro (Eds.), *Cognition, education, multimedia. Exploring ideas in high technology* (pp. 115-141). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Brinkley, V. M., & Watson, J. A. (1987-88). Effects of microworld training experience on sorting tasks by young children. *Journal of Educational Technology Systems*, 16, 349-364
- Brown, D. L. (1996). Kids, computers, and constructivism. *Journal of Instructional Psychology*, 23, 189-195.
- Brush, T. A. (1998). Embedding cooperative learning into the design of integrated learning systems: Rationale and guidelines. *Educational Technology Research and Development*, 46(3), 5-18
- Brush, T. A., Armstrong, J., Barbrow, D., Ulintz, L. (1999). Design and delivery of integrated learning systems: Their impact on student achievement and attitudes. *Journal of Educational Computing Research*, 21(4), 475-486.

- Brush, T. A., Armstrong, J., Barbrow, D., Ulintz, L. (1999). Design and delivery of integrated learning systems: Their impact on student achievement and attitudes. *Journal of Educational Computing Research*, 21(4), 475-486
- Chapman, G. (2000). Federal support for technology in K-12 education. *Brooking papers on education policy 2000*. Retrieved June 18,2003 from <http://www.brook.edu/index/research.htm>
- Clements, D. H. (1987). Computers and young children: A review of research. *Young Children*, 43(1). 34-44.
- Clements, D. H. (1993). Computer technology and early childhood education. In J. L. Roopnarine & J. E. Johnson (Eds.), *Approaches to early childhood education (2nd ed.)*. Upper Saddle River, NJ: Prentice Hall.
- Clements, D. H. (1999). Young children and technology. Based on papers commissioned for the forum on Early Childhood Science, Mathematics, and Technology Education February 6-8, 1998 American Association for the Advancement of Science Washington D.C. p 92-103.
- Clements, D.H., & McMillen, S. (1996). Rethinking “concrete” manipulatives. *Teaching Children Mathematics*, 2(5), 270-279.
- Clements, D.H., & Nastasi, B.K. (1993). “Electronic media and early childhood education”. In B. Spodek (Ed.), *Handbook of research on the education of young children* (pp. 251-275). New York: Macmillan.
- Clements, D. H., & Sarama, J. (2000). Strip mining for gold: Research and policy in educational technology – a response to “Fool’s gold”. *Educational Technology*

Review. 11(1). Retrieved July 1, 2004 from

<http://www.aace.org/pubs/etr/issue4/clements2.pdf>

Cody, R. P., & Smith, J. K. (1997). *Applied statistics and the SAS programming language (4th ed.)*. Upper Saddle Creek, N.J.: Prentice Hall.

Constas, M. A. (1992). Qualitative analysis as a public event: The documentation of category development procedures. *American Educational Research Journal*, 29, 253-266.

Cook, D. A. (1993). Behaviorism evolves. *Educational Technology*. 33(10) p 62-77

Cordes, C., & Miller, E. (2000). *Fool's gold: A critical look at computers in childhood*.

Alliance for Childhood. Retrieved July 1, 2003 from

http://www.allianceforchildhood.net/projects/computers/computers_reports.htm

Corning, N., & Halapin, J. (1989, March). *Computer applications in an action-oriented kindergarten*. Paper presented at the meeting of the Connecticut Institute for Teaching and Learning Conference, Wallingford, CT.

Creswell, J. W. (1994). *Research design qualitative and quantitative approaches*.

Thousand Oaks, CA: Sage.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage.

Creswell, J. W. (2002). *Educational research: Planning, conducting, and evaluating*

quantitative and qualitative approaches to research. Upper Saddle, N.J.:

Merrill/Pearson Education.

Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003).

Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.),

- Handbook of mixed methods in social & behavioral research* (pp. 209-240). Thousand Oaks, CA: Sage.
- Crook, C. (1987). Computers in the classroom: Defining a social context. In J. C. Rutkowska & C. Crook (Eds.), *Computers, cognition and development: Issues for psychology and education* (pp. 35-51). New York: John Wiley.
- Crook, C. (1994). *Computers and the collaborative experience of learning*. London: Routledge.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
- Davis, B.C., & Shade, D.D. (1997). Integrating computers into the early childhood curriculum. *Principal*, 76, 34-35.
- Deatsman, G. A., & Keough, S. (1989). The effect of computer simulated number blocks on retention of double-digit addition and subtraction ability. *Journal of Computing in Childhood Education*, 1(1), 85-93.
- Dexter, S. L., Anderson, R. E., & Becker, H. J. (1999). Teachers' view of computers as catalysts for changes in their teaching practice. *Journal of research on computing in education*. 31(3), 221-239.
- Dockstader, J. (1999). Teachers of the 21st century know the what, why, and how of technology integration. *T.H.E. Journal*, 26(6), 73-74
- Elkind, D. (1987). *Miseducation: preschoolers at risk*. New York: Knopf.
- Estep, S. G., McInerney, W.D., Vockell, E., & Kosmoski, G. (1999). An investigation of the relationship between integrated learning systems and academic achievement. *Journal of Educational Technology Systems*, 28(1), 5-19.

- Esterberg, K. G. (2002). *Qualitative methods in social research*. New York: McGraw Hill.
- Fitzgerald, D., & Fitzgerald, R. (2002). *The use of integrated learning systems in developing number and language concepts in primary school children: A longitudinal study of individual differences*. Commonwealth Department of Education Science and Training. Canberra, Australia.
- Florida Department of Education (2003). Office of Policy Research and Improvement. Retrieved December 7, 2003 from www.fldoe.org
- Florida Department of Education (2003b). School Advisory Council and Florida Indicators Report 2002-2003, Retrieved September 2, 2004 from www.greatschools.net
- Fulton, K. (1988). Preservice and inservice: What must be done in both. *Electronic Learning*, 8(3), 32-37.
- Fulton, K. (1997). Learning in a digital age: Insights into the issues: The skills students need for technological fluency. Retrieved June 21, 2004 from <http://www.mff.org/pub/ME164.pdf>.
- Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and applications* (7th ed.). Upper Saddle River, NJ: Merrill Prentice Hall.
- Geary, D. C., Fan, L., & Bow-Thomas, C. C. (1992). Numerical cognition: Loci of ability differences comparing children from China and the United States. *Psychological Science*, 3, 180-85.

- Ginsburg, H. P., Zelman, S. (1988). Understanding individual differences in the computer age. In G. Forman & P. B. Pufall (Eds.), *Constructivism in the computer age* (pp. 151-169). Hillsdale, N J: Lawrence Erlbaum Associates.
- Glass, G. V., & Hopkins, K. D. (1996). *Statistical methods in education and psychology (3rd ed.)* Needham, MA: Allyn & Bacon.
- Greene, J. C., & Caracelli, V. J. (1997). Defining and describing the paradigm issue in mixed-method evaluation. In J. C. Greene & V. J. Caracelli (Eds.), *Advances in mixed-method evaluation: The challenges and benefits of integrating diverse paradigms*. San Francisco: Jossey-Bass. Need page numbers of chapter
- Greene, J. C., & Caracelli, V. J. (2003). Making paradigmatic sense of mixed methods practice. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 91-110). Thousand Oaks, CA: Sage.
- Hadley, M., & Sheingold, K. (1993). Commonalities and distinctive patterns in teachers' integration of computers. *American Journal of Education*, 101, 261-315
- Haughland, S.W. (1997). How teachers use computers in early childhood classrooms. *Journal of computing in childhood education*, 8(1), 3-14.
- Haughland, S.W. (1999). What role should technology play in young children's learning? *Young Children*, 54(6), 26-31.
- Healy, J. .M. (1998). *Failure to connect how computers affect our children's minds – for better and worse*. New York: Simon & Schuster.
- Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G. E. (1987). *Taking charge of change*. Alexandria, VA: ASCD Publications.

