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Computer-Based Instruction to Improve Literacy Performance of Students with Disabilities

by

Candace Easterling

Submitted in Partial Fulfillment of the

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Acknowledgements

I am living proof of the old saying, "That what doesn't kill you will make you stronger." This has been the story of my life for the past 15 years. I feel as though I have so many people to express my deepest gratitude to, but there is simply not enough room in this paper. However, I have to begin with thanking my father and mother. My struggles and triumphs began 15 years ago with the passing of my father. I was scheduled to start the Multiple Subject teaching credential program at Cal State University San Marcos (CSUSM) in the fall of 1999, when he passed after a long battle with cancer just shy of his 65 birthday. He was one of the main influences in my life, first for valuing education and, second, for having the perseverance to stick with a goal to see it through to completion. He was the first one in his family to obtain a college degree and set the bar high for future generations. I also thank my mother, who has been a great source of strength and support emotionally, financially, spiritually, and physically throughout out my life - especially through the trials and tribulations of the last 15 years.

I started the Multiple Subject (elementary education) credential program in the spring of 2000 and my student teaching in the fall of 2001. Shortly after I began my student teaching, while I was at my school site on the morning of September 11th, 2001, the lives of all Americans were forever altered with the terrorist attack of the twin towers of the world trade center in New York City. This is a day I will never forget. I was able to complete the credential in 2002, but consciously chose to only work part time since my youngest son, who had been diagnosed with Attention Deficit Disorder, was in second grade and still wasn't able to read.

By the time I was ready to work full time, because of the economic turn down, teachers were being laid off and no positions were available. I was financially forced to return to my previous career in health care. Then, in 2005, my husband was admitted to the hospital and was

later diagnosed with congestive heart failure, which again rocked my world. It became clear to everyone that he needed to slow his work life down and that I needed to pursue teaching again. I returned to substitute teaching in October of that year. During the winter break, I was contacted to cover a special education class as a long-term substitute for the teacher who had been killed in an automobile accident. Coincidently, it was at the same school as my two sons attended.

This experience began my career as a special educator (referred to in California as an Education). In this position, my students represented just about every disability in the 13 qualifying conditions. In hopes of continuing to work within my hometown, I immediately pursued the added credential in special education at CSUSM. Not finding work in my hometown, I went in search of an internship, which I found an hour and a half away in the county north of where I lived. I ended up interning at a school that was in danger of being taken over by the state if student performance did not improve. This was actually a positive experience since the staff had an "all for one and one for all" attitude.

Continuing working and attending classes at CSUSM, in 2007, my oldest son was hit by a car while crossing the road on his way to high school. Fortunately, he only suffered a broken shoulder bone. However, shortly after that, the real life-changing event occurred. Our home was destroyed in the 2007 wildfires of southern California. Everything got put on hold while we scrambled to get our lives back. I was somehow able to complete all of my credential work in 2010 and hoped to finish the Master's degree, but we were still were in the middle of rebuilding our home. My stamina was waning, forcing me yet again to put my plans on hold. The delays continued after having surgery and then later being hit by a car as a pedestrian requiring another surgery.

This brings us to 2016. I am finally able to see my dream of obtaining the Master's degree through to completion. I share the background of my journey in order to help whoever reads this to understand the depth of gratitude and appreciation I have for every person who has helped me along the way. My deepest gratitude goes to my family, especially my husband and two sons, who have literally been there with me through it all. A special acknowledgement goes out to my wonderful husband who has literally been by my side through all the years of schooling, experiencing it right along with me. He invested countless hours of editing revising my assignments; and being a source of encouragement, support, and strength.

My gratitude goes out to my countless professors, especially Jacqueline Thousand and Leslie Mauerman who have also been there beside me through the entire journey and without whose never-ending encouragement and optimism I would not have made it this far. Many thanks to my friends, coworkers, and colleagues – especially Dawn Perfect, Lori Tipane, Alicia Stem, Tammra Tagaboni, Cassy Taylor Campos, Francine McClemens, Cheryl Tausig, Kerri Garrison, Bryan Crawford, Jamie Ward, Pamela Campbell, Stacie Carlini, and the entire staff of the elementary schools I have been at for the last 11 years. Thanks to my administrators – Carol Tennenbaum, Rory O'Connor, Eileen Highly, Jinane Annous, Dana Child-Matsai, Janet Mendoza, and my Special Education Director, Leah Davis. I especially need to thank Dr. Marco Baeza for support through very difficult personal and professional times, always being a mentor and master teacher and always caring. You have helped to shaped me as a person, learner, and special educator. I am a stronger and better person both personally and professionally as a result of the life experiences and people bringing me to this point in time.

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Abstract

This study was initiated, at least in part, due to the researcher's school district purchased a computer-based intervention program for use with students eligible for special education, English learners and other learners needing literacy intervention. The researcher is responsible for the design and delivery of special education services for 24 students for whom this program was intended. The purpose of this study was to determine the effectiveness of using the adopted computer-based instructional approach, *Imagine Learning*, in combination with the traditional *Accelerated Reading* literacy instructional approach to improve the overall literacy skills of students with mild and moderate disabilities as compared to instruction using only the traditional Accelerated Reading approach. Student data was collected over the period of a school year for a control group of students in a classroom in which *Imagine Learning* was not used and the experimental group taught by the research, who supplemented the use of *Accelerated Reading* with *Imagine Learning*. Results suggest that students in the experimental group outperformed those in the control group across measures, although a significant proportion of students in both groups made little or no progress or regressed in their performance on the assessment measures. There was no relationship between the number of minutes students engaged in *Imagine Learning* instruction and student performance. Given the obvious limitations of comparing results for students who were at different grade levels and who are instructed in different classrooms by different teachers, results are inconclusive, but clearly beg for further investigation of the effectiveness of computer-based instruction as a component of the literacy instruction of students eligible for special education.

Keywords: Computer-based literacy instruction, literacy instruction, special education, students with disabilities

Chapter One

Introduction

"Education is most often [students] only way out of poverty"

Taylor & Whittaker (2009, p. 146)

Setting the Context

Many of the students I serve as a special educator struggle with reading for a variety of reasons - vision and hearing problems, gaps in their educational history, processing deficits, memory problems, frequent school changes, neurological and attention problems, chronic stress to home life problems. In addition to these obstacles to literacy development, many of the students at the researcher's school site live in low socio-economic households resulting in the vast majority of students only having access to technology at school.

Special educators are faced with the daunting task of finding ways to teach students who have a multitude of obstacles to learning to acquire skills and dispositions to succeed in life. Literacy is one of those skills. Computer literacy is another; computer literacy is not just an advantage, but a requirement for continued schooling and employment.

Federal and State Student Curriculum Standards and Student Learning Accountability

With the Common Core State Standard (CCSS) focus upon college and career readiness, effective use of technology rises to the top as a key 21st century skill set. Assessment of student progress in the Common Core is computer-based (i.e., the Smarter Balance Computer Consortium assessment system). With these changes in standards, curriculum expectations, and assessment methods comes continued scrutiny of student subgroups such as students learning English and students with identified disabilities.

The federal Elementary and Secondary Education Act of 1965 requires and governs state and district accountability for student learning. It was most recently reauthorized in December of 2015 and dubbed the *Every Student Succeeds Act (ESSA).* This 2015 reauthorization provides states more flexibility in their student learning accountability systems than did the 2001 reauthorization, known as the *No Child Left Behind Act*. Yet, it maintains the act's legacy as a civil rights law by (a) ensuring that states and districts hold schools accountable for the progress of every student subgroup (e.g., students with disabilities and English learners) and (b) continuing to dedicate resources and supports so that students with disabilities, English learners, and vulnerable student subgroups (e.g., children of low-income, homeless, or migrant worker families) have equitable access to rigorous curriculum and quality educators, and (c) require districts to use evidence-based, whole-school interventions in its lowest-performing schools and in schools where subgroups (e.g., students with IEPs, English learners) persistently underperform. ESSA reflects a seemingly increased public expectation that schools foster and be held accountable for high educational standards, equality of opportunity to learn, and excellence in student performance for all students, including students with disabilities.

A 2013-14 school district funding reform in California (reflected in the Local Control Funding Formula) requires each school district to develop a Local Control Accountability Plan (LCAP) that accounts for how the district uses state funding. This researcher's school district surveyed parents, school staff, and students to discover what they considered to be the most important areas to address to positively impact learning. The areas that emerged were technology class size reduction, support for English learners, professional development for teachers, and the need for support staff such as reading intervention teachers. With regard to technology, there is a district need for additional computers, computer-based learning, and training for teachers to

become *tech-know-teachers* able to integrate technology into their lessons creating a digital classroom.

The Researcher's Personal and School District Context

As in other districts, improving literacy performance of all students is a central goal of the researcher's district. One of the ways in which districts, including the researcher's district, have attempted to accelerate literacy learning for targeted students is to use evidence-based and computer-based literacy instructional programs. Of the students in the researcher's district, 17.4% are identified as English learners and another 17.4% identified as students with disabilities. To support these subgroups, as part of its LCAP, the researcher's district adopted the computer-assisted learning program, *Imagine Learning*. This program provides instructional support in all foundational reading and oral comprehension skills.

Over the last 50 years, there has been an unprecedented change in technology, which has transformed our daily lives. Growing up with a father who was a computer programmer, this researcher witnessed firsthand computers change from large room-sized machines to multiple small digital devices such as smart phones, laptop computers, chrome books, iPads, and iPods.

For me, the use computers and technology have been a lifelong pursuit. Within my classroom of students with mild and moderate disabilities, I have informally observed how technology can bridge the learning gap for students with a variety of disabilities. Technology can help students who struggle with attention to better focus. It can assist students who struggle with writing show what they know through the use of speech-to-text software and the use of a mouse to select among choices. It can help students with speech difficulties perform the same as other students by having an alternative mode of production. Students that struggle to read can use text-

to-speech software to allow them to verbally demonstrate their comprehension of stories and other passages.

Purpose and Significance of the Study

As a special educator in search of best practices and evidence-based practices, this researcher became interested in determining the most effective ways to increase literacy performance among the students with identified mild and moderate disabilities. The researcher has also observed both traditional teaching approaches and computer-assisted learning enhancing and improving the literacy instruction and became interested in examining how combining both might better support this population.

This study was initiated, at least in part, due to the researcher's school district purchase of a computer-based intervention program for use by students eligible for special education, English learners and other learners needing literacy intervention. The researcher is responsible for the design and delivery of special education services for 20 students for whom this program was intended. The purpose of this study was to determine the effectiveness of using a combination of the computer-based instructional program, *Imagine Learning* and the *Accelerated Reading* program traditionally used by the school district to improve the literacy skills of students with mild and moderate disabilities as compared to providing instruction using only the *Accelerated Reading.* The first research hypothesis is that the use of a combination of a computer-assisted instructional program (i.e., *Imagine Learning*) and an evidence-based program (*Accelerated Reading*) for teaching literacy skills to students with mild and moderate disabilities will result in greater growth in student literacy performance as compared to the use of only evidence-based instruction (*Accelerated Reading*) as measured by the district curriculum-based Measure of Academic Performance (MAP) RIT assessment; STAR reading Scaled Score, Independent

Reading Level comprehension measure, and estimated fluency assessments. The second research hypothesis is that there is a positive relationship between the number of minutes a student spends engaged in computer-assisted *Imagine Learning* instruction and a student's performance on any of the STAR or MAP measures.

There is an emerging literature regarding evidence-based practices that are effective in enhancing literacy learning for students in general. This study is significant in that it fills a gap in the research examining evidence-based literacy instructional practices that are most effective with students with disabilities. In particular, this study fills a gap in the literature examining the effectiveness of computer-assisted literacy instruction in enhancing literacy skills of students with mild and moderate disabilities.

Summary

Although this study was limited to the researcher's school site, the results of the study has much larger implications within the field of education and. All students, not just those with disabilities, need literacy skills that include computer literacy in order to be productive members of a 21st century society that includes a global economy, social media, and digital technology. In the introductory message to the 2013 Common Core State Standards document, the California State Superintendent of Public Instruction highlights the importance of these both sets of literacy skills, stating the following.

