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How a Computer-Assisted Instructional Program Affects the Reading Fluency of a Selected Group of 2nd Grade Students

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HOW A COMPUTER – ASSISTED INSTRUCTIONAL PROGRAM AFFECTS THE READING FLUENCY OF A SELECTED GROUP OF 2^{nd} GRADE STUDENTS

by

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DEDICATION

I dedicate this to my grandmother, the late Mrs. Louise Morris Jenkins, who instilled in me the value of getting a quality education. I miss you so much Mama! I hope that you are proud!

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ABSTRACT

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This study examined the effectiveness of Headsprout Early Reading to augment fluency abilities for second grade students in an urban public school system. Headsprout, a Computer- Assisted Instruction program (CAI), provided internet-based reading instruction based on the National Reading Panel's recommendations. All second grade students were assessed to determine who would use the program. Second grade students who participated in Headsprout sessions were compared with second grade students who did not use Headsprout. All participants were assessed again at the end of the study.

Analysis of the students' gains was conducted using a Repeated Measures Analysis of Variance (R-ANOVA). It revealed that the participants showed more growth from their entry benchmark and exit benchmark scores than from their entry benchmark and mid-entry benchmark scores. Results of a Regression-Discontinuity Data design approach analysis showed an observable "discontinuity" between the mean averages for the treatment group and control group. Overall, results were more significant for those students who had participated in the program.

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CHAPTER 1

Introduction

Technology is all around us! According to Merriam–Webster (2010), technology is the manner of accomplishing a task using technical processes, methods, or knowledge. Technology empowers those who are able to use it. Schools are relying heavily on technology to assist students in making academic gains and in meeting Adequate Yearly Progress (AYP). We see that technology is changing continuously. However, is this change proving to be beneficial to students?

Technology is now a part of students' and teachers' daily lives. Technology is encountered at home, in the community, and especially at school. Technology comes in many various forms. Computers, videotapes, computer–assisted instruction, CD–ROMS, hypermedia, The World Wide Web (www.), interactive whiteboards, blogs, websites, and overhead projectors are just a few of the forms used frequently in the classroom.

Many teachers and administrators have expressed different reasons for bringing technology into their schools and classrooms. They believe that technology supports the thinking processes of students; stimulates motivation and self–esteem in students; promotes equity; prepares students for the future; supports changes in school structure; and explores technology capabilities for both teachers and students. By providing technology in classrooms, teachers can provide opportunities for students to acquire problem–solving skills – either through instructional software designed to teach problem solving or through the many requirements for solving problems that naturally emerge when one is trying to use computer tools to accomplish a task. Supporters of technology describe technology as being able to provide students with opportunities to acquire various complex concepts and/or provide opportunities for scaffolding for thinking.

Reeves (1998) pointed out that technology was introduced into schools because it was believed that it would have positive effects on teaching and learning. Since technology is a part of students' daily learning, then it must be effectively integrated into the curriculum (Edutopia, 2010). Technology can extend learning by providing teachers and students with access to up–to–date, primary source materials, methods of collecting and recording data, ways to collaborate with teachers, students, and experts, opportunities for expressing understanding via images, sound, and text, and learning that is relevant.

However, further discussion about the benefits of bringing technology into schools is warranted. Technology promotes collegiality and helps students to develop positive cooperative learning relationships. Technology addresses acquiring skills such as reading and problem–solving. Students attain reading and problem–solving skills through computer–assisted instruction (CAI) and/or when using technology to accomplish assigned tasks (SRI International, 2001). Students' levels of interest in learning with technology also improve their self–concept about their own competence as a learner. Having technology in schools also promotes equity among students who come from low–socioeconomic backgrounds and affluent backgrounds. Since all students are being given ample opportunities to achieve with technology, school districts and schools are preparing them for the future. It is the ultimate goal of all schools to produce competent and productive citizens. Technology in schools supports that endeavor and therefore promotes change in the structure of schools.

The 2010 *Technology Counts* publication reported the various trends that schools and districts are using to improve teaching and learning using technology (Ed Tech Stats, 2010). They discussed the use of multimedia digital content, the growth of online curricula, online course taking opportunities, online assessments, and school policies on cell phones, iPods, and blogs.