- International Society for Technology in Education. (1992). *Curriculum guidelines for accreditation of educational computing and technology programs*. Eugene, OR: International Society for Technology in Education Press.
- Johnson, B., & Turner, L. A. (2003). Data collection strategies in mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 297-319). Thousand Oaks, CA: Sage.
- Kemper, E. A, Stringfield, S., & Teddlie, C. (2003). Mixed methods sampling strategies in social science research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 273-296). Thousand Oaks, CA: Sage.
- Kerkman, D. D., & Siegler, R. S. (1993). Individual differences and adaptive flexibility in lower-income children's strategy choices. *Learning and Individual Differences, 5*, 113-36.
- Kohn, Alphonse. (1993). *Punished by rewards: the trouble with gold stars, incentive plans, A's, praise, and other bribes*. Boston: Houghton Mifflin
- Koppel, T. (1998). *Will computers improve public education, [TV program transcript]*. *ABC News Nightline Program*. Retrieved July 1, 2004 from www.edfreefoundation.org/computers.htm [1998, September 30].
<http://static.highbeam.com/a/abcnightline/september301998/computersintheclassrooms/index.html>
- Langford, B. E., Schoenfeld, G., & Izzo, G. (2002). Nominal grouping sessions vs. focus groups. *Qualitative Market Research, 5*(1), 58-70.

- Magidson, E. R. (1978). Trends in computer-assisted instruction. *Educational Technology*, 18(4), 23-36.
- Mann, D., Shakeshaft, C., Becker, J., & Kottkamp, R. (1999). *West Virginia's Basic Skills/Computer Education Program: An analysis of student achievement*. Santa Monica, CA: Milken Family Foundation.
- Maxwell, J. A., & Loomis, D. M. (2003). Mixed methods design: An alternative approach. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 241-271). Thousand Oaks, CA: Sage.
- McCollister, T. S., Burts, D. C., Wright, V. L., & Hildreth, G. J. (1986). Effects of computer-assisted instruction and teacher-assisted instruction on arithmetic task achievement scores of kindergarten children. *Journal of Educational Research*, 80, 121-125.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: A sourcebook of new methods*. Beverly Hills, CA: Sage.
- Mills, S.C. (2000-2001). The technology implementation standards configuration matrix: A tool for analyzing technology integration. *National Forum of Applied Educational Research Journal*, 14, 26-42.
- Mills, S. C., Ragan, T. R. (1998, February). *An implementation model for integrated learning systems*. Paper presented at the annual conference of the Association for Educational Communications and Technology, St. Louis, MO.
- Mills, S. C., & Ragan, T. J. (2000). A tool for analyzing implementation fidelity of an integrated learning system. *Educational Technology Research and Development Journal*, 48(4) 21-41.

- National Association for the Education of Young Children. (1995). NAEYC Position Statement: Technology and young children – ages three through eight. *Young Children*, 51(6), 11-16.
- National Association for the Education of Young Children. (2002). Early childhood mathematics: Promoting good beginnings. *Joint position statement of the National Association for the Education of Young Children and the National Council of Teacher of Mathematics*. Retrieved June 24,2004 from http://www.naeyc.org/resources/position_statements/psmath.htm
- National Clearinghouse for Comprehensive School Reform (2002). Funded by the Office of Elementary and Secondary Education of the U.S. Department of Education, Retrieved March 3,2004 from <http://www.goodschools.gwu.edu/>
- National Commission on Teaching and America’s Future (2003). *No dream denied: A pledge to America’s children*.
- National Council for the Accreditation of Teachers. (1994). *NCATE Standards*. Washington, DC: National Council for the Accreditation of Teachers Press.
- Neisworth, J. T., & Buggey, T. J. (1993). Behavior analysis and principles in early childhood education. In J. L.Roopnarine & J. E. Johnson (Eds.), *Approaches in Early Childhood Education (2nd ed.)*(pp.113-135). Upper Saddle River, New Jersey: Prentice Hall.
- Newman, F., & Holzman, L. (1993). *Lev Vygotsky: revolutionary scientist*. New York: Routledge
- No Child Left Behind Act of 2001, Public Law 107-110 (2002).