> Students learn to closely read and analyze critical works of literature and an array of nonfiction text exploring both print and digital formats. They use research and technology to sift through the staggering amount of information available and engage in collaborative conversations, sharing and reforming viewpoints through a

> variety of written and speaking applications. (California Department of Education, 2013, v.).

The bar is set high for all students including students with special education needs. Combining the use of effective evidence-based teaching strategies and technology to provide students access and motivation, students will be able to rise to the challenge

Definition of Terms

Computer-Assisted Learning

Computer–assisted learning (CAL) is instruction that uses computers and similar digital devices (e.g., iPads, chrome books) to aid and support the education or training of children and adults. The benefits of using CAL include immediate and anytime feedback concerning goal attainment, the provision of faster or slower routes through material for people with different proficiency levels, and maintenance of a progress record for instructors and learners. Computer-assisted learning is one of several terms used to describe this application of computers. Other terms that have been used for *computer-assisted learning* include: *computer-aided* instruction, *computer-assisted instruction*, *computer-based learning*, and *computer-managed instruction* (Danith, 2004).

Digital Literacy

Digital literacy is the term used to describe knowledge, skills, and behaviors needed to use in a broad range of digital devices such as smart phones, tablets, laptops and desktop computers, all of which are seen as a network rather than computing devices. Digital literacy is a *person's ability to perform tasks effectively in a digital environment and includes the ability to read and interpret media, to reproduce data and images through digital manipulation, and to*

evaluate and apply new knowledge gained from digital environments.(University of Illinois, website 2008)

Smarter Balanced Assessment Consortium Assessment

The Smarter Balanced Assessment Consortium (SBAC) assessment is a system of valid, reliable, and fair next-generation assessments aligned to the *Common Core State Standards (CCSS)* in English language arts/literacy and mathematics (www.smarterbalanced.org). The system includes both summative assessments for accountability purposes and optional interim assessments for instructional use. It uses *computer adaptive testing* technology to provide meaningful feedback and actionable data teachers and other educators can use to help students succeed. These assessments provide more accurate and meaningful information about what students are learning by adapting to each student's ability, giving teachers and parents better information to help students succeed. (Smarter Balance Assessment Consortium website, 2016)

Students with Mild and Moderate Disabilities

"Students with mild and moderate disabilities" is the phrase used to describe school-aged students (age 5 to 22) eligible for special education who are eligible in the following six of the 14 federal disability categories: Autism (AUT), Emotional Disturbance (ED), mild and moderate Intellectual Disability (ID), Other Health Impairment (OHI), Specific Learning Disability (SLD), and Speech and Language Impairment (SLI). The students who are the subjects of this study all have disabilities in one or more of these mild and moderate disability categories. (California Teacher Credentialing Website, 2015)

Chapter Two

Literature Review

For people without disabilities, technology makes things easier.

For people with disabilities, technology makes things possible.

IBM Training Manual (1991)

Introduction

With the Common Core State Standards being implemented in most states including California, school districts and their teachers are challenged to identify and use the best instructional practices to effectively achieve Common Core outcomes. This educational shift has been challenging, particularly for special education teachers (Larabee, Burns, & McComas, 2014). Instruction, especially in special education, now is expected to be based upon evidence-based practices that have a history of being an effective teaching and learning method (Caldwell, 1992; Miller & Burnett, 1986).

In addition to the curriculum and instruction shift described above, school funding in California provides for local control, but requires districts to develop a Local Control Accountability Plan (LCAP) that identifies the most important needs within a district as well as describes how districts will use the funds to put the needed supports in place. This change has come about to help schools to focus their efforts to increase student performance, particularly in schools that serve low income families and that have historically been low performing.

Adelman and Taylor (2011) note that state and school district priorities follow national policy makers' views and actions regarding how best to turn around low performing school. They identify needed actions in three areas. First, states and districts need to ensure standards and assessments related to instruction are globally competitive. Second, states and districts need

to develop and enhance data systems for accountability, personalize instruction, and monitor progress to graduation. Third, they need to enhance human capital by recruiting and developing teachers and educational leaders. A large body of research has influenced policy makers. Among the influences are works published by Aladjem, Birman, Harr-Robins, and Parrish (2010); Bryk, Sebring, Allensworth, Luppescu, and Easton (2010); the Center for Comprehensive School Reform and Improvement (2009); the Center on Innovation and Improvement (2007, 2010); Herman, Dawson, Dee, Greene, Maynard, and Darwin (2008); Kowal, Hassel, and Hassel (2009); the Mass Insight Education and Research Institute (2007); Mazzeo and Berman (2003); Murphy and Meyers (2007); Redding (2010); Steiner (2009); Steiner, Hassel, and Hassel (2008); the U.S. Department of Education (2010); and WestEd (2010).

Taking the findings of these researchers and research and policy organization into consideration, in the school district involved in this study, constituents identified as top priorities for funding and intervention (a) class size reduction, (b) tiered literacy intervention as part of a district-wide Multi-tiered System of Support, (c) designated support for learners of English, and (d) targeted specific professional development for teachers. However, the top curriculum and funding priority was the upgrading of technological infrastructure and student and teacher technology literacy in order to prepare students for college and career technology demands of a global economy.

John Rickford (1999) has noted the link between language, cognitive abilities, and school performance in all subject areas. Taylor and Whittaker (2009) also note a link between language and culture including nonverbal communication such as sign language. For students with disabilities, language and literacy development can be elusive and a struggle, requiring a culturally relevant and meaningful “language.” In this study, this researcher is testing the

hypothesis that computer-assisted learning is a culturally relevant and meaningful language for 21st century students with disabilities that, when combined with the evidence-based literacy instruction already provided, will better support students to improve their literacy abilities and performance.

Evidence-Based Practices

At this point in time, many evidence-based practices have emerged to be effective with all student populations, and especially some with students with disabilities. For example, Direct Interactive Instruction (Herchert, 2015) is a research-based approach to teacher best practice through strategies proven to be effective in increasing student achievement. Differentiated instruction and the use Universal Design for Learning principles (Tomlinson, 1999; Thousand, Villa, & Nevin, 2015) encompasses a variety of methods and the use of technology to (a) get to know each students well, (b) provide multiple ways of representing information (i.e., the content of instruction), (c) providing students multiple ways of showing what they know and have learned (i.e., the product of instruction), and (d) multiple ways for students to interact with the content, the teacher, and their peers during the course of instruction (i.e., the process of instruction). Key to differentiating instruction is the recognition that every classroom is filled with diverse learners, the use of ongoing formative assessment to inform instruction, and the use of instruction methods that require student interaction, problem solving, and choice (Robb, 2015). Computer-assisted programs have differentiated instruction built directly into the assessment and instruction. Evidence based practices are not new to education. For example, cooperative group learning has been an evidence-based instructional arrangement that has been known to increase student performance for several decades (Thousand et al., 2015). The difference today is that it is an expectation that evidence-based approaches will be used with all

students and teachers will be held accountable for the use of approaches that have been demonstrated to work.

Research on Reading Interventions

A number of studies have examined the effect of various reading instructional approaches on student literacy growth. Studies that examined populations of students considered at risk, but not eligible for special education include master's theses by Strang (2012) and Girard (2015). Strang (2012), using Accelerated Reader, examined the effect of the amount of reading on literacy growth, concluding that this practice positively effects literacy growth. She was a reading intervention teacher when she conducted this research and did not use any other computer-based learning program for instructional. Girard (2015), using the Measures of Academic Progress (MAP) assessment to determine literacy growth, compared the results of a trimester of instruction for an experimental group of "at risk" students using instructional reading technology (i.e., Read 180) with a control group that had been instructed using the school's traditional small group guided reading approach. Students in the experimental group outperformed those in the control group at a statistically significant level, increasing overall student performance by 11 levels.

Garan and DeVoogd (2008) in their review of the literature on silent sustained reading (SSR) found hundreds of correlational studies which showed that children who read more (i.e., engaged in more sustained silent reading) had better fluency, vocabulary, and comprehension performance. In essence these children were better readers. These results helped this researcher to hypothesize that when a traditional reading approach such as SSR is combined with computer assisted instruction to support reading foundational skills, student outcomes could be enhanced.

Further studies conducted by Topping, Samuels, and Paul (2007) attempted to determine whether it was quantity or quality of reading practice that most influenced reading proficiency. The study included 45,000 students in first through twelfth grade, who read over 3 million books during one school year. Achievement was measured with the STAR test, a computerized standardized reading test that continually adjusts to a student's achievement level based upon responses to previous test items. Accelerated Reading was used to track the amount each student read and literacy growth. Results indicate a positive relationship between achievement gains and quality of instruction, acknowledging the importance of the integrity with which teachers implement instruction and the need for teacher action to guide students through instruction.

Reading Instruction Programs and Assessment Tools Used in This Study

Accelerated Reader

Renaissance Learning Company is a provider of technology-based assessment programs for K-12 schools. One program the company offers to assist in assessing and monitoring independent reading is a computer-based reading program called *Accelerated Reader* (AR). As claimed on the Renaissance Learning website, AR makes reading practice effective by personalizing reading practice to a student's current level and assessing reading and vocabulary practice, literacy skills, and textbook quizzes. Students read books of their choice and take short quizzes on the computer. Every book for which there is an AR quiz has a reading level and point value based on the readability and length of the book. For example, a book coded as 4.2 equate to a fourth grade, second month readability. Longer books written at a higher level have a higher point.

AR is designed to increase students' motivation to read and students' overall achievement in reading. Studies conducted on the effectiveness of AR of fiction and non-fiction books

through quizzes have shown varied results (Renaissance Learning, 2010). To ensure the program is implemented with integrity, Renaissance Learning (2015) prescribes best practices in AR program delivery; namely, practice at the correct level of difficulty, over a sufficient time period, guided by an informed instructor, with enough enjoyment to sustain student engagement.

The *Imagine Learning* Computer-Assisted Instructional Program

The *Imagine Learning* program is a computer-based literacy instructional system designed to assist students to acquire literacy proficiency using a systematic, step-by-step process (Imagine Learning, 2015). *Imagine Learning* instruction addresses five essential components of reading - phonological awareness, phonics, fluency, vocabulary, and comprehension. *Imagine* Learning also directly teaches a variety of reading strategies. The program guides students, as they read literature and informational text adapted to their reading instructional skill level. When answering common comprehension questions, students receive immediate instructive feedback. Direct instruction on the use of text features enables students to use their texts more fully. The program features over 500 activities with a variety of texts that target the development of the Common Core State Standard categories of Informational Text, Foundational Skills, Literature, and Language. With this kind of exposure to literature and direct instruction in reading, speaking, and listening skills, students become better equipped to succeed in literacy.

STAR Reading Assessment

Many studies examining reading achievement use STAR Reading placement assessment to initially assess a student's reading comprehension level. This assessment tool serves multiple assessment purposes - screening, benchmarking of standards, progress monitoring, and provides reports of skills attainment with aligned instructional planning & resources. It aids in accurate

reading level placement, with students working at their individual independent reading level. The assessments dynamically adjust to each student's unique responses through extensive item calibration, which determines each test item's difficulty in relation to thousands of actual students, applying advanced principles of Item Response Theory (IRT) and computer-adaptive testing (Renaissance Learning Website, 2012). Assessment results provide teachers and students a starting point for determining individual students' reading level.

Summary

The literature clearly supports the importance of literacy interventions for students with disabilities. This is needed in order to access and progress in the Common Core standards and develop skills to become a productive member of today's 21st century society. Today literacy has a more expansive meaning beyond reading, writing, and speaking. It includes computer literacy skills. For example, job applications now are on line; many jobs require the use of a digital device and applications. Recognizing the importance of both sets of literacy skills, the Council for Exceptional Children and the Center on Online Learning and Students with Disabilities has been jointly working to understand the challenges and opportunities of online learning environments, especially as they lead to promising practices associated with K-12 online learning (centerononlinelearning.org).

Chapter Three

Methodology

This study explored the effects of adding computer-assisted instruction to the literacy intervention program for elementary students eligible for special education. The researcher hypothesized that the use of a combination of computer-assisted learning (i.e., *Imagine Learning*) and an evidence-based program (*Accelerated Reading*) for teaching literacy skills to students with disabilities would result in increased growth in students' literacy performance as compared to the use of only the evidence-based program (*Accelerated Reading*) as measured by the district curriculum-based Measure of Academic Performance (MAP) RIT assessment; STAR reading Scaled Score, Independent Reading Level comprehension measure, and estimated fluency assessments. The *Imagine Learning* computer-assisted program was purchased by the school district in order to address the literacy instructional needs of (a) the 16% of the school's students population, including learners of English, who were not making expected academic gains; and the 17% of the school population eligible for special education. The researcher also hypothesized that there a positive relationship between the number of minutes that a student spends engaged in the computer assisted instruction program, *Imagine Learning,* and students performance on any of the STAR or MAP measures.