Technology is used one of two ways in schools (Reeves, 1998). The first way, learning with technology, has tremendous power to help students obtain, organize, manipulate, and display information (Means, 1997). Spreadsheets, word processing, and databases help students become better equipped to handle real–world technology while developing their reading, thinking, and writing capabilities. By using this technology, students are afforded opportunities to convey what they know to others. Therefore, teachers must not only teach students the basic technology skills, but they must use technology to cultivate meaningful experiences for students. Researchers have argued that technology has the potential to dramatically change the way in which schools are structured – providing pressure to do away with the division of instructional time into small blocks and discrete disciplines and to rethink the way we use physical classrooms and teaching resources (Newman, 1990).

Reeves (1998) suggested that there are foundations for using technology as cognitive tools in schools. First, cognitive tools will have the greatest impact if they are applied within constructivist learning environments. Cognitive tools allow students to create their own illustrations of knowledge. Reflective thinking, which is essential in order for students to have meaningful learning, is supported by cognitive tools. An intellectual partnership is formed between the student and cognitive tools and thus remains embedded in their minds afterward.

Learning from technology is the other way that technology is used in schools. Learning from technology strategies include instructional television, computer–assisted instruction, and integrated learning systems. Reeves (1998) argued that it is presumed that the students will learn something from the technology. In the case of computers, the flow of the information goes directly from the computer to the student (Soe, Koki, & Chang, 2000). The computer presents the new material to be learned and also maintains a record of the student's progress.

Are teachers using technology regularly and to what extent? Reeves (1998) maintained that past educational research has suggested that technology is effective in schools as a means of learning with and learning from. Gray, Thomas, Lewis, and Tice (2010) presented key findings on teachers' use of educational technology during the winter and spring of 2009. Teachers reported that their students often used the computers in their classrooms or in other locations during instructional time. Educational technology was used during classes to assist students in learning and practicing new skills. However, Blackhurst (2002) states that the use of technology cannot compensate for instruction that is poorly designed or implemented. Another issue is if the teachers are able to use and understand the computer and its wares, both hard and soft.

"The Information Superhighway" is a phrase we have heard since the mid–1990s. We can thank former President Clinton and former Vice President Gore for coining the phrase. "The Information Superhighway" simply refers to the World Wide Web, the Internet, or most recently developed cyberspace. President Clinton's "Call to Action for

American Education in the 21st Century" ("Debunking the Digital Classroom", 2005) had four primary goals: (1) connect every school and classroom in America to the Information Superhighway, (2) provide access to modern computers for all teachers and students, (3) develop engaging software and online learning resources as an integral part of the school curriculum, and (4) provide teachers all of the training and support they need to help students learn through computers and the Information Superhighway.

Background of the Problem

As a result of President Clinton's call, schools invest thousands of dollars each year on computers, computer software, audio–visual equipment, Internet access, and videos for the classroom (Oppenheimer, 2003). The total cost of technology in U.S. schools in the late 1990s was approximately $3 billion, or $70 per pupil (Christensen, 2002). Local, state, and national leaders want to see an increase in student achievement. Therefore, school districts have had to reorganize and revamp their instructional budget spending to meet this demand of incorporating technology into their district's curriculum and instruction.

Now additional, important and key questions to contemplate come to mind. How does technology integration directly impact student learning and achievement? Are schools receiving the maximum benefits from these expensive computer–assisted instruction programs that are paid for with taxpayers' hard earned dollars? Cradler, McNabb, Freeman, and Burchett (2002) stated that before these questions can be answered accurately, three key factors must be considered. First, technology and its use must be clearly defined. Technology refers to a wide array of electronic materials and strategies that can be used for learning. It is not confined to just one type of technology.

Second, assessing the effect of technology on student achievement is a very complex procedure to monitor. Third, there must be changes within the classroom that correlate with other local, state, and federal mandates. In other words, technology integration/usage must be matched with the various curriculums, standards and/or objectives. There are a lot of factors that must be considered. School district superintendents, school district administrators, school board members, building principals, and teachers all play vital roles in ensuring that this happens.