- Onwuegbuzie, A. J. (2002, November). *Validity and qualitative research: An oxymoron?*
Paper presented at the annual conference of the mid-south educational research association, Chattanooga, TN.
- Onwuegbuzie, A. J. (2003). Expanding the framework on internal and external validity in quantitative research. *Research in the Schools, 10*(1) 71-89.
- Onwuegbuzie, A. J., Teddlie, C. (2003). A framework for analyzing data in mixed research. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 423-455). Thousand Oaks, CA: Sage.
- Papert, S. (1980). *Mindstorms: children computers, and powerful ideas*. New York: Basic Books.
- Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*. New York: Basic Books.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. Thousand Oaks, CA: Sage.
- Pearson Education Technologies (2003). Validated achievement results with successmaker enterprise. Retrieved September 4, 2003, from <http://www.pearsonedtech.com/successmaker/results; htm>
- Ratner, C. (1991). *Vygotsky's sociohistorical psychology and its contemporary applications*. New York: Plenum Press.
- Ravitz, J. L., Becker, H. J., & Wong, Y. (2000). *Constructivist-compatible beliefs and practices among U.S. teachers. Teaching, Learning, and computing: 1998 National survey*. Center for Research on Information Technology and

- Organizations, University of California, Irvine. Irvine California. Retrieved July 1, 2004 from www.crito.uci.edu/tlc/html/findings.html
- Rocco, T. S., Bliss, L. A., Gallagher, S., Perez-Prado, A., Alacaci, C., Dwyer, E. S., Fine, J. C., Pappamihiel, N. E. (2003). The pragmatic and dialectical lenses: Two views of mixed methods use in education. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of Mixed Methods in Social & Behavioral Research* (pp. 595-615). Thousand Oaks, CA: Sage.
- Rogers, L., & Newton, L. (2001). Integrated Learning Systems – an ‘open’ approach. *International Journal of Science Education*, 23(4), 405-422.
- Roschelle, J.M., Pea, R.D., Hoadley, C.M., Gordin, D.N., & Means, B.M. (2000). Changing how and what children learn in school with computer-based technologies. [electronic version] *The Future of Children: Children and Computer Technology* 10(2), Retrieved Oct. 4,2003 from <http://www.futureofchildren.org>
- Salpeter, J. (2003). Professional development: 21st century models. *Technology & Learning*. 24(1). 34-50.
- Sandholtz, J. H., Ringstaff, C. & Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms*. New York: Teachers College Press.
- Schacter, John. (1999). *The impact of education technology on student achievement: What the most current research has to say*. Milken Exchange on education technology. Retrieved on June 23, 2004 from www.milkenexchange.org.
- Shade, D. D. (1996). Software Evaluation. *Young Children*, 5(6), 17-21.