Design of Study and Assessment Measures

The study was primarily a quantitative study that uses multiple measures (i.e., the district's curriculum-based Measure of Academic Performance (MAP) assessment administered three times per year; the STAR Reading placement assessment, which is part of the district Accelerated Reading program and administered three times per year; hours of instructional time on task, Imagined Reading lessons completed, STAR assessment's Independent Reading Level

(IRL), Zone of Proximal Development (ZPD), fluency measures) to track student comprehension and fluency growth over the period of the study.

Students in the experimental group received both *Accelerated Reading* and *Imagine Learning* literacy interventions from the researcher, a special educator responsible for the design and delivery of the students' specialized academic instruction. Students in the control group received only the traditional *Accelerated Reading* literacy intervention from another special educator in the school who was responsible for those students' specialized academic instruction. She used the Developmental Reading Assessment (DRA) system to (www.scholastic.com/parents/resources/article/book-selection-tips/assess-dra-reading-levels) to assess their literacy levels and timed reading to determine their words per minute. These scores then were changed to the grade-level equivalents, using a conversion chart provided by DRA.

Quantitative measures were supplemented with teacher informal observations of student behavior and performance, which add a qualitative dimension to the study.

The research questions that guided this study were the following:

1. Will the use of a combination of a computer-assisted instructional program (i.e., *Imagine Learning*) and an evidence-based program (*Accelerated Reading*) in teaching literacy skills to students with mild and moderate disabilities result in greater growth in student literacy performance as compared to the use of only the evidence-based instructional program (*Accelerated Reading*), as measured by an estimated reading comprehension grade level equivalence and associated Zone of Proximal Development (ZPD), a fluency measure (i.e., an estimated oral reading rate in words per minute); the district curriculum-based Measure of Academic Performance (MAP)

assessment; and (for the experimental group) the minutes of Imagine Learning time completed?

2. Is there a positive relationship between the number of minutes that a student spends engaged in computer-assisted *Imagine Learning* instruction and a students' performance on any of the STAR or MAP measures?

Setting and Participants

The setting for this study is an elementary school in a large southern California school district that serves a diverse population of students, many of whom are English learners. Of the school's total population, 79% live in households that are considered socio-economically disadvantaged and 17% have identified disabilities and receive special education services. It should be noted that the national average of students eligible for special education is 10%, so this school has a disproportionately large percentage of its students identified as eligible for special education services.

Special Education Instructional Personnel Participants

The teacher who is the researcher in this study holds two credentials, a Multiple Subject (elementary education) credential and an Education Specialist (special education) credential. The researcher also holds a Bachelor's degree in Psychology and a Master's degree in education counseling and, at the time of this study, was finishing a Master of Arts degree in special education while in her 11th year as an elementary-level Education Specialist. As part of her employment requirements, the researcher has attended extensive professional development trainings regarding computer-based learning and management, the Common Core standards training in Language Arts and Mathematics, Direction Interactive Instruction, and differentiated

instruction. In addition there is one male paraeducator in the classroom assisting with small group instruction under the supervision of the researcher/teacher.

The students in the control group were instructed by a fully-credentialed Education Specialist in her second year of teaching as a full-time primary grade (i.e., K-3) special educator. She has 4 years of experience. She also is in the process of obtaining her Master's degree in special education. She also had one primary paraeducator with a few part-time paraeducators to assist students with one-to-one guidance.

Overview of Student Participants

The students involved in this study were a convenience sample; namely, the group of students receiving special education services from the researcher and a second group of students receiving special education services from the school's other primary-level special educator. The experimental group was comprised of 24 students (i.e., 13 third graders and 14 fourth graders) with mild and moderate disabilities who receive literacy instruction in the researcher's self-contained special education classroom. Of the 24 students, 20 were boys and 4 are girls. Students in the experimental group received both *Accelerated Reading* and *Imagine Learnin*g instruction as literacy interventions.

The control group was comprised of 10 students - one first grader, five second graders and four third graders. All students had identified mild and moderate disabilities and were taught by the other primary special educator in the school. Of the 10 students, four were girls and six were boys. The teacher of this classroom had not yet implemented *Imagine Learning* and uses only *Accelerated Reading* as the literacy intervention with her students.

Student Participant Descriptions

Since this study examines the impact of instruction of 34 students instructed in both the researcher's classroom and the control group teacher's classroom, descriptions of students in both classrooms are presented here. Descriptions include student gender, grade level, category of special education eligibility, beginning assessed literacy performance, and status as an English learner. Any other relevant cultural, behavioral or social characteristics also are included.

The students in both groups represent several ethnicities – Anglo-Saxon, Latino, Native American, Asian, Pilipino, and African American. The students had various mild and moderate disabilities and were instructed in self-contained special education classrooms.

To keep student identity anonymous, the students receiving only the *Accelerated Reading* intervention are identified by number and are additionally coded as being in the control group (CG) with a CG coding before their student number (i.e., Student CG1, Student CG2 and so forth). This group was comprised of one first grader, five second graders, and four third graders eligible for special education and was taught by another primary special educator in the school. Half of the students were male and the other half were female.

The students receiving both *Accelerated Reading* and *Imagine Learnin*g interventions in the experimental group are identified as Students 11 through 34. Of the 24 students in the experimental group, 20 were boys and four were girls. Ten of the 24 students (i.e., six third graders and four fourth graders) spent most of the day with the teacher/researcher; the other 14 came in and out of the researcher's classroom to receive specialized academic instruction. Students in the intervention group who spent the majority or all of the day with the researcher are coded as full time or FT. Students who were not with the researcher for the majority of the day, but came in after the first recess or lunch for intervention are coded as part time or PT.

Control Group (CG)

Table 2 summarizes the data presented below in the descriptions of the 10 control group students. The first two columns of Table 1 show the estimated reading comprehension grade level and the associated Zone of Proximal Development for the 10 students at the start of the school year in which this study was conducted. The third column shows each student's beginning fluency score as represented by an estimated oral reading rate in words per minute. The fourth column presents each students Scaled Score on the Accelerated Reading STAR reading assessment. The Scaled Score ranges from 0 to 1400 and spans grades 1 through 12. It is calculated based on the difficulty of the questions and the number of correct responses. The Scaled Score is used to compare student performance over time and across grades. The final column represents each student's RIT score on the district-wide Northwest Evaluation Association (NWEA) Measure of Academic Performance (MAP) benchmark. A RIT score is a score on a curriculum scale indicates the level at which a student answers the questions on the assessment 50% of the time and suggests the literacy skills and concepts the student needs to develop. A The RIT scale is an equal interval scale. So, regardless of whether a student is at the top, middle, bottom, or middle of the RIT scale and it has the same meaning regardless of grade level.

Table 1. Control group baseline data from Accelerated Reading STAR reading assessments and the Measure of Academic Performance Benchmark testing

Student	Estimated Reading Comprehension Grade level	Estimated Zone of Proximal Development	Fluency: Estimated Oral Reading RateWPM	Approximate Scaled Score	Measure of Academic Performance 12 months
1st Grade					
Student CG1	1.1	1.1 – 2.1	40	75	159
2nd Grade					
Student CG2	0.7	0.7 – 1.7	7	70	141
Student CG3	1.0	1. 0– 2.0	5	73	159
Student CG4	1.2	1.2 – 2.2	15	77	155
Student CG5	1.1	1.1 – 2.1	8	75	140
Student CG6	1.1	1.1 – 2.1	8	75	141
3rd Grade					
Student CG7	1.1	1.1 – 2.1	8	75	144
Student CG8	*1.9*	1.9 – 2.9	47	160	154
Student CG9	*1.2*	1.2 – 2.2	40	78	150
Student CG10	*1.2*	1.2 – 2.2	20	78	152

Student CG1. Student 1 was a 1st grade Caucasian female with a primary language of English. The student had an IEP with a primary disability designation of Emotional Disturbance. Her baseline comprehension was at a grade level of 1st grade, 1st month (i.e. 1.1) grade level equivalency. Her zone of zone of proximal development (ZPD) range was between the 1.1 and 2.1 grade levels. Her estimated oral fluency was 40 words per minute, with a scaled score of 75. Her baseline MAPS RIT score for reading was 159.

Student CG2. Student 2 was a second grade Filipino male with a primary language of English. The student had an IEP with the primary disability designation of Specific Learning Disability. His measured baseline comprehension was at a kindergarten, 7th month (i.e., 0.7)

grade level equivalency. His ZPD range was between the 0.7 and 1.7 grade levels. His estimated oral fluency was 7 words per minute, with a scaled score of 70. His baseline MAPS RIT score for reading was 141.

Student CG3. Student 3 was a second grade Native American male whose primary language is English. The student had an IEP with the primary disability designation of Specific Learning Disability. His measured baseline comprehension was at a grade 1, 0 month (i.e., 1.0) grade level equivalency. His zone of proximal development (ZPD) range was between the 1.0 and 2.0 grade levels. His estimated oral fluency was 5 words per minute, with a scaled score of 73. His baseline MAPS RIT score for reading was 159.

Student CG4. Student 4 was a second grade African American male with a primary language of English. The student had an IEP with the primary disability designation of Other Health Impairment. His measured baseline comprehension was at a grade 1, 2nd month (i.e., 1.2) grade level equivalency. His ZPD range was between the 1.2 and 2.2 grade levels. His estimated oral fluency was 15 words per minute, with a scaled score of 77. His baseline MAPS RIT score for reading was 155.

Student CG5. Student 5 was a second grade Caucasian female with a primary language of English. The student had an IEP with the primary disability designation of Specific Learning Disability. Her measured baseline comprehension was at a grade 1, 1st month (i.e., 1.1) grade level equivalency. Her ZPD range was between the 1.1 and 2.1 grade levels. Her estimated oral fluency was 8 words per minute, with a scaled score of 75. Her baseline MAPS RIT score for reading was 140.

Student CG6. Student 6 was a second grade Hispanic male with primary languages of both English and Spanish. The student had an IEP with the primary disability designation of

Autism. His measured baseline comprehension was at a grade 1, 1st month (i.e., 1.1) grade level equivalency. His ZPD range was between the 1.1 and 2.1 grade levels. His estimated oral fluency was 8 words per minute, with a scaled score of 75. His baseline MAPS RIT score for reading was 141.

Student CG7. Student 7 was a third grade Hispanic Native American female with primary languages of both English and Spanish. The student had an IEP with the primary disability designations of Other Health Impaired and Hard of Hearing. Her measured baseline comprehension was at a grade 1, 1st month (i.e., 1.1) grade level equivalency. Her ZPD range was between the 1.1 and 2.1 grade levels. Her estimated oral fluency was 8 words per minute, with a scaled score of 75. Her baseline MAPS RIT score for reading was 144.

Student CG8. Student 8 was a third grade African American female with a primary language of English. The student had an IEP with the primary disability designation of Other Health Impaired. Her measured baseline comprehension was at a grade 1, 9th month (i.e., 1.9) grade level equivalency. Her ZPD range was between the 1.9 and 2.9 grade levels. Her estimated oral fluency was 47 words per minute, with a scaled score of 160. Her baseline MAPS RIT score for reading was 154.

Student CG9. Student 9 was a third grade Caucasian male with a primary language of English. The student had an IEP with the primary disability designation of Other Health Impaired. His measured baseline comprehension was at a grade 1, 2nd month (i.e., 1.2) grade level equivalency. His ZPD range was between the 1.2 and 2.2 grade levels. His estimated oral fluency was 40 words per minute, with a scaled score of 78. His baseline MAPS RIT score for reading was 150.

Student CG10. Student 10 was a third grade Vietnamese Hispanic male with a primary language of English. The student had an IEP with the primary disability designations of Autism and Speech and Language Impairment. His measured baseline comprehension was at a grade 1, 2nd month (i.e., 1.2) grade level equivalency. His ZPD range was between the 1.2 and 2.2 grade levels. His estimated oral fluency was 20 words per minute, with a scaled score of 78. His baseline MAPS RIT score for reading was 152.