Oak (2011) states that the administrative processes and the official procedures of schools can be simplified by the means of technology. School records, the information about all the students, the teachers, and also other school employees, can efficiently be maintained by means of the advanced technology. The data pertaining to the school employees and students can effectively be stored and secured in a school database. The school could have a separated library system, which by the utilization of technology can be maintained in an efficient manner. On similar line, the attendance records of the pupils and teachers can be maintained by means of a student database. Moreover, the school can host a website of its own holding information about the school. The introduction of technology in schools can thus result in a decreased use of paper and in bringing most of the school office work in an e–format.

What does this ultimately mean? Oak (2011) argues that technology not only benefits the school students but also eases the office work. It makes possible a more effective way of storing and distributing information. The realization of the importance of technology in schools and its successful implementation is a necessity. The introduction of technology in schools is the means to bridge seemingly long distance between the present and the future.

Therefore, we must ask how important is technology usage in education? It is quite important it would seem. Computers have been used in the educational setting since the 1960s. Computer usage, the most common type of technology, has exploded over the last couple of decades. Computers are everywhere! Pflaum (2004) discovered that the average student spends about an hour a week with a computer at school. Computers are an essential piece of the learning environment in today's classrooms in urban, independent, and rural school districts in the United States. For that reason, policymakers and researchers have argued whether computers play a productive role in the classroom (Wenglinsky, 2005).

Since computers now play a major role in student learning, different tools have been developed to support them. One such tool is computer–assisted instruction (CAI). Computer–assisted instruction is a program of instructional material that is presented through computers to ultimately enhance the student's learning (Access Center, 2004). These remedial programs are offered online and usually come as an additional resource with most textbooks and books. Computer–assisted instruction monitors the students' progress of learning and selects additional teaching materials in view of a learner's present level of performance. Computer–assisted instruction refers to drill–and–practice, tutorial, or simulation activities that are offered by themselves or as supplements to traditional, teacher–directed instruction (Cotton, 1997).

An influential software industry group has unrolled a project to help education and business better define the role of technology in the 21st century education (Trotter, 2008). The Vision K – 20 Initiative offers schools an online survey to measure their progress towards the Software and Information Industry Association's goals. These goals concentrate on student achievement, student engagement, equity, technology access, and accountability for student performance. However, the initiative's primary purpose is to convince schools to include the goals in their standards and missions. This can influence how computer–assisted instruction is integrated into the classrooms.

Computer–assisted instruction is an asset to the learning environment. Computer–assisted instruction supplements the teacher's delivery of instruction in several ways (Access Center, 2004). First, computer–assisted instruction programs are interactive and use eye–catching animations, hands–on demonstrations, and distinctive sounds. Secondly, students work on their own and at their own pace. Thirdly, another benefit of computer–assisted instruction is its ability to give the students immediate feedback and redirection if necessary. Waxman, Padrón, and Arnold (2001) also pointed out that computer–assisted instruction is motivational and non–judgmental. Ota and DePaul (2002) claimed that computer–assisted instruction provides students with the benefits of one–on–one instruction without leaving the larger classroom. Consequently, research substantiates that all types of students and learners benefit from using computer–assisted instruction.

Statement of the Problem

In an effort to improve reading skills for primary grade students, the school district purchased *Headsprout® Early Reading*. The focus of this study is to determine if *Headsprout® Early Reading*, an animated, online program and basis of this study, can support its guarantee statement: second graders who were initially identified as being struggling readers will become skilled and fluent readers. In other words, will *Headsprout® Early Reading* increase students' abilities to read fluently and on grade level?

Purpose of the Study

The purpose of this study is to determine if *Headsprout® Early Reading* technology is an effective tool in assisting second (2nd) grade students who are experiencing difficulties with oral reading fluency. This study will also determine Headsprout's proficiency ability to support those students in attaining grade level comprehension capabilities especially reading fluently. Currently, *Headsprout® Early Reading* is the only computer–assisted reading software program chosen by the selected schools and district to enhance the oral reading fluency of elementary (K-2) school students.