- Shade, D. D., & Davis, B. C. (1997). The role of computer technology in early childhood education in J. P. Isenberg & M. R. Jalongo (Eds.), *Major Trends and Issues in Early Childhood education: challenges, controversies, and insights* (pp. 90-103) New York: Teachers College Press.
- Sheingold, K. (1986). The microcomputer as a symbolic medium. In P.F. Campbell & G. C. Fein (Eds.), *Young children and microcomputers*. Englewood Cliffs, NJ: Prentice-Hall.
- Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York: Center for Technology in Education, Bank Street College of Education.
- Shields, M. K., & Behrman, R.E. (2000). Children and computer technology: Analysis and recommendations. [electronic version] *The Future of Children: Computer Technology 10*(2), Retrieved Oct. 4, 2003 from <http://www.futureofchildren.org>
- Siegler, R. S. (1986). Unities in strategy choices across domains. In M. Perlmutter (Ed.), *Minnesota symposium on child psychology, vol. 19*. Hillsdale, NJ: Erlbaum.
- Siegler, R. S. (1998). *Children's thinking (3rd ed.)*, Upper Saddle River, NJ: Prentice-Hall.
- Siegler, R. S., & Alibali, M. W. (2005). *Children's thinking (4th ed.)*, Upper Saddle River, NJ: Prentice-Hall.
- Siegler, R. S., & Shipley, C. (1995). Variation, selection, and cognitive change. In T. Simon & G. Halford (Eds.), *Developing cognitive competence: New approaches to process modeling*. Hillsdale, NJ: Erlbaum.

- Simon, T. (1987). Claims for LOGO – what should we believe and why? In J. C. Rutkowska & C. Crook (Eds.), *Computers, Cognition and development: Issues for psychology and education* (pp.115-142). London: John Wiley & Sons Ltd.
- Solomon, C. (1986). *Computer environments for children: A reflection on theories of learning and education*. Cambridge MA: MIT Press.
- Spiro, R. J., Feltovich, P. J., Jacobson, M. J. & Coulson, R. L. (1992). Cognitive flexibility, constructivism and hypertext: Random access instruction for advanced knowledge acquisition in ill-structured domains. In T. Duffy & D. Jonassen (Eds.), *Constructivism and the technology of instruction* (pp.57-76). Hillsdale, N.J.: Erlbaum
- Suppes, P., & Macken, E. (1978). The historical path from research and development to operational use of CAI. *Educational Technology*, 18(4), 9-12.
- Surry, D. W. (1997). Diffusion theory and instructional technology. Paper presented at the Annual Conference of the Association for Educational Communications and Technology, Albuquerque, NM.
- Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology*. Thousand Oaks, CA. Sage.
- Tashakkori, A., & Teddlie, C. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 3-50). Thousand Oaks, CA: Sage.
- Thrall, T., & Tingey, B. (2003). *Technical note TN030409 Successmaker motion: A research summary*. Pearson Education Technologies: Pearson Education.

- Thouvenelle, S. & Bewick, C. J. (2003). *Completing the computer puzzle: A guide for early childhood educators*. Boston: Allyn & Bacon
- Underwood, J., Cavendish, S., Dowling, S., Fogelman, K., & Lawson, T. (1996). Are integrated learning systems effective learning support tools? *Computers Education*, 26(1-3), 33-40.
- Underwood, J. D. M., & Underwood, G. (1990). *Computers and learning: Helping children acquire thinking skills*. Cambridge, MA: Basil Blackwell.
- U. S. Department of Education (2004). *The facts about... math achievement*. Retrieved June 23, 2004 from <http://www.ed.gov/nclb/methods/math/math.html>
- Vygotsky, L. S. (1978). *Mind in society*. Cambridge MA: Harvard University Press.
- Vygotsky, L. S. ([1960]1981). The genesis of higher mental functions. In J. V. Wertch (Ed.), *The concept of activity in Soviet psychology* (pp.144-88). Armonk, New York: Sharpe
- Vygotsky, L. S. (1986). *Thought and language*. Cambridge MA: MIT Press.
- Wartella, E.A., & Jennings, N. (2000). Children and computers: New technology – old concerns. *The Future of Children: Children and Computer Technology*, 10(2), <http://www.futureofchildren.org>
- Wayne, A. J., & Youngs, P. (2003). Teacher characteristics and student achievement gains: a review. *Review of Educational Research*, 73(1), 89-122.
- Weglinsky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. Princeton, NJ: Policy Information Center Educational Testing Service. Retrieved February 14, 2004 <http://www.ets.org/research/pic>

White, M.A. (1992). Are ILSs good education? *Educational Technology*, 39(9), 49-50.