Intervention Group Participant Descriptions

Table 2 summarizes the data presented below in the descriptions of the 13 third grade students (i.e., Students 11 through 23) and 11 fourth grade students (i.e., Students 24 through 34) in the researcher's experimental group. The first two columns of Table 2 show the estimated reading comprehension grade level and the associated Zone of Proximal Development for the 13 third graders and 11 fourth graders. The third column shows each student's beginning fluency rate in words per minute. The fourth column presents each students Scaled Score on the Accelerated Reading STAR reading assessment. The final column represents each student's beginning RIT score on the MAP benchmark assessment.

Table 2. Experimental group baseline data from Accelerated Reading STAR reading assessments and the Measure of Academic Performance benchmark testing

Student #	Reading Comprehension Grade Level	Zone of Proximal Development (ZPD)	Fluency: Estimate Oral Reading Rate WPM	STAR Scaled Score	Measure of Academic Performance RIT score
3rd Grade					
Student FT11	1.1	1.1 - 2.1	16	73	138
Student FT12	1.2	1.2 - 2.8	22	149	157
Student FT13	1.1	1.1 - 2.1	14	71	156
Student FT14	1.6	1.6 - 2.6	38	118	157
Student FT15	2.4	2.2 - 3.2	63	261	159
Student FT16	1.8	1.8 - 2.8	46	162	158

Student PT17	2.5	2.3 – 3.3	68	284	157
Student PT18	2.3	2.3 – 3.2	59	257	175
Student PT19	2.4	2.2 – 3.2	60	260	155
Student PT20	1.8	1.8 – 2.8	46	164	160
Student PT21	2.2	2.1 – 3.1	55	224	170
Student PT22	1.1	1.1 – 2.1	17	72	149
Student PT23	2.9	2.5 – 3.5	78	341	178
4th Grade					
Student FT24	1.0	1.0 – 2.0	8	75	161
Student FT25	1.1	1.1 – 2.1	8	72	152
Student FT26	1.3	1.3 – 2.3	26	88	151
Student FT27	1.1	1.1 – 2.1	8	71	159
Student PT28	2.6	2.4 – 3.4	71	297	176
Student PT29	2.7	2.4 – 3.4	70	311	181
Student PT30	2.6	2.4 – 3.4	67	295	172
Student PT31	1.2	1.2 – 2.2	10	78	152
Student PT32	2.4	2.2 – 3.2	60	260	184
Student PT33	2.7	2.4 – 3.4	75	317	187
Student PT34	2.0	2.0 – 3.0	45	205	160

Student FT11. Student FT11 was a third grade Caucasian male with a primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 1st month (i.e., 1.1) grade level equivalency. His ZPD range was between the 1.1 and 2.1 grade levels. His oral fluency was at a rate of 16 words per minute, with a scaled score of 73. His baseline MAPS RIT score for reading was 138.

Student FT12. Student FT12 was a third grade Hispanic male with a primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 2nd month (i.e., 1.2) grade level equivalency. His ZPD range was between the 1.2 and 2.8 grade levels. His oral fluency was

at a rate of 22 words per minute, with a scaled score of 149. His baseline MAPS RIT score for reading was 157.

Student FT13. Student FT13 was a third grade Hispanic female with a primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. Her measured baseline comprehension was at the 1st grade, 1st month (i.e., 1.1) grade level equivalency. Her ZPD range was between the 1.1 and 2.1 grade levels. Her oral fluency was at a rate of 14 words per minute, with a scaled score of 71. Her baseline MAPS RIT score for reading was 156.

Student FT14. Student FT14 was a third grade Hispanic male with primary languages of English and Spanish. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 6th month (i.e., 1.6) grade level equivalency. His ZPD range was between the 1.6 and 2.6 grade levels. His oral fluency was at a rate of 38 words per minute, with a scaled score of 118. His baseline MAPS RIT score for reading was 157.

Student FT15. Student FT15 was a third grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Emotional Disturbance. His measured baseline comprehension was at the 2nd grade, 4th month (i.e., 2.4) grade level equivalency. His ZPD range was between the 2.2 and 3.2 grade levels. His oral fluency was at a rate of 63 words per minute, with a scaled score of 261. His baseline MAPS RIT score for reading was 159.

Student FT16. Student FT16 was a third grade African American male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 8th month (i.e.,

1.8) grade level equivalency. His ZPD range was between the 1.8 and 2.8 grade levels. His oral fluency was at a rate of 46 words per minute, with a scaled score of 162. His baseline MAPS RIT score for reading was 158.

Student PT17. Student PT17 was a third grade Hispanic male with primary languages of English and Spanish. The student had an IEP with a primary disability designation of Other Health Impaired. His measured baseline comprehension was at the 2nd grade, 5th month (i.e., 2.5) grade level equivalency. His ZPD range was between the 2.3 and 3.3 grade levels. His oral fluency was at a rate of 68 words per minute, with a scaled score of 284. His baseline MAPS RIT score for reading was 157.

Student PT18. Student PT18 was a third grade Caucasian female with primary language of English. The student had an IEP with primary disability designations of Specific Learning Disability and Other Health Impairment. Her measured baseline comprehension was at the 2nd grade, 3rd month (i.e., 2.3) grade level equivalency. Her ZPD range was between the 2.3 and 3.2 grade levels. Her oral fluency was at a rate of 59 words per minute, with a scaled score of 257. Her baseline MAPS RIT score for reading was 175.

Student PT19. Student PT19 was a third grade Hispanic male with primary language of English. The student had an IEP with a primary disability designation of Speech and Language Impairment. His measured baseline comprehension was at the 2nd grade, 4th month (i.e., 2.4) grade level equivalency. His ZPD range was between the 2.2 and 3.2 grade levels. His oral fluency was at a rate of 60 words per minute, with a scaled score of 260. His baseline MAPS RIT score for reading was 155.

Student PT20. Student PT20 was a third grade Hispanic male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning

Disability. His measured baseline comprehension was at the 1st grade, 8th month (i.e., 1.8) grade level equivalency. His ZPD range was between the 1.8 and 2.8 grade levels. His oral fluency was at a rate of 46 words per minute, with a scaled score of 164. His baseline MAPS RIT score for reading was 160.

Student PT21. Student PT21 was a third grade Caucasian male with primary language of English. The student had an IEP with primary disability designations of Specific Learning Disability and Speech and Language. His measured baseline comprehension was at the 2nd grade, 2nd month (i.e., 2.2) grade level equivalency. His ZPD range was between the 2.1 and 3.1 grade levels. His oral fluency was at a rate of 55 words per minute, with a scaled score of 224. His baseline MAPS RIT score for reading was 170.

Student PT22. Student PT22 was a third grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Speech and Language. His measured baseline comprehension was at the 1st grade, 1st month (i.e., 1.1) grade level equivalency. His ZPD range was between the 1.1 and 2.1 grade levels. His oral fluency was at a rate of 17 words per minute, with a scaled score of 72. His baseline MAPS RIT score for reading was 149.

Student PT23. Student PT23 was a third grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Other Health Impaired. His measured baseline comprehension was at the 2 grade, 9th month (i.e., 2.9) grade level equivalency. His ZPD range was between the 2.5 and 3.5 grade levels. His oral fluency was at a rate of 78 words per minute, with a scaled score of 341. His baseline MAPS RIT score for reading was 178.

Student FT24. Student FT24 was a fourth grade Hispanic male with primary language of English. The student had an IEP with primary disability designations of Other Health Impairment and Speech and Language Impairment. His measured baseline comprehension was at the 1st grade, 0 month (i.e., 1.0) grade level equivalency. His ZPD range was between the 1.0 and 2.0 grade levels. His oral fluency was at a rate of 8 words per minute, with a scaled score of 75. His baseline MAPS RIT score for reading was 161.

Student FT25. Student FT25 was a fourth grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 1st month (i.e., 1.1) grade level equivalency. His ZPD range was between the 1.1 and 2.1 grade levels. His oral fluency was at a rate of 8 words per minute, with a scaled score of 72. His baseline MAPS RIT score for reading was 152.

Student FT26. Student FT26 was a fourth grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Other Health Impairment and Speech and Language Impairment. His measured baseline comprehension was at the 1st grade, 3rd month (i.e., 1.3) grade level equivalency. His ZPD range was between the 1.3 and 2.3 grade levels. His oral fluency was at a rate of 26 words per minute, with a scaled score of 88. His baseline MAPS RIT score for reading was 151.

Student FT27. Student FT27 was a fourth grade Hispanic male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 1st month (i.e., 1.1) grade level equivalency. His ZPD range was between the 1.1 and 2.1 grade levels. His oral fluency was

at a rate of 8 words per minute, with a scaled score of 71. His baseline MAPS RIT score for reading was 159.

Student PT28. Student PT28 was a fourth grade Hispanic male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 2nd grade, 6th month (i.e., 2.6) grade level equivalency. His ZPD range was between the 2.4 and 3.4 grade levels. His oral fluency was at a rate of 71 words per minute, with a scaled score of 297. His baseline MAPS RIT score for reading was 176.

Student PT29. Student PT29 was a fourth grade Hispanic male with primary languages of English and Spanish. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 2nd grade, 7th month (i.e., 2.7) grade level equivalency. His ZPD range was between the 2.4 and 3.4 grade levels. His oral fluency was at a rate of 70 words per minute, with a scaled score of 311. His baseline MAPS RIT score for reading was 181.

Student PT30. Student PT30 was a fourth grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Other Health Impairments. His measured baseline comprehension was at the 2nd grade, 6th month (i.e., 2.6) grade level equivalency. His ZPD range was between the 2.4 and 3.4 grade levels. His oral fluency was at a rate of 67 words per minute, with a scaled score of 295. His baseline MAPS RIT score for reading was 172.

Student PT31. Student PT31 was a fourth grade Hispanic male with primary languages of English and Spanish. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 1st grade, 2nd month (i.e.,

1.2) grade level equivalency. His ZPD range was between the 1.2 and 2.2 grade levels. His oral fluency was at a rate of 10 words per minute, with a scaled score of 78. His baseline MAPS RIT score for reading was 152.

Student PT32. Student PT32 was a fourth grade African American female with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. Her measured baseline comprehension was at the 2nd grade, 4th month (i.e., 2.4) grade level equivalency. Her ZPD range was between the 2.2 and 3.2 grade levels. Her oral fluency was at a rate of 60 words per minute, with a scaled score of 260. Her baseline MAPS RIT score for reading was 184.

Student PT33. Student PT33 was a fourth grade African American female with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. Her measured baseline comprehension was at the 2nd grade, 7th month (i.e., 2.7) grade level equivalency. Her ZPD range was between the 2.4 and 3.4 grade levels. Her oral fluency was at a rate of 75 words per minute, with a scaled score of 317. Her baseline MAPS RIT score for reading was 187.

Student PT34. Student PT34 was a fourth grade Caucasian male with primary language of English. The student had an IEP with a primary disability designation of Specific Learning Disability. His measured baseline comprehension was at the 2nd grade, 0 month (i.e., 2.0) grade level equivalency. His ZPD range was between the 2.0 and 3.0 grade levels. His oral fluency was at a rate of 45 words per minute, with a scaled score of 205. His baseline MAPS RIT score for reading was 160.

Description of Control Group and Experimental Instruction and Assessments

Students in both the control and intervention groups received instruction for 12 months, from either the fall of 2015 to the fall of 2016; or the winter of 2015 to the winter of 2016. They all had pre and post-intervention period MAPs scores that were compared before and after the period of the study. They all also had pre and post-intervention period scores on Accelerated Reading STAR reading placement measures, which included an independent reading comprehension level, a Zone of Proximal Development (ZPD) range that prescribed the low to high range of difficulty of reading material with which a student should interact, an oral fluency measure expressed in words per minute (WPM), and an individual scaled scores (SS) from which the comprehension and ZPD estimates were derived. For students in the experimental group, an additional measure was the number of minutes spent over the year completing the computer-assisted *Imagine Learning* lessons. Each student's total number of minutes was compared to the other literacy measures to determine if the number of minutes had a positive, negative, or no relationship with any of the other measures.