Research Questions

In order to investigate the concepts of *Headsprout® Early Reading*, computer–assisted instruction and oral reading fluency, the following research questions will guide this study:

1. Do students who participated in Headsprout evidence significant growth in reading fluency when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

2. Do Headsprout participants' pattern of growth in reading fluency differ significantly by their cohort (year of participation) or by their tier level (grouping for instruction) when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

3. After controlling for differences on a literacy pretest, do students who participated in Headsprout evidence significantly greater growth in reading fluency than students not participating in Headsprout, when their scores on a literacy posttest are compared?

Clarification of Terms

In order to discuss the concepts of *Headsprout® Early Reading*, computer–assisted instruction and student achievement, a common vocabulary must be established. Listed below were the terms that need to be clarified:

Computer–assisted instruction refers to the interactive, instructional computer programs that are used to teach and/or remediate skills students have not mastered.

Fluency refers to the smoothness or flow with which sounds, syllables, words and phrases are joined together when speaking quickly and with expertise.

Headsprout® Early Reading refers to a computer–assisted instructional program used to help students achieve literacy skills.

Oral reading refers to the ease at which a student is able to read a passage of text aloud.

Traditional instruction refers to the manner in which students are taught and the instructional methods used by the teacher.

Summary

There are several reasons for using technology in schools. First, technology supports thinking. It stimulates the thinking of both the teachers and the students. Teachers are able to provide instruction in a variety of ways using technology. Information is readily available at their fingertips. Next, students are able to experience success by using technology. This in turn would boost their self- esteem and self-confidence. Technology will prepare students for the future. Technology can be found in developed countries to developing countries. Technology is on an evolutionary cycle. It just gets better and better each day!

Although there is a struggle for some school districts to find funding for technology, many are now employing technology- enriched curricula and instruction (Van Roekel, 2008). This has shown a direct correlation to student achievement in a variety of subject areas. When technology is an integral part of the teaching and learning, both teachers and students are engaged. Many schools now offer online learning to address the high levels of student enjoyment of learning with technology. The number of virtual schools, schools who offer online instruction to students in grades 6 – 12, is on the rise in several states across the country.

Opponents of technology in schools would argue that the ratio of students to technology is inadequate. Classrooms are not fully equipped to handle the demand of technology. Students must be able to access technology in order for it to become a reliable tool for learning. More computers must be made available for student use. School districts must build wireless networks that can support increased access to technology (Van Roekel, 2008). More technology access is needed to allow teachers to plan and teach. More age-appropriate software programs and high speed Internet access is a must for elementary schools. Teachers are not being afforded enough professional development opportunities to support their needs and their students' needs. High-quality technology professional development should be offered year round. It would probably be advantageous if teacher education programs would agree to incorporate more technology courses as a requirement of getting a teacher’s license. Consequently, school districts and private sectors are constantly and creatively finding ways to fund the upsurge of technology procurement and usage. Teachers can advocate and lobby for additional monies by finding creative means to better integrate technology in their teaching. Their students’ achievement results would be the evidence the community, state, and federal stakeholders would need to support their efforts financially.

CHAPTER 2

Review of the Relevant Research Literature

Overview

Today's students use technology in almost everything they do. From the moment they wake up from the digital alarm clocks, listening to their iPods as they walk to school, communicating with their friends on Twitter and Facebook, or sharing information on YouTube, they are used to customizing their worlds at the click of a computer. But school today for far too many kids does not look like the rest of their world. It does not capitalize on technology's potential to engage students and to improve learning. One critical element of learning in the future must be to provide technology–rich classrooms for all students. Research shows that when technology is systemically integrated into classrooms and used by digitally–savvy staff, it can improve teacher effectiveness and student achievement and reduce the dropout rate (Miller, 2009).

The literature on the impact computer–assisted software and instructional programs has had on student achievement has mixed findings. Since technology has been used in a variety of ways and purposes, much research has been completed to understand its impact on the education of children (Cotton, 1997). It is important to revisit the areas that technology (computer–assisted instruction) has influenced.

The Process of Beginning Reading

Adams (1990) states that children begin learning to read well before they enter their formal school years. For that reason, the questions of when to begin formal instruction has become somewhat debatable while the issue of how to provide this instruction has risen to the spotlight (Teale & Yokato, 2000).