Yazdani, M. (1987). Artificial Intelligence, powerful ideas and children's learning. In J.

C. Rutkowska & C. Crook (Eds.), *Computers, cognition and development: Issues for psychology and education* (pp. 92 -114). New York: John Wiley.

Appendices

Informed Consent

Social and Behavioral Sciences
University of South Florida

Information for People Who Take Part in Research Studies

The following information is being presented to help you decide whether or not you want to take part in a minimal risk research study. Please read this carefully. If you do not understand anything, ask the person in charge of the study.

Title of Study: The Relationship Between Teaching Experience and Style and Primary Student Gains in Mathematics Using an Integrated Learning System

Principal Investigator: Marilyn N. Meub

Study Location(s): Taylor Ranch School, Venice, FL

You are being asked to participate because the focus of this study is to ask teachers of primary students their perceptions and attitudes concerning the Successmaker ILS and how their style of interaction with children during the Successmaker lab time.

General Information about the Research Study

The purpose of this research study is to ascertain, using multiple tools and methods, the impact of teachers' interactions with primary students on mathematics performance using an ILS to determine effective teacher practices.

Plan of Study

Each teacher will be asked to state their years of teaching experience including number of years at different grade levels. Additionally, each volunteer will be asked to participate in a one hour focus group. Some teachers will be asked to be interviewed individually for approximately one hour. No teacher will be asked to participate more than a total of two hours for this study.

Payment for Participation

There will be no payment for participation in this study.

Benefits of Being a Part of this Research Study

By taking part in this research study, you will be adding to the knowledge base as to what teacher practices are most effective to increasing primary student gains in mathematics as measured by the Successmaker Management program. This knowledge base will provide you with information to improve your students' gains in mathematics while in the Successmaker Lab.

Appendix A: (Continued)

Risks of Being a Part of this Research Study

There are no known risks by participating in this research study.

Confidentiality of Your Records

Your privacy and research records will be kept confidential to the extent of the law. Authorized research personnel, employees of the Department of Health and Human Services, and the USF Institutional Review Board, its staff, and other individuals acting on behalf of USF may inspect the records from this research project.

The results of this study may be published. However, the data obtained from you will be combined with data from others in the publication. The published results will not include your name or any other information that would personally identify you in any way. Code names will be used and only the principal investigator will have access to the individual data. All data will be kept in the possession of the principal investigator.

Volunteering to Be Part of this Research Study

Your decision to participate in this research study is completely voluntarily. You are free to participate in this research study or to withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive, if you stop taking part in the study. In addition, your decision to participate or not to participate will in no way affect your job status.

Questions and Contacts

- If you have any questions about this research study, contact Marilyn Meub at 941-544-7372.
- If you have questions about your rights as a person who is taking part in a research study, you may contact the Division of Research Compliance of the University of South Florida at (813) 974-5638.

Consent to Take Part in This Research Study

By signing this form I agree that:

- I have fully read or have had read and explained to me this informed consent form describing this research project.
- I have had the opportunity to question one of the persons in charge of this research and have received satisfactory answers.
- I understand that I am being asked to participate in research. I understand the risks and benefits, and I freely give my consent to participate in the research project outlined in this form, under the conditions indicated in it.

Appendix A: (Continued)

- I have been given a signed copy of this informed consent form, which is mine to keep.

Signature of Participant Printed Name of Participant Date

Investigator Statement

I have carefully explained to the subject the nature of the above research study. I hereby certify that to the best of my knowledge the subject signing this consent form understands the nature, demands, risks, and benefits involved in participating in this study.

Signature of Investigator
Or authorized research
investigator designated by
the Principal Investigator Printed Name of Investigator Date

Appendix B: Interview Protocol
Interview Protocol

Time of interview

Data:

Place:

Interviewee:

Position of Interviewee:

Grade teaching

Years of experience:

Questions:

1. What time of day do you go to the Successmaker Lab?

Probe: Do you feel the time of day affects performance?