Measure of Academic Performance (MAP) RIT

The MAP assessment measures students' performance in key literacy areas of word recognition, structure and vocabulary, reading literature and informational texts, key ideas, reading for understanding, craft, structure, and evaluation. Results of the assessment are used to derive a Rasch Units or RIT score. Rash Units are like units on a ruler and represent a student's progress over time. The scale is divided into equal intervals that are different than grade level equivalence. They are broken down into performance levels - Advanced, Proficient, Basic, Below Basic, and Far Below Basic (Northwest Evaluation Association, 2012)

Developmental Reading Assessment 2 (DRA2)

The Developmental Reading Assessment 2 (DRA2) is a product of Pearson Learning. Levels A to 3 of the assessment assess emergent reading skills and are comprised of highly repetitive with many sight words, but are not highly decodable. Levels 6 to 8 address long and short vowels. The remainder of the assessment levels focused upon reading accuracy, fluency, predicting, and summarizing. For the purpose of this study, a Reader Conversion Chart was used to determine grade level equivalency for the control group students who were assessed on the DRA2. See Appendix A for the DRA2 Conversion Chart.

Renaissance Learning STAR Reading Instruction and Assessment

STAR reading assessments are computer-based assessments that are adaptive, using sophisticated item calibration and psychometrics that dynamically adjust to each student's unique responses (www.renaissance.com/Products/Star-Assessments/Star-Reading/Skills). This assessment has undergone extensively researched over many years to determine its reliability and validity. It is easy to administer and produces valid, reliable, actionable data. The four primary skill areas assessed are (1) foundational skills, (2) the reading of literature text, (3) the reading of informational text, and (4) language. Once a student completes the assessment, a report regarding the student's progress is generated. For this study, the researcher used the Student Diagnostic Report that included:

1. STAR Independent Reading Level (IRL) – The independent reading level is based upon the scaled score, this assessment determines the level a student is able to independently read a text without the assistance of others. The results of this measure were used to estimate a student's grade level equivalent comprehension.

2. STAR Zone of Proximal Development (ZPD) – The ZPD also is based upon the Scaled Score and determines the optimal instructional reading range. The lower score is a minimal level to ensure continued progress. The higher score is the most difficult book a student should read without become frustrated and unable to complete the book.
3. STAR Fluency- the STAR fluency represents a student's estimated reading fluency and also provides insight into the student processing speeds. It determines a student's words read per minute (WPM), a student's response times, and a student's current grade levels.
4. STAR Scaled Score (SS) - The Scaled Score is the basic overall score that the student receives based upon a number of factors including the difficulty of the questions, the correct number of responses, and response time. As already noted this score on the Accelerated Reading STAR reading assessment ranges from 0 to 1400 and spans grades 1 through 12 and is used to compare student performance over time and across grades.

Imagine Learning Instruction and Assessment

Imagine Learning (www.imaginelearning.com/programs/imaginelearning), the intervention for the experimental group, is a computer-based learning program that was originally designed to address all aspects of English language acquisition for students learning English as an additional language. A primary instructional thrust is increasing vocabulary, a key aspect of language acquisition for English learners and any students struggling with language processing. In the program, students are taught vocabulary through videos, pictures, glossaries, and direct translations. Words and concepts are repeated in multiple contexts in various books and activities, which provide students with a rich language experience and deeper understanding. By highlighting both general academic words and content-specific vocabulary words, allowing students opportunities to apply the language across the curriculum.

The goal was for students using *Imagine Learning* to complete 90 minutes of *Imagine Learning* time per week. The lessons are on a timer and automatically stop after 30 minutes. This means students were to complete approximately three 30-minute sessions per week.

The program provides explicit instruction in each of the five key reading instruction areas: phonological awareness, phonics, fluency, vocabulary, and comprehension. Comprehension is an especially difficult skill for students learning English and students struggling to master language, such as the students I serve. The program helps comprehension by building students' background knowledge through pre-reading activities. It provides scaffolding reading opportunities with multiple levels of feedback. For example, students do not simply complete lessons on the computer with a key board and mouse, but they also have headsets with microphones and are asked to respond verbally to parts of the lesson. Further, they are able to record themselves speaking and listen to the recording. Through these processes, this program targets listening comprehension, grammar, and speaking. For students with disabilities the program offers a multi-sensory approach, provides continual assessment for automatic placement at an appropriate instructional level and feedback. It also allows for peer student modeling.

Baseline Determination and Instructional Routines

This study's methodology was very much like that of California State University San Marcos Master's degree recipient, Windy Strang (2012) whose thesis was entitled *Using Accelerated Reader to Compare the Amount of Reading with Reading Growth.* The researcher study was conducted prior to the knowledge of Stang's study. However, coincidently, the studies were very similar in design. Both used the Accelerated Reading program and another computer-assisted learning program. The following steps were used to gather baseline data and provide the experimental and control interventions.

Step 1. Baseline Determination

Prior to the initiation of control and experimental group instruction, students were assessed using the Northwest Evaluation Association (NWEA) *Measure of Academic Performance* (MAPs) district benchmark assessment. This measure determines a student's RIT score. RIT is an abbreviation for the Rausch Unit. The difficulty and complexity of each MAP assessment question is measured using the RIT scale. A student's RIT score indicates the level at which the student answers questions correctly 50% of the time.

Students also were assessed with the STAR reading placement test that comes with the Renaissance Accelerated Reader program. In the semester prior to the implementation of this study, each student's individual comprehension level, zone of proximal development (ZPD), oral fluency in words per minute (WPM) and Scaled Score (SS) was determined. Each student's baseline performances on these assessments are described in the previous student participant section.

Step 2. Delivery of Control Group and Experimental Group Intervention

Control group routine. For the group of students who received only the *Accelerated Readin*g instruction, the instructional routine was as follows. On Monday through Thursday students who spent more than 50% of the day being instructed by the teacher in the control group started the day with a morning warm up activity along with morning announcements.

This opening was followed by a 30-minute mathematics lesson and then a 30-minute calendar skill period that focused upon skills such as the name and number of the days of the week and months in a year, seasons, math skills, and so forth. Writing instruction followed from 9:00 to 9:20. Students then went to recess until 9:40 a.m.

Once recess was over, the students worked on phonics and spelling from 9:40 a.m. to 10:30 a.m. and reading comprehension and computer skills from 10:30 a.m. to 11:05 a.m. This was a time when additional student receiving specialized academic instruction (SAI) came in for instruction.

Lunch was from 11:05 a.m. until 11:45 a.m. From 11:45 a.m. to 12:45 p.m., students worked on specific skills in their individual IEP plans as well as other computer skills. The exception was on Wednesdays, when students went to the library. From 12:45 p.m. to 1:25 p.m. on Tuesdays, Wednesdays, and Thursdays, students had physical education; on Mondays students worked on individual IEP goals. The afternoon recess was from 1:25p.m. to 1:37 p.m. The day concluded with students engaging in reading tasks either in groups or with a reading buddy.

Experimental group intervention routine. For the group of students in the experimental group, who received both the *Imagine Learnin*g as well as *Accelerated Reading* instruction, the instructional routine on Monday through Thursday was as follows. Students who spent more than 50% of the day being instructed by the researcher (usually 11 to 13 students) start the day with a calendar review of the day's, week's, and month's events along with morning announcements.

This opening was followed by a phonics lesson using a *Spelling with Morphographs* program, a one-year program developed and published through SRA to teach spelling to older students (i.e., students who are 4th grade and older). Students learn that words are composed of morphographs, which roughly are prefixes, suffixes, and bases or roots. This instruction lasted for 20 minutes. Three days a week, this was followed by a 40-minute physical education class.

When students did not go to physical education, they have additional instruction time in reading and mathematics, implementation of the experimental *Imagine Learning* intervention, and one-on-one assistance with reading and assignments. The 9 to 9:30 a.m. morning block is designated reading time with small reading groups and *Imagine Learning* lesson completion on the computers. Recess was from 9:30 to 9:50 a.m.

For 70 minutes after recess (from 9:50 to 11:00 a.m.) the class engaged in writing, modified Common Core literature units and with additional reading. Mathematics instruction occurred from 11 to 11:35 a.m., with mathematics curriculum at each student's performance level. The exception was on Tuesdays, when this time was spent in the library. For full-time students, lunch was from 11:35 a.m.to 12:10 p.m. During this time, students with addition specialized academic instruction (SAI) service time, some third graders who had scheduling conflicts later in the day, and a few students with severe disabilities served by another teacher came to the class for instruction.

Full-time students returned from lunch at 12:10 p.m. and were joined by 3rd and 4th grade part-time students for what is called *Resource* center time. During this period, there were four designated centers through which four groups rotated: (1) the Reading Center where the teacher/researcher served as the instructor, (2) the Math Center where a paraeducator served as the instructor, (3) the Computer Center where students worked on designated district-approved computer-based instructional programs, and (4) the Desk Work Center where students completed work in their individual binders, read, or engaged in other activities that they can accomplish independently. Each student worked in at least two centers during two 30-minute blocks. At 1:15 students had a 15-minute recess. During the last 45 minutes, students who came in for their SAI instruction returned to their classrooms. The remaining students had additional computer time,

watched videos related to the current topic of study, read, finish uncompleted work, or engaged in other academic-related activities. During this time, the teacher/researcher also wrote communication notes to parents about the day's events, upcoming activities, and so forth. The last 10 minutes of the day usually was a "choice" block. Most students chose to work on computers during this time.

For both the control and experimental groups, the Friday schedule is different that the routines described above. The student experiences are the other measure than the academic interventions described.

Step 3. Periodic Performance Assessment Measurement

Control group performance assessment routine. For the control group students the literacy assessment routine was as follows. These students were assessed with the Developmental Reading Assessment (DRA). This assessment is typically administered four times per year (i.e., in August, November/December, January/February, and May) in order to track student progress and gather report card data. In the fall, winter, and spring students also are assessed using the district's computerized benchmark assessment, the Northwest Evaluation Association Measure of Academic Performance.

Experimental group assessment routine. For the experimental group students who received both *Imagine Learnin*g and *Accelerated Reading* instruction, the literacy assessment routine was as follows. Students were assessed using STAR reading placement assessments typically administered four times per year (i.e., in August, November/December, January/February, and May) in order to track student progress and gather report card data. In the fall, winter, and spring students also were assessed using the district's computerized benchmark assessment, the Northwest Evaluation Association Measure of Academic Performance.

Chapter 4

Results

Research Questions

The research question that guided this study was the following questions:

1. Will the use of a combination of a computer-assisted instructional program (i.e., *Imagine Learning*) and an evidence-based program (*Accelerated Reading*) for teaching literacy skills to students with mild and moderate disabilities result in greater growth in student literacy performance as compared to the use of only evidence-based instruction (*Accelerated Reading*) as measured by the district curriculum-based Measure of Academic Performance (MAP) RIT assessment; STAR reading Scaled Score, Independent Reading Level comprehension measure, and estimated fluency assessments?
2. Is there a positive relationship between the number of minutes that a student spends engaged in computer-assisted *Imagine Learning* instruction and a students' performance on any of the STAR or MAP measures?

At the beginning of the study the researcher obtained baseline date for the 10 students in the control group and the 24 students in the intervention group. These data are presented in Tables 1 and 2 in Chapter 3. For both groups reading performance was assessed using Renaissance STAR reading placement tests and the district MAPs assessments. For the experimental group, an additional measure was the number of commutes completed using the computer based learning program Imagine Learning.

As a reminder of what each of these measures represents in the tables that follow, a description of each measure is presented here, as it was in Chapter 3.

Performance Assessments

Renaissance Learning STAR Reading Instruction and Assessment

STAR reading assessments are computer-based assessments that dynamically adjust to each student's unique responses (www.renaissance.com/Products/Star-Assessments/Star-Reading/Skills). The four primary skill areas assessed are (1) foundational skills, (2) the reading of literature text, (3) the reading of informational text, and (4) language. For this study, the researcher used the Student Diagnostic Report that included:

5. STAR Scaled Score (SS) - The Scaled Score is the basic overall score that the student receives based upon a number of factors including the difficulty of the questions, the correct number of responses, and response time. As already noted this score on the Accelerated Reading STAR reading assessment ranges from 0 to 1400 and spans grades 1 through 12 and is used to compare student performance over time and across grades.
6. STAR Independent Reading Level or Grade Level Equivalent – The independent reading level is based upon the scaled score; this assessment determines the level a student is able to independently read a text without the assistance of others. The results of this measure were used to estimate a student's grade level equivalent comprehension.
7. STAR Zone of Proximal Development (ZPD) – The ZPD also is based upon the Scaled Score and determines the optimal instructional reading range. The lower score is a minimal level to ensure continued progress. The higher score is the most difficult book a student should read without become frustrated and unable to complete the book.