Gaining proficiency in reading is a process that takes many years. In describing this process, Chall (1983) distinguishes between six different stages, three of which fall within the scope of this review: stage 0 (pre-reading), stage 1 (learning to decode), and stage 2 (acquiring fluency). Consider these stages as a useful organizer for the present section (Blok, Oostdam, Otter, & Overmaat, 2002).

Different researchers use different conceptualizations of the process of learning to read. For instance, Goodman and Goodman (1979) advocate a reading model as a psycholinguistic guessing game, whereas Clay (1993) views reading as a complex, developmental psycholinguistic process. Different views are also held on the amount and kind of instructions students need to become proficient readers. Encouraging students to think aloud, articulate thoughts, and receive feedback may support the development of comprehension skills (Gersten, Fuchs, Williams, & Baker, 2001). According to the self-teaching hypothesis (Share, 1995; Share & Stanovich, 1995), children basically learn to read by developing phonological awareness, learning some basic letter–sound relationships, and phonologically re–coding specific printed words a few times. Provided with sufficient reading opportunity, they basically become their own teachers. We have a pertinent reason, however, to use the well-known skills–based approach (Adams, 1990) as a framework here. This reason follows from a foreknowledge of the computer–assisted instruction (CAI) programs available. Most programs offer students the opportunity to practice specific sub–skills. We realize that this framework builds on a limited view of reading, setting aside many issues and concerns that would belong to a comprehensive consideration of literacy instruction. Such issues and concern are being represented convincingly by professional organizations such as the International Reading Association and the Reading Recovery Council, promoting Marie Clay's approach. But the literature on computer–assisted reading instruction being biased to a decoding skills–based approach, simply leaves us little choice. Generally, most of the reviewed studies stand out in ignoring the complex nature of becoming literate (Blok et al., 2002).

Pre-Reading Skills

In most developed countries, the acquisition of reading skills is a long–lasting process that starts years before formal reading instruction is provided in school or elsewhere. Living in an environment in which written or printed language is almost universally present, children spontaneously accumulate a wealth of knowledge relevant to their literacy development. Relevant developments take place in many respects, three of which are generally seen as major domains: language abilities, phonological awareness, and growing experiences with written or printed language (Snow, Burns, & Griffin, 1998).

According to Clay (1993), important concepts children should know about print are as follows:

- Can identify the front of a book
- Understands that print contains a message
- Knows where to begin reading, which way to go, makes return sweep to left and is capable of matching words
- Understands the concept of first and last, big and little, can locate directionality or spatial relations and positions
- Understands the role of punctuation

Language specialists distinguish between various components of language. From a reading instruction perspective, vocabulary is probably a key component. Vocabulary growth is rapid throughout childhood years. An average increase of around seven words per day would not seem an unreasonable estimate (Anglin, 1993). Although a positive correlation between vocabulary and reading comprehension has often been demonstrated (Davis, 1944, 1968), it is doubtful whether a large vocabulary is a facilitating condition in the phase of initial reading instruction. Many 5– or 6–year–old students have a vocabulary that spans several thousand words, which seems extensive enough to cover all–or at least most–of the words used in basal reading programs for the lower grades.

The best predictor of how well children will comprehend text is their vocabulary knowledge (National Reading Panel, 2000). Wilcox and Morrison (2013) state that there are four strategies that can be implemented to ensure children explicitly develop their vocabulary. They refer to them as the four E's: experience, exposure, environment, and engagement. Experience gives children opportunities to connect word meaning to their everyday life experiences. Saturating children with vocabulary words repeatedly makes it possible to for them to make them apart of their repertoire. Children must also be taught that vocabulary words are a part of the big picture of all kinds of text. Finding ways to actively engage students with learning vocabulary words can be a task but careful planning will guarantee that all children's needs are met during instruction. Computer assisted instruction addresses all of the 4 E's.

Phonological awareness is synonymous with emergent literacy (Lundberg, Larsman, & Strid, 2012). Phonological awareness refers to the child's ability to attend to and analyze the internal phonological structure of words. Noticing similarities between spoken words, enjoying rhymes, and counting syllables are among the generally accepted constituents of this skill. Phonological awareness should be distinguished from phonemic awareness. A more specific skill, phonemic awareness entails insight into how spoken words are built from phonemes, an insight that children develop somewhat later than phonological awareness. There is abundant evidence that the performance of kindergartners on tests of phonological awareness is a strong predictor of their future reading level (Juel, 1991; Scarborough, 1989; Stanovich, 1986; Wagner, Torgeson, & Rashotte, 1994).