Why?

2. Is anyone else there when you are in the lab with your students?

Probe: How often are they there?

Do they work with their own children or with children you assign?

3. Do you ever miss Successmaker lab? Explain

4. Can you tell me how you see Successmaker lab as part of your grade level curriculum?

Unscheduled probes as needed

5. Do you use any of the Successmaker Management System?

Unscheduled probes as needed

6. Has Successmaker lab changed your teaching in your classroom?

Probe: How and why?

Appendix B: (Continued)

7. What did you do the last time you were in the lab?

Probe: Would you consider it a typical day?

8. What barriers do you see which inhibit or prevent maximum effectiveness of the Successmaker lab?

Probe: What could be implemented or changed to attain maximum effectiveness?

9. What amount and type of professional development have you had since entering teaching?

Probe: Do you have any advanced degrees and in what areas?

Do you have any plans for further professional development other than required by certification?

Appendix C: Focus Group Questions

Date of focus group:

Number of participants:

Place:

1. Can you tell me how you see Successmaker lab as part of your grade level math curriculum?

Follow-up questions as needed

2. Has Successmaker lab changed your math teaching or grouping in your classroom?

3. What do you think influences the effectiveness of the Successmaker lab?

Explain

4. Have you observed any changes in student achievement in math since the school implemented the Successmaker?

Do you believe there is any correlation to the Successmaker?

Follow-up questions as needed

Appendix D: Probes/ Confirmations for Focus Groups

1. *Is everyone pleased with the time of day you are assigned? If not why? Do you think it affects performance?*
 - a. Everyone seems to have adjusted to the time of day even if they are sluggish in the morning or tired in the afternoon. It is routine.
2. Others in the lab?
 - a. Appears sporadic
 - b. Quality assistance seems welcomed such as interns, aides,
 - c. Another pair of eyes
 - d. Teacher assigns whom they work with based on reports and observations
3. Time in lab
 - a. Alternate reading and math
 - b. Some do double math/reading
 - c. Teacher works with different children

Question probe: In the lab, do you work with one or more students? About how long do you spend with a child having difficulty?

Question probe: logistics of pencils and paper for students in math

Question probe: Mechanical difficulties

Appendix D: (Continued)

Reports

4. *Questions: When you get reports how do you respond to the information on the specific report?*

- a. Today's session – daily
 - i. Scores for stickers
 - ii. Averages for the day
 - iii. Students having problems or just bored
- b. Course Report

Question: What suggestions do you have that the school can provide you to make Successmaker more effective?

Question: What types of motivation do you use and do you think it is effective?

Question: I have heard that many teacher felt one of the major barriers is the daily drudgery of going to the lab, how have you address this in your classroom?

Question probe: Do you feel there are other barriers?

Question probe: Do you have any other suggestions?

Questions: The principal has spoken with each team and explained that some teachers are showing more gains than others, what factors do you think contribute to this? Why?

Appendix E: Instructional Technology Facilitator Interview Protocol
Interview Protocol

Time of interview

Date:

Place:

Interviewee:

Position of Interviewee: Technical Support

Grade teaching

Years of experience:

Questions:

1. What type of training have you had for this position and who has provided it?

Probe: Researcher: Do they give you update at that meeting?

2. What type of training and support do you give to new hires to our school?

Probe: What type of ongoing support do you provide to the entire faculty

3. Do all teachers take advantage of this support?

4. What strengths and weaknesses do you see in the Successmaker program?

Probe:

5. Have you seen any pattern emerging year after year, as you analyze the data?

6. Do you feel gains follow the children (i.e. high gains first grade, high gains second grade) or do you see a pattern among teachers as far as student performance and gains?

Appendix E: (Continued)

Probe: Do you see any correlation between years of using the Successmaker and increased students gains?