8. STAR Fluency- the STAR fluency represents a student's estimated reading fluency and also provides insight into the student processing speeds. It determines a student's words read per minute (WPM), a student's response times, and a student's current grade levels.

Measure of Academic Performance RIT

The Measure of Academic Performance (MAP) assessment measures students' performance in key literacy areas of word recognition, structure and vocabulary, reading literature and informational texts, key ideas, reading for understanding, craft, structure, and evaluation. Results of the assessment are used to derive a Rasch Units or RIT score. Rash Units are like units on a ruler and represent a student's progress over time. The scale is divided into equal intervals that are different than grade level equivalence.

Imagine Learning Instruction and Assessment

Imagine Learning (www.imaginelearning.com/programs/imaginelearning), the intervention for the experimental group, is a computer-based learning program with a primary instructional thrust of increasing vocabulary, a key aspect of language acquisition for English learners and any students struggling with language processing. The program provides explicit instruction in phonological awareness, phonics, fluency, vocabulary, and comprehension. The students using *Imagine Learning* were expected complete 30 minutes of *Imagine Learning* time. The lessons are on a timer and automatically stop after 30 minutes. This means the student are to complete approximately three 30-minute sessions per week for a total of 90 minutes per week.

Pre- and Post-Intervention Results

The findings presented in this chapter represent student progress over the course of one academic calendar year during which the experimental group intervention was implemented. Grade level equivalency performance and change is represented in years and tenths of a year for

comprehension performance. So, a change in performance of 8 months is represented as .8, and a first grade, 3rd month performance is represented as 1.3.

Control Group Results

Table 3 shows the control group students' end performances on the measure STAR and MAP measures after 12 month of instruction during the intervention year. As the table shows, the first grade student ended with outstanding above grade level performances on all measures. The second and third graders had variable end-of-year performances, with reading comprehension scores below grade level expectations, particularly for the 3rd graders, who should have been at the end of third grade but were, overall, still performing at the beginning of first grade.

Table 3. Control group post-intervention period (i.e., 12 months later) results for Accelerated Reading STAR reading and Measure of Academic Performance assessment

Student	Estimated Reading Comprehension Grade level	Zone of Proximal Development ZPD	Estimate Oral Reading Rate WPM	Approx Scaled Score	Measure of Academic Performance 12 months
1st Grade					
Student CG1	3.0	3.0 – 3.5	102	439	183
2nd Grade					
Student CG2	1.2	1.2 – 2.2	18	75	160
Student CG3	1.3	1.3 – 2.3	25	85	150
Student CG4	1.2	1.2 – 2.2	33	99	165
Student CG5	0.5	0.5 – 0.9	10	69	157
Student CG6	1.0	1.0 – 2.0	8	62	150
3rd Grade					
Student CG7	0.9	0.9 – 1.9	0	62	169
Student CG8	*1.2*	1.4 – 2.4	30	96	152
Student CG9	*1.1*	1.1 – 2.1	8	71	155
Student CG10	*1.4*	1.4 – 2.4	31	99	160

Table 4 shows the change in student performance over the year of instruction on each of the measures. Noted with a * are the students who made the most gain in performance on each measure over the intervention period. Noted with a # are students who made no gains or regressed on the corresponding measure. This table is more telling, as it shows that 60% of the students either regressed or made no change in their reading comprehension performance. Two of the second graders, Students CG2 and CG3, made some gain. However, the gains are not large enough to accelerate their learning, making half or less than a half of a year's gain in reading comprehension over the course of a year of instruction.

On the oral fluency measure, in addition Student CG1, only two students (Students CG3 and CG4) made more than a negligible gain in words per minute and 50% made no gains or regressed in their performance. The same was true for the STAR Scaled score. On the MAP RIT assessment, in addition to Student CG1, three students (Students CG4, CG5, and CG7) made modest (i.e., 15 to 19 points) gains in their RIT scores. In summary, the first grader in the control group made dramatic gains and is at or above grade level on all measures of literacy. The second graders had scattered gains and losses in performance, with 3 of 5 students making regressing or making no gains in reading comprehension. The third graders overall made little to no progress on most measures and, in all cases, regressed or remained constant on two or more of the measures of literacy performance. It does need to be noted that the students in the control group are not only much younger and at the early stages of reading, they also as a group display many more severe behaviors and are students whose disabilities impeded their learning much more than most of the students in the experimental group.

Table 4. Control group student performance changes over 12 months using the computer based learning program, *Imagine Learning*, as a reading intervention as measured by the STAR grade level equivalent reading comprehension score, the estimated oral fluency rate in words per minute, and the Scaled Score and Measure of Academic Performance RIT scores * = large change and most gain # = no change or regression

Student Identification Number	Grade equivalent comprehension change in years and months (tenths of a year)	Change in oral fluency in WPM	Change in STAR Scaled Score	Change in Measure of Academic Performance RIT score
First grade				
Student CG1	+1.9 *	+27 *	+280 *	+24 *
Second grade				
Student CG2	+0.5	+11	+5	+19 *
Student CG3	+0.3	+20 *	+12	-9 #
Student CG4	0.0 #	+18 *	+22 *	+10
Student CG5	-0.6 #	+2	-6 #	+17 *
Student CG6	-0.1 #	0 #	-13 #	+9

Third grade								
Student CG7	-0.2	#	-8	#	-13	#	+25	*
Student CG8	+0.7	#	-17	#	-64	#	-2	#
Student CG9	+0.1	#	-32	#	-7	#	+5	
Student CG10	0.2		+11		+21	*	+8	
• **% w/most gain**	10%		30%		30%		40%	
• **% w/increase**	40%		60%		50%		80%	
• **% w/no change or regression**	60%		30%		50%		20%	

Experimental Group Results

Table 5 shows the experimental group students' end performances on the STAR and MAP measures after 12 months of instruction during the intervention year as well as the total number of minutes each student was engaged using the Imagine Learning online program during the year. Students are codes as full time (FT) or part time (PT) and presented by grade level. As the table shows, the third graders had variable end-of-year performances on all measures. For third graders, ending reading comprehension grade level equivalencies ranged from 1.1 to 2.8 for full-time third graders and from 1.1 to 3.7 for part-time third graders, with two of the seven students performing in the third grade range (i.e., 3.3 and 3.7). These two students were performing the closest to expected end-of-year third grade level performance (i.e., 3.9 or greater). The end of year performance for the remaining 11 third graders left them from 1.0 year to 2.8 years below expected end-of-year grade level performance (i.e., 3.9 or greater) in reading comprehension.

As with the third graders, fourth graders had variable end-of-year literacy performances across the several measures. Reading comprehension grade level equivalencies ranged from 1.1 to 1.3 for full-time fourth graders and from 1.2 to 3.3 for part-time fourth graders, with three of the part-time fourth graders performing in the third grade range (i.e. 3.0, 3.0, and 3.3). These

end-of-year performances left fourth graders from 1.6 years to 3.8 years below expected end-of-year grade level performance (i.e., 4.9 or greater) in reading comprehension.

Table 5. Experimental Group post-intervention period (i.e., 12 months later) results for Accelerated Reading STAR and Measure of Academic Performance assessments and total minutes of Imagine Learning lesson engagement

Student #	Reading Comprehension Grade level	Zone of Proximal Development ZPD	Estimate Oral Reading Rate WPM	Scaled Score	Measure of Academic Performance RIT score	Imagine Learning minutes
3rd Grade						
Student FT11	1.2	1.2 – 2.2	15	76	155	1,789
Student FT12	2.1	2.1 – 3.1	49	209	166	438
Student FT13	1.1	1.1 – 2.1	8	72	170	713
Student FT14	1.8	1.8 – 2.8	42	163	182	948
Student FT15	2.8	2.8 – 3.5	76	330	188	266
Student FT16	2.1	2.1 – 3.1	49	212	176	971
Student PT17	3.3	2.7 – 3.8	91	388	180	1,003
Student PT18	2.8	2.5 – 3.5	75	318	197	1,473
Student PT19	1.8	1.8 – 2.8	47	168	176	1,072
Student PT20	2.2	2.1 – 3.1	55	240	177	1,582
Student PT21	2.9	2.5 – 3.5	79	343	189	584
Student PT22	1.1	1.1 – 2.1	16	73	158	912
Student PT23	3.9	3.0 – 4.4	104	441	189	751
4th Grade						
Student FT24	2.0	2.0 – 3.0	29	194	174	307
Student FT25	1.2	1.2 – 2.2	10	78	160	609
Student FT26	1.9	1.9 – 2.9	22	177	170	796
Student FT27	1.3	1.3 – 2.3	28	86	177	827
Student PT28	3.0	2.6 – 3.6	114	351	177	1,379
Student PT29	3.0	2.6 – 3.6	116	353	189	984
Student PT30	2.6	2.4 – 3.4	67	292	178	521
Student PT31	1.9	1.9 – 2.9	40	183	166	2,450
Student PT32	3.4	2.8 – 3.9	107	391	189	256
Student PT33	2.6	2.4 – 3.4	70	301	200	947
Student PT34	2.0	2.0 – 3.0	45	205	179	1,089

Table 6 shows the change in student performance on all measures over the 12-month period, with students rank ordered by the number of minutes of *Imagine Learning* program instruction the students had logged. Noted with a * are the students who made the most gain in

performance on a corresponding measure over the intervention period. Noted with a # are students who made no gains or regressed on the corresponding measure. Table 6 will be analyzed from right to left, starting with MAP RIT scores.

Of the 24 students, all students made gains on the MAP RIT measure, with 58% (14) making modest to large (i.e., from 15 to 40 points) gains. On the STAR Scaled Score measure, 54% (14) of students made large gains of 50 to 131 points. However, 21% (5) students made no gains or dropped in their performance.

The measure of oral fluency, which is derived from the Scaled Score, changed in a positive direction for 67% (16) of the students, with 46% (11) of students making large gains of between 20 and 47 words per minutes. However, 33% (8) students made no gains or regressed in their words per minute fluency.

Finally, 13% (3) of the 24 students made one year or more gain over the course of the year of instruction in grade equivalent comprehension performance, putting them in a position to catch up to the performance of their grade-level peers. However, 33% (8) of the students either regressed or experienced no change in their reading comprehension. In summary, several third grade students (i.e., Students PT17, PT18, PT 21, and PT23) and fourth grade students (i.e., FT24, FT28, PT 31, and PT 32) made notable progress in their literacy performance on two or more of the STAR and MAP measures. The remainder of the students (67%) had negligible or variable performance across the measures and there does not appear to be any relationship between the number of *Imagine Learning minutes* and either gains or lack thereof.

An examination of the data presented in Table 6 reveals that higher and lower performing students appear almost randomly throughout the table, suggesting that there is no discernible direct relationship between the number of minutes that a student engaged in Imagine Learning

instruction and their performance on any of the STAR or MAP measures. In fact, the two highest performing students – Student PT23 and PT32 spent considerable less time engaged in Imagine Learning instruction (i.e., the least 751 and 256 minutes) that lower performing students who spent the greatest amount of time (i.e., Students 31, 11, and 20 who spent between 1,582 and 2,450 in instruction). The researcher's informal observations of classroom performance indicate this is because both of these students are advanced readers, reading chapter books between the 4th and 5th grade level reading, and have surpassed the foundational reading skills learned from the Imagine Learning program.