Recent meta–analyses of the many training studies show that phonemic awareness instruction helps students to become better readers (Bus & Van Ijzendoorn, 1999; Ehri et al., 2001). Phonemic awareness studies conducted in the 1980s and 1990s discovered that phonemic awareness increased early word reading performances for children (Murray, 2012). However, the fruition of phonemic awareness instruction has been quite dismal.

Many parents assist in their children's literacy development by reading books and by providing models for working with written and printed materials. There is evidence that reading to children strengthens their literacy skills (Blok, 1999; Bus, Van Ijzendoorn, & Pellegrini, 1995). Sulzby and Teale (1991) provide a comprehensive description of the way children develop more – or – less spontaneously emergent literacy skills. As a result, before entering pre–school or kindergarten, many children are familiar with the function and the global characteristics of print, know the names of some letters, and are able to write their names.

Learning to Decode

Students must master the alphabetic code. This requires knowledge of two aspects of the code: (a) the visual identity of letters and (b) the speech sounds of letters (Blok et al., 2002). The English language is based on a standard set of letters and symbols. Students must have the ability to determine the sounds of each symbol and letter. Spencer (2002) argues that because the English language is comprised of irregularities, this makes it difficult for some students to learn how to read.

Learning the visual identity of the thirty (30) odd letters that most alphabetic languages feature (in lower and upper cases, as well as in manuscript and printed forms) is a perceptual discrimination task. It involves recognizing and remembering the distinctive features of each letter (Gibson & Levin, 1975). It is also a very sophisticated task, requiring careful visual attention, as letters are abstract, highly similar to each other, and defy the indifference to orientation acquired earlier by the student. Over time, students become sensitive to the types of spatial relationships that distinguish one character from another and recognize them across a variety of hands and typefaces. Even errors in letter orientation seem to disappear with sufficient practice.

While learning the visual identity of different letters, the student also becomes familiar with the corresponding speech sounds or phonemes. However, recognition of the primary correspondences is not sufficient. Readers also need to be aware of the nature of the alphabetic script. Alphabetic scripts are not symbol systems for words or meaning but symbol systems for phonemes, the sounds comprising words. This understanding is hampered by the fact that in speaking and listening, we focus on meaning, not on phonemes. Reading requires an explicit understanding of phonemes, which is not required in speaking and listening (Liberman, 1992, 1998; Liberman, Shankweiler, & Liberman, 1989). The relationship seems to be reciprocal. Phonemic awareness is a critical requirement in learning to read effectively in an alphabetic language, while the development of reading skills is critical to a full development of phonemic awareness (Barron, 1998; Muter, 1998). Hatcher, Hulme, and Ellis (1994) call this alleged reciprocal relationship “the phonological linkage hypothesis.”

A very essential part of phonemic awareness is the ability to manipulate phonemes, in particular the skills of blending and segmenting. Blending separate phonemes into words is essential for reading. Segmenting words into separate phonemes is essential for writing or spelling. Armbruster (2010) emphasizes that teaching children to segment words helps them to spell words because they learn that sounds and letters are related. Using phonics to teach students the relationship between written letters and the sounds they make has been successful (Mesmer, 2005). Blending and segmenting appear to be difficult for many students, especially when a word begins or ends with more than one consonant (Adams, 1990). It also seems difficult for students when they are taught several different ways to manipulate phonemes (Armbruster, 2010).

To highlight the alphabetic principle, many basal reading programs start with primary letter-sound correspondences and words that conform to these rules. The alphabetic principle has been complicated by the lack of a one-to-one correspondence. All languages use more phonemes than letters, and the spelling system reflects not only phonics but also etymology and grammar. Consequently, some phonemes require more than one letter, some letters can represent more than one phoneme, and some phonemes can be represented by different letters. Thus, learning the many spelling-sound correspondences of a language, the "orthographic cipher," as dubbed by Gough and colleagues (Gough, Juel, & Griffith, 1992; Gough & Wren, 1998), is a complicated task. This task becomes even more complicated when a particular language shows a less consistent orthographic cipher.