7. What is your role in providing the principal with information about the program?

8. What barriers do you see which inhibit or prevent maximum effectiveness of the Successmaker lab?

Probe: What could be implemented or changed to attain maximum effectiveness?

What do you think TRS could do to improve the effectiveness of this program?

Probe: How and why?

9. What amount and type of professional development have you had since entering teaching?

Probe: Do you have any advanced degrees and in what areas?

Do you have any plans for further professional development other than required by certification?

Appendix F :Years of Teaching Experience Survey

Name _____

Years of Teaching Experience

Total years of teaching experience _____

Years of teaching at research site _____

Years of teaching at other schools - Please include the state

Years of experience at each grade level



Appendix G: Implementation Log

- January 28,2005** Defended dissertation proposal
- February 2,2005** Held meeting after school to explain study to participants. Ten teachers attended
- February 3,2005** Held meeting before school to explain study to participants. Three teachers attended
- February 4, 2005** Another teacher signed consent form
- February 7,2005** Collected data on all participants running a course report on Mathematics Concepts Skills to report students gains at this point in the year
- February 7-10, 2005** Decide to make 10:00 hours be the cut off point for reporting gains on students based on average time on computer for all teachers. This is also the time restriction Pearson Technology uses to conduct reports.
- February 10, 2005** After evaluating data, decide to use just 2004-2005 gains report to decide teachers to be interviewed. There are too many changes in classroom teachers to get enough data to use the previous years. Discovered the teachers with the highest gains were consistent most years.
- February 11, 2005** Interviewed first grade teacher with highest gains
- February 15, 2005** Interviewed second grade teacher with lowest gains
- February 17, 2005** Interviewed third grade teacher with highest gains
Interviewed second grade teacher with highest gains
Another teacher agreed to participate in the study
- February 18,2005** Interviewed first grade teacher with lowest gains
Another teacher agreed to participate in the study

Appendix G: (Continued)

February 21, 2005: Met with two members of committee to discuss qualitative data analysis procedures.

February 24, 2005: Put flyers in mailboxes announcing the dates for the two focus groups. Participants ask to select one day that fits their schedule the best. If no dates work asked to suggest alternative date.

March 2, 2005: Second grade teacher who has been absent due to death in the family and hospitalized for pneumonia signs informed consent form.

March 2, 2005: Interviewed Instructional Technology Facilitator (ITF) concerning the training of teachers. We also spoke of topic probes to be used for the focus groups including what is being done in the classroom for motivation, follow up for students having difficulty at any level, above on or below, what are teachers doing once they have the reports.

March 14, 2005: Interviewed third grade teacher in her classroom. She would not allow me to use an audiotape recorder during the interview, therefore took careful notes.

March 15, 2005: Held focus group with ten teachers. There were three representatives from first grade, five representatives from second grade, and two representatives from third grade. The focus group took place in my classroom and lasted approximately one hour and fifteen minutes.

March 17, 2005: Held second focus group. There were two representatives from first grade, two representatives from second grade, and three representatives from third grade. The focus group took place in my classroom and lasted approximately one hour and ten minutes.

About the Author

Marilyn N. Meub received a Bachelor's degree in Early Childhood Education from Wheelock College. Upon graduation, she taught primary grades in eastern Pennsylvania, worked with Cedar Crest College and attended Lehigh University. She later moved to Florida and received a Master's degree in Educational Leadership from Nova Southwestern University.

She is currently teaching in southwest Florida and certified in primary grades, gifted education, ESOL, and educational leadership. Besides her teaching responsibilities, she has taken leadership roles both within the school and school district including mentoring new teachers, creating school policy and vision, and facilitating, coordinating, and teaching inservice courses. She has also working closely with the University of South Florida's teacher intern program. While in the Ph.D. program at USF, Ms Meub continued to teach full time and maintain her other leadership roles with both the school district and the University of South Florida.