Table 6. Experimental group student performance changes over the period of 12 months rank ordered by the number of minutes of *Imagine Learning* program use as measured by the STAR grade level equivalent reading comprehension score, the estimated oral fluency rate in words per minute, and the Scaled Score as well as the Measure of Academic Performance RIT scores

* = large change and most gain # = no change or regression

Students rank ordered by number of Imagine Learning minutes	Most to least number of minutes	Number of Imagine Learning minutes	Grade equivalent comprehension change in years and months (tenths of a year)		Change in Oral Fluency in WPM		Change in STAR Scaled Score		Change in Measure of Academic Performance RIT score	
Student PT31	1st	2,450	+0.7		+30	*	+105	*	+14	
Student FT11	2nd	1,789	+0.1	#	-1	#	+3	#	+17	*
Student PT20	3rd	1,582	+0.4		+9		+76	*	+17	*
Student PT18	4th	1,473	+0.5		+16	*	+61	*	+40	*
Student FT28	5th	1,379	+0.4		+43	*	+54	*	+3	
Student PT34	6th	1,089	0.0	#	+0	#	+0		+19	*
Student PT19	7th	1,072	-0.6	#	-13	#	-92	*	+21	*
Student PT17	8th	1,003	+0.8		+23	*	+104	*	+23	*
Student PT29	9th	984	+0.3		+46	*	+42		+8	
Student FT16	10th	971	+0.3		+3		+50	*	+18	*
Student FT14	11th	948	+0.2		+4		+45		+25	*
Student PT33	12th	947	-0.1	#	-5	#	-16	#	+16	*
Student PT22	13th	912	0.0	#	-1	#	+1	#	+9	
Student FT27	14th	827	+0.2		+20	*	+15		+18	*
Student FT26	15th	796	+0.6		-4	#	+89	*	+19	*

Student PT23	16th	751	+1.0	*	+26	*	+100	*	+11			
Student FT13	17th	713	0.0	#	-6	#	-10	#	+14			
Student FT25	18th	609	+0.1	#	+2		+6		+8			
Student PT21	19th	584	+0.7		+24	*	+119	*	+19	*		
Student PT30	20th	521	0.0	#	0	#	-3	#	+6			
Student FT12	21st	438	+0.9		+27	*	+60	*	+17	*		
Student FT24	22nd	307	+1.0	*	+21	*	+119	*	+13			
Student FT15	23rd	266	+0.4		+13		+69	*	+29	*		
Student PT32	24th	256	+1.2	*	+47	*	+131	*	+6			
• **% w/most gain**			13%		46%		54%		58%			
• **% w/an increase**			67%		67%		79%		100%			
• **% w/no change or regression**			33%		33%		21%		0%			

Comparison of Control and Experimental Group Results

Table 7 presents a comparison of student gains and losses for the control and experimental groups as represented by the percentage of students with the most gain and some gain versus no change or regression in performance over the 12 months of intervention. These percentages are the same as those presented at the bottom of Tables 4 and 6, which summarize overall change on STAR and MAPS measures. An examination of the data reveals that overall a larger percentage of students in the researchers' experimental group made some or large gains in comprehension grade level equivalency, oral fluency, and on the Scaled Score and MAP RIT score assessments. Likewise, a smaller percentage of students in the researchers' experimental group regressed or failed to make progress. So, students in the experimental group who engaged in a variable number of minutes (i.e., from 256 to 2, 450 minutes) of *Imagine Learning* instructional time did outperform students in the control group who did not receive this computer-based instruction.

However, an obvious limitation of this comparison is that the students were in different classrooms, instructed by different teachers, and of different grade levels (except for third

graders). Further, the teacher/researcher was a veteran teacher with over 10 years of experience; the teacher of the control group was a beginning teacher. The control experimental group populations were not comparable in overall academic and adaptive skills.

Finally, a large percentage of students in both classes did not make substantial gains or who regressed in comprehension and oral fluency performance is of great concern and an area for deeper exploration. Further analysis of the entire instructional package being delivered in each environment as well as the relationship of the nature of that instruction to the development of comprehension, fluency, and the other variables that factor into the STAR Scaled Score and the MAP RIT score needs further examination.

Table 7. Comparison of student performance for the control and experimental groups as represented by the percentage of students with the most gain and some gain, or no change or regression in performance over the 12 months of intervention.

	Comprehension Grade Equivalence	**Oral Fluency**	**Scaled Score**	**MAP RIT Score**
% Most Gain				
Control	10%	30%	30%	40%
Experimental	13%	46%	54%	58%
% difference	+3%	+16%	+24%	+18%
% Some Increase				
Control	40%	50%	50%	80%
Experimental	67%	67%	79%	100%
% difference	+27%	+17%	+29%	+20%
% Regression or No Increase				
Control	60%	50%	50%	20%
Experimental	33%	33%	21%	0%
% difference	-27%	-17%	-29%	-20%

Summary

Did the use of a combination of a computer-assisted instructional program (i.e., *Imagine Learning*) and an evidence-based program (*Accelerated Reading*) for teaching literacy skills to students with mild and moderate disabilities result in greater growth in student literacy performance as compared to the use of only evidence-based instruction (*Accelerated Reading*) as measured by the district curriculum-based Measure of Academic Performance (MAP) assessment; STAR reading placement, Independent Reading Level (IRL), Zone of Proximal Development (ZPD), and Fluency assessments; and hours of instructional completion time? On the face of results, it appears that it did. However, because of the limitations identified above, it is safe to say that more research is needed with more comparable groups of students in comparable settings.

Chapter 5

Discussion

This study was initiated, at least in part, due to the researcher's school district purchased a computer-based intervention program for use with students eligible for special education, English learners and other learners needing literacy intervention. The researcher is responsible for the design and delivery of special education services for 24 students for whom this program was intended. The purpose of this study was to determine the effectiveness of using the adopted computer-based instructional approach, *Imagine Learning*, in combination with the traditional *Accelerated Reading* literacy instructional approach to improve the overall literacy skills of students with mild and moderate disabilities as compared to instruction using only the traditional Accelerated Reading approach. Student data was collected over the period of a school year for a control group of students in a classroom in which *Imagine Learning* was not used and the experimental group taught by the research, who supplemented the use of *Accelerated Reading* with *Imagine Learning*. Results suggest that students in the experimental group outperformed those in the control group across measure, although a large proportion of students in both groups made little or no progress or regressed in their performance on the assessment measures. There was no relationship between the number of minutes students engaged in *Imagine Learning* instruction and student performance.

Limitations

A major limitation of this study was that the control and experimental groups were convenient samples limited to the students on the caseload of each of the two special educators at the researcher's school site. Therefore, the members of the two groups of students were not exactly comparable. For example, the experimental group was a much larger group (i.e., 24

students) than the control group (i.e., 10 students). The experimental group was comprised of older and more experienced readers (i.e., third and fourth graders), while the control group was comprised of less experienced readers (i.e., first, second and third graders). The experimental group was largely male, with 84% of the group being boys. The control group was more evenly split between boys and girls with 60% of that group being boys. In addition, other factors such as changes in students' schedules and school absences were not examined or factored into possible differences in learning performances

Probably the most significant limitation of this study is the fact that the two groups of students were taught by two different teachers. In the absence of direct observations of both teachers, it was impossible to know to what degree the instruction in the two environments were or were not comparable. Although the two teachers had somewhat similar instructional routines, the addition of the computer-based instruction in the experimental group may have increased the number of minutes of instruction the experimental group students received, yielding more positive results. Or other differences in the instructional methods used by the two different teachers may have influenced student performance.

Given the obvious limitations of comparing results of students who were instructed in different classrooms, by different teachers, at different grade levels, results are inconclusive and beg further investigation of the effectiveness of computer-based instruction with students eligible for special education.

Lessons Learned and Educational Implications

Clearly further and continued research is needed to examine and determine the most effective literacy interventions for students with learning difficulties and who are performing at the lowest percentile (e.g., 10%) of their grade levels. Much of the information on expected

literacy performance references the "average" student. For example, while conducting my research I looked for data regarding expected growth rates in fluency as measured by words read per minute. The only tables available were for students performing at the 20th percentile or higher at each grade level.

Students with identified disabilities frequently have difficulties in processing language which impedes their learning processes and literacy development. In addition, without effective intervention, the gap between students' actual performance and expected grade level performance increases. This poses a particular problem, as research suggests that for students to interact with the rigorous secondary curriculum and pass the high stakes high school exist exams, they need relatively high (e.g., 8th grade) literacy skills. Challenges to literacy development are myriad and including cognitive coding and memory problems. I would like to see future research focused upon these areas of neurology and the relationship of literacy and cognitive psychology.

The researcher is an experienced special educator, with a decade of teaching experience. Despite this experience, the researcher learned a great deal from conducting this study. Engaging in this study improve my own pedagogy in numerous ways. First, it improved by technology skills, proficiency, and fluency. My knowledge about and skill in using technology has increased and therefore better equips me to assist, guide, and teach my students through the use of technology, making me a more effective educator able to prepare my students to be college and career ready.

` The entire process of engaging in this year-long project has been journey and opportunity for professional growth. Now that I have actually conducted, completed, and written about my own research I have a deeper understanding and appreciation for what goes into conducting researching. I learned how to interpret research papers and their findings; how to format

organization, reference citations, and apply APA conventions; and how to find documents through data bases and online searches. Now, at the end of the process, I realize how simple it is to obtain information and how much is available to educators. I am better able to discern quality research-based information from opinion. The entire process has reinforced me to believe in and act on my personal motto of "working smarter not harder."

My final learning is that act of conducting research and writing a thesis is not for the faint of heart. However, you will emerge a better educated and skilled professional with new appreciation and depth of knowledge that makes it all worth the effort.

Future Research Directions

There seems to be a multitude of computer-based learning programs available today. More are being developed and made available to educators, parents, and students at a very rapid rate. It is imperative that special educators are able to identify and effectively use these emerging technological tools and programs in ways to maximize the learning of students. Therefore, continued research is needed on the most effective use of computer-assisted instruction and assessment in the development of literacy competence among different populations of students including students in the various special education qualifying categories. For example computer-assisted learning may be found to be highly effective with students who have attention deficits and who have trouble maintaining focus, while it may be less effective with students who have intellectual disabilities and who, struggle with higher order thinking and reasoning. What is commonly agreed upon is that reading instruction needs to address all five dimensions of reading - phonological awareness, phonics, fluency, comprehension, and vocabulary. What needs continued exploration is the degree to which computer-based learning can address each of these dimensions in comparison to traditional teaching methods.

Summary

The more that you read, the more things you will know.

The more you'll learn the more places you'll go.

-Dr. Seuss

This quote from Dr. Seuss' *I Can Read with my Eyes Shu*t reinforces for this researcher the importance of explicit instruction and focus upon literacy development and success for all students, but particularly for the student with learning and other identified disabilities. Through specific, directed, individualized, intensive remedial instruction that included computer-based learning, this researcher tried to illuminate the best way to accomplish the goal of improving literacy performance among students with mild and moderate disabilities in order to move them toward the desired end results of being college and career ready and armed with the necessary 21st century skills to support them throughout their lifetimes.

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Appendix A - Reader Conversion Chart

Reader Conversion Chart

This leveling chart approximates how these leveling systems relate to grade levels, stages of reading, and one another.

Stages of Reading	Grade Level	Lexile Level	DRA2 Level	Guided Reading Level	AR Level	Reading A to Z Level	Rigby PM Readers
Emergent	Kindergarten	BR -70	A	A		aa	Starters 1
			1	A		A	Starters 1
			2	B	1.1	B	Starters 2
			3	C	1.2	C	3-4 red
Early	First	80-450	4	C	1.2	C	3-4 red
Early			6	D	1.3	D	5-6 red/yellow
Early			8	E	1.4-1.5	E	7-8 yellow
Early			10	F	1.6	F	9-10 blue
Early			12	G	1.7-1.8	G	11-12 blue/green
Transitional			14	H	1.9	H	13-14 green
Transitional			16	I	2.0	I	15-16 orange
Transitional	Second	451-600	18	J	2.1	J-K	17-18 turquoise
			20	K	2.2	L	19-20 purple
			24	L	2.6	M	21 gold
Extending	Third	601-770	28	M	2.9	N, O, P	22 gold
			30	N	3.0	Q-R	23 silver
			34	O	3.5	S	24 silver
			38	P	3.9	T	25 emerald
Fluent	Fourth	771-860	40	Q	4.1-4.5	U-V	26 emerald
				R	4.5-4.7	W	27 ruby
				S	5.0		
Fluent	Fifth	831-980	40	S	5.0-5.2	X	28 sapphire
				T	5.5-5.8	Y	29 sapphire
				U-V	6.0+	Z	30 sapphire

- **Lexile:** Lexile level are trademarks of Metametrics, Inc. www.lexile.com Website provides lists of books for each level. Parents/teachers should use discretion when choosing books for students to read.
- **DRA2:** Developmental Reading Assessment 2 is a product of Pearson Learning. Levels A-3 are highly repetitive with lots of sight words, but aren't highly decodable texts. Level 6-8 starts addressing long vowels. Areas assessed in K- 3rd are reading accuracy, fluency, predicting, and summarizing.
- **Guided Reading Levels:** Guided Reading Level are taken from The Fountas and Pinnell Leveled Book List, K-8 (2006-2008 Edition) Go to this website for Scholastic books for each level. www.scholastic.com
- **Accelerated Reader (AR):** is a daily progress monitoring software assessment in wide use by primary and secondary schools for monitoring the practice of reading, and is created by Renaissance Learning, Inc.
- **Reading A to Z:** has books and resources correlated to state and Common Core Standards. It contains reading lessons, decodable books, reader's theater scripts, reading worksheets, and assessments.
- **Rigby Readers:** The Rigby PM series of precisely leveled fiction and nonfiction texts will support and challenge your students. With authentic storylines that ignite student interest, Rigby PM leveled readers systematically build high-frequency words and reading skills.