A final step in decoding is recognizing and checking the meaning of a word after it has been sounded out. Students use their listening vocabularies to check whether the words they have sounded out exist, and they make corrections in stress and pronunciation if necessary. They also use context to verify the meanings of words (Blok et al., 2002).

Acquiring Fluency

Current syntheses of the literature concur that the following skill components are essential for developing proficient reading fluency: phonemic awareness, phonics practice, repeated reading, and sight word knowledge (Hitchcock, Prater, & Dowrick, 2004). Fluency (automaticity) is reading words with no noticeable cognitive or mental effort (University of Oregon Center on Teaching and Learning, 2011). It is having mastered word recognition skills to the point of overlearning. Fundamental skills are so "automatic" that they do not require conscious attention. The importance of automatic word recognition is obvious. Automatic word recognition enables readers to process text in greater units and to use the capacity of their working memories for grasping meaning. Adams (1990) argues that it is important for beginning readers, who have only a small repertoire of sight words, to have automated not only the primary letter-sound correspondences but also the frequent spelling patterns of their language. This will speed up their recognition of unfamiliar words and will help them build up a growing stock of swiftly recognizable words. Reis, Eckert, McCoach, Jacobs, and Coyne (2008) state that there is a positive correlation between reading fluency and comprehension. Students who read fluently are much more likely to comprehend what they read.

The NRP (2000) identified five skills that all good readers should possess: phonemic awareness, phonics, vocabulary, fluency, and comprehension. This is referred to as the “big five ideas” in reading. Whitehurst and Lonigan (1998) have classified them into two groups: inside-out and outside-in. Phonemic awareness, phonics, and fluency all rely on students’ ability to decipher the alphabet to read words from the inside- out. Meanwhile, vocabulary and comprehension depend on students’ prior knowledge and word repertoire to construct meaning of what they read. Thus, processing the information from the outside-in.

What is a true definition of phonemic awareness? Phonemic awareness is the only aspect of reading that is essential for children to develop before they can begin learning to read (Charles & Charles, 2012). Like previously mentioned, phonemic awareness is also the strongest indicator of a child’s potential for learning to read.

Students must have the understanding that words are made up of small units of sound that influence the meaning of the word. Teachers must show students how to blend and manipulate words. Then, students will be able to use what they know about phonemes in order to begin reading.

The NRP (2000) stated that phonemic awareness is one area where many preschool and kindergarten students need additional support. Phonemic awareness is crucial to the pre-reading stage because children must be able to identify phonemes in spoken words. The NRP declared that the following strategies are used to assess children’s phonemic awareness capabilities:

- Phoneme isolation (recognizing individual sounds in words) (/k/a/t!)
- Phoneme identity (recognizing common sounds in different words)
  (d-ad, p-ad)
- Phoneme categorization (recognizing the word with the different sound in a sequence of words) (pour, more, some, soar)
- Phoneme blending (listening to a sequence of separately spoken sounds and combining them to form a recognizable word) (/b/ /a/ /t/ bat)
- Phoneme segmentation (breaking a word into its sounds by counting the sounds in each word) (dogs - /d/ /o/ /g/ /s/ - 4)
- Phoneme deletion (recognizing what word remains when a specified phoneme is removed) (cat - /c/ - at)

It is important that children come equipped with phonemic awareness skills in order to become successful readers (Charles & Charles, 2012). This is mainly because phonemic awareness enables children to unquestionably realize that both oral and written words are comprised of sounds. Phonemic awareness also affords children opportunities to build upon another element of reading-phonics. Phonemic awareness creates a bridge between spoken and written words. Once children can manipulate sounds orally, they are ready to transfer this knowledge to written words.

Researchers have focused on two main types of phonics instruction: analytical phonics and synthetic phonics. Watson and Johnston (1998) state that children focus on whole words, and compare and contrast them (slip/slop, cat/fat) to figure out the sounds that go with the letters in analytical phonics. This is in general the whole language approach to phonics. Another name that for analytical phonics is implicit phonics.