Appendix B - Tables 1 through 7

Table 1. Control group baseline data from Accelerated Reading STAR reading assessments and the Measure of Academic Performance Benchmark testing

Student	Estimated Reading Comprehension Grade level	Estimated Zone of Proximal Development	Fluency: Estimated Oral Reading Rate WPM	Approximate Scaled Score	Measure of Academic Performance 12 months
1st Grade					
Student CG1	1.1	1.1 – 2.1	40	75	159
2nd Grade					
Student CG2	0.7	0.7 – 1.7	7	70	141
Student CG3	1.0	1. 0– 2.0	5	73	159
Student CG4	1.2	1.2 – 2.2	15	77	155
Student CG5	1.1	1.1 – 2.1	8	75	140
Student CG6	1.1	1.1 – 2.1	8	75	141
3rd Grade					
Student CG7	1.1	1.1 – 2.1	8	75	144
Student CG8	*1.9*	1.9 – 2.9	47	160	154
Student CG9	*1.2*	1.2 – 2.2	40	78	150
Student CG10	*1.2*	1.2 – 2.2	20	78	152

Table 2. Experimental group baseline data from Accelerated Reading STAR reading assessments and the Measure of Academic Performance benchmark testing

Student #	Reading Comprehension Grade Level	Zone of Proximal Development (ZPD)	Fluency: Estimate Oral Reading Rate WPM	STAR Scaled Score	Measure of Academic Performance RIT score
3rd Grade					
Student FT11	1.1	1.1 - 2.1	16	73	138
Student FT12	1.2	1.2 - 2.8	22	149	157
Student FT13	1.1	1.1 - 2.1	14	71	156
Student FT14	1.6	1.6 - 2.6	38	118	157
Student FT15	2.4	2.2 - 3.2	63	261	159
Student FT16	1.8	1.8 - 2.8	46	162	158
Student PT17	2.5	2.3 – 3.3	68	284	157
Student PT18	2.3	2.3 – 3.2	59	257	175
Student PT19	2.4	2.2 – 3.2	60	260	155
Student PT20	1.8	1.8 – 2.8	46	164	160
Student PT21	2.2	2.1 – 3.1	55	224	170
Student PT22	1.1	1.1 – 2.1	17	72	149
Student PT23	2.9	2.5 – 3.5	78	341	178
4th Grade					
Student FT24	1.0	1.0 – 2.0	8	75	161
Student FT25	1.1	1.1 – 2.1	8	72	152
Student FT26	1.3	1.3 – 2.3	26	88	151
Student FT27	1.1	1.1 – 2.1	8	71	159
Student PT28	2.6	2.4 – 3.4	71	297	176
Student PT29	2.7	2.4 – 3.4	70	311	181
Student PT30	2.6	2.4 – 3.4	67	295	172
Student PT31	1.2	1.2 – 2.2	10	78	152
Student PT32	2.4	2.2 – 3.2	60	260	184
Student PT33	2.7	2.4 – 3.4	75	317	187
Student PT34	2.0	2.0 – 3.0	45	205	160

Table 3. Control group post-intervention period (i.e., 12 months later) results for Accelerated Reading STAR reading and Measure of Academic Performance assessment

Student	Estimated Reading Comprehension Grade level	Zone of Proximal Development ZPD	Estimate Oral Reading Rate WPM	Approx Scaled Score	Measure of Academic Performance 12 months
1st Grade					
Student CG1	3.0	3.0 – 3.5	102	439	183
2nd Grade					
Student CG2	1.2	1.2 – 2.2	18	75	160
Student CG3	1.3	1.3 – 2.3	25	85	150
Student CG4	1.2	1.2 – 2.2	33	99	165
Student CG5	0.5	0.5 – 0.9	10	69	157
Student CG6	1.0	1.0 – 2.0	8	62	150
3rd Grade					
Student CG7	0.9	0.9 – 1.9	0	62	169
Student CG8	*1.2*	1.4 – 2.4	30	96	152
Student CG9	*1.1*	1.1 – 2.1	8	71	155
Student CG10	*1.4*	1.4 – 2.4	31	99	160

Table 4. Control group student performance changes over the period of 12 months using the computer based learning program, *Imagine Learning*, as a reading intervention as measured by the STAR grade level equivalent reading comprehension score, the estimated oral fluency rate in words per minute, and the Scaled Score as well as the Measure of Academic Performance RIT scores

* = large change and most gain # = no change or regression

Student Identification Number	Grade equivalent comprehension change in years and months (tenths of a year)		Change in oral fluency in WPM		Change in STAR Scaled Score		Change in Measure of Academic Performance RIT score	
First grade								
Student CG1	+1.9	*	+27	*	+280	*	+24	*
Second grade								
Student CG2	+0.5		+11		+5		+19	*
Student CG3	+0.3		+20	*	+12		-9	#
Student CG4	0.0	#	+18	*	+22	*	+10	
Student CG5	-0.6	#	+2		-6	#	+17	*
Student CG6	-0.1	#	0	#	-13	#	+9	
Third grade								
Student CG7	-0.2	#	-8	#	-13	#	+25	*
Student CG8	+0.7	#	-17	#	-64	#	-2	#
Student CG9	+0.1	#	-32	#	-7	#	+5	
Student CG10	0.2		+11		+21	*	+8	
• **% w/most gain**	10%		30%		30%		40%	
• **% w/increase**	40%		60%		50%		80%	
• **% w/no change or regression**	60%		40%		50%		20%	

Table 5. Experimental Group post-intervention period (i.e., 12 months later) results for Accelerated Reading STAR and Measure of Academic Performance assessments and total minutes of Imagine Learning lesson engagement

Student #	Reading Comprehension Grade level	Zone of Proximal Development ZPD	Estimate Oral Reading Rate WPM	Scaled Score	Measure of Academic Performance RIT score	Imagine Learning minutes
3rd Grade						
Student FT11	1.2	1.2 – 2.2	15	76	155	1,789
Student FT12	2.1	2.1 – 3.1	49	209	166	438
Student FT13	1.1	1.1 – 2.1	8	72	170	713
Student FT14	1.8	1.8 – 2.8	42	163	182	948
Student FT15	2.8	2.8 – 3.5	76	330	188	266
Student FT16	2.1	2.1 – 3.1	49	212	176	971
Student PT17	3.3	2.7 – 3.8	91	388	180	1,003
Student PT18	2.8	2.5 – 3.5	75	318	197	1,473
Student PT19	1.8	1.8 – 2.8	47	168	176	1,072
Student PT20	2.2	2.1 – 3.1	55	240	177	1,582
Student PT21	2.9	2.5 – 3.5	79	343	189	584
Student PT22	1.1	1.1 – 2.1	16	73	158	912
Student PT23	3.9	3.0 – 4.4	104	441	189	751
4th Grade						
Student FT24	2.0	2.0 – 3.0	29	194	174	307
Student FT25	1.2	1.2 – 2.2	10	78	160	609
Student FT26	1.9	1.9 – 2.9	22	177	170	796
Student FT27	1.3	1.3 – 2.3	28	86	177	827
Student PT28	3.0	2.6 – 3.6	114	351	177	1,379
Student PT29	3.0	2.6 – 3.6	116	353	189	984
Student PT30	2.6	2.4 – 3.4	67	292	178	521
Student PT31	1.9	1.9 – 2.9	40	183	166	2,450
Student PT32	3.4	2.8 – 3.9	107	391	189	256
Student PT33	2.6	2.4 – 3.4	70	301	200	947
Student PT34	2.0	2.0 – 3.0	45	205	179	1,089

Table 6. Experimental group student performance changes over the period of 12 months rank ordered by the number of minutes of *Imagine Learning* program use as measured by the STAR grade level equivalent reading comprehension score, the estimated oral fluency rate in words per minute, and the Scaled Score as well as the Measure of Academic Performance RIT scores

* = large change and most gain # = no change or regression

Students rank ordered by number of Imagine Learning minutes	Most to least number of minutes	Number of Imagine Learning minutes	Grade equivalent comprehension change in years and months (tenths of a year)		Change in Oral Fluency in WPM		Change in STAR Scaled Score		Change in Measure of Academic Performance RIT score	
Student PT31	1st	2,450	+0.7		+30	*	+105	*	+14	
Student FT11	2nd	1,789	+0.1	#	-1	#	+3	#	+17	*
Student PT20	3rd	1,582	+0.4		+9		+76	*	+17	*
Student PT18	4th	1,473	+0.5		+16	*	+61	*	+40	*
Student FT28	5th	1,379	+0.4		+43	*	+54	*	+3	
Student PT34	6th	1,089	0.0	#	+0	#	+0		+19	*
Student PT19	7th	1,072	-0.6	#	-13	#	-92	*	+21	*
Student PT17	8th	1,003	+0.8		+23	*	+104	*	+23	*
Student PT29	9th	984	+0.3		+46	*	+42		+8	
Student FT16	10th	971	+0.3		+3		+50	*	+18	*
Student FT14	11th	948	+0.2		+4		+45		+25	*
Student PT33	12th	947	-0.1	#	-5	#	-16	#	+16	*
Student PT22	13th	912	0.0	#	-1	#	+1	#	+9	
Student FT27	14th	827	+0.2		+20	*	+15		+18	*
Student FT26	15th	796	+0.6		-4	#	+89	*	+19	*
Student PT23	16th	751	+1.0	*	+26	*	+100	*	+11	
Student FT13	17th	713	0.0	#	-6	#	-10	#	+14	
Student FT25	18th	609	+0.1	#	+2		+6		+8	
Student PT21	19th	584	+0.7		+24	*	+119	*	+19	*
Student PT30	20th	521	0.0	#	0	#	-3	#	+6	
Student FT12	21st	438	+0.9		+27	*	+60	*	+17	*
Student FT24	22nd	307	+1.0	*	+21	*	+119	*	+13	
Student FT15	23rd	266	+0.4		+13		+69	*	+29	*
Student PT32	24th	256	+1.2	*	+47	*	+131	*	+6	
• **% w/most gain**			13%		46%		54%		58%	
• **% w/an increase**			67%		67%		79%		100%	
• **% w/no change or regression**			33%		33%		21%		0%	

Table 7. Comparison of student grade equivalent comprehension performance change over the 12-months intervention period for control and experimental groups as represented by the percentage of students with (a) the greatest gains, (b) some gains, and (c) no gains, including regression

	Comprehension Grade Equivalence	**Oral Fluency**	**Scaled Score**	**MAP RIT Score**
Percentage of Students with Greatest Gain				
Experimental	13%	46%	54%	58%
Control	10%	30%	30%	40%
Percentage difference between experimental and control groups	+3%	+16%	+24%	+18%
Percentage of Students with Some Gain				
Experimental	67%	67%	79%	100%
Control	40%	60%	50%	80%
Percentage difference between experimental and control groups	+27%	+7%	+29%	+20%
Percentage of Students Who regressed or Had No Gain				
Experimental	33%	33%	21%	0%
Control	60%	50%	50%	20%
Percentage difference between experimental and control groups	-27%	-17%	-29%	-20%