This approach teaches letter-sound relationships in the context of the word in which it is found (Ruddell, 2002). Children compare unfamiliar or unknown words to familiar or known words. Children are not taught to pronounce words in isolation. An example would be “b says bat and not buh”. Ruddell also stresses that children learn words by their shape, beginning and ending letters, pictures and by the context which they are used in sentences.

Watson and Johnston (1998) emphasize that analytical phonics instruction begins at the whole word level. Children are taught to read what we know as sight words. Sight words are a pre-selected list of words by sight. The goal is to teach children one letter sound a week, which is quite similar to kindergarten curriculums used in today’s classrooms. The next step is to show children a series of alliterative pictures and words which start with that sound. An example is car, cat, cake, castle. Children are exposed to additional middle and ending sounds once they have learned the 26 initial letter sounds. If children encounter difficulty pronouncing unfamiliar words , they divide the word into onset- the beginning letter sound and rime- the rhyming family the word comes from.

In synthetic phonics, students are first taught the sounds that go with a few letters (m says mmm, s says sss, a says aaa) than then students are taught to use this knowledge to sound out words written with those letter—ma, sam, am (Watson & Johnston, 1998). Gradually, more letter-sounds and words to decode with these letters are added. Synthetic phonics is also called explicit phonics.

Synthetic phonics is taught to children when they are first introduced to reading. Synthetic phonics instruction teaches letter-sound relationships by articulating the sound in isolation. This is a stark difference from analytical phonics which stresses letter-sound relationships in the context of sentences. The goal of synthetic phonics is to teach children how to synthesize pronunciations of unknown words by transforming letters into sounds and then blending the sounds together.

The first step children are taught during synthetic phonics is how to connect individual letters and letter combinations with sounds (Phonics International, 2011). Next, children are taught to blend sounds together to make words they recognize and know. Then, students are taught to sound out and blend letters to pronounce unfamiliar words. Children normally tackle six phonemes weekly.

The NRP (2000) maintains that in the area of phonics, meta-analyses revealed the following:

- Systematic phonics instruction produces significant benefits for students in kindergarten through Grade 6 and for students with reading disabilities, regardless of socioeconomic status.
- The impact is strongest in kindergarten and Grade 1.
- Phonics must be integrated with instruction in phonemic awareness, fluency, and comprehension.Studies show that children in grades 2-6 also show growth in these areas, but theirs is not as considerable as that seen in primary grade students (Charles & Charles, 2012). Phonics instruction has a positive impact on the reading abilities of disabled, low achieving non-disabled students and students from low socio-economic backgrounds. These groups of children showed growth in their abilities to decode and spell new words. However, their reading comprehension skills were not affected by phonics instruction.

Fluency is the speed, accuracy and prosody that a person uses when reading a text (Charles & Charles, 2012). A key skill a reader must possess is being able to efficiently decode and comprehend any text he reads. Fluency is the most overlooked of the five essential aspects of reading. Fluency is usually assessed during oral reading. Thus, it is not considered to be equal to independent silent reading. Nonetheless, fluency plays an important role in a reader's ability to comprehend texts.

Hasbrouck, Ihnot, and Rogers (1999) argue that successful readers:

- Rely primarily on the letters in the word rather than context or pictures to identify familiar and unfamiliar words.
- Process virtually every letter.
- Use letter-sound correspondences to identify words.
- Have a reliable strategy for decoding words.
- Read words for a sufficient number of times for words to become automatic.

The NRP (2000) has also noted a combination of methods to effectively teach children how to read. It recommended repetition and multiple exposures to vocabulary words to enhance students' fluency. Students' instructional vocabulary gets increasingly difficult as they progress through their academic school years.

Spor (2005) states that eventually students are no longer taught to read but are expected to gather information from reading. Gough and Wren (1998) conclude that skillful readers build up a reading lexicon over and above the orthographic cipher-not separate from it. This lexicon contains specific knowledge of words, including spelling and pronunciation of irregularities and exceptions. The larger the vocabulary a student has determines the level of success a student will have in school and ultimately later on in life (Hart & Risley, 1992).

Word recognition will improve by reading whole sentences and interconnected text. Repetition appears to be important. Repeated readings is a process in which students practice reading the same passage until they are able to read it with speed and accuracy to meet a certain criterion such as 50 words a minute. Samuels (1979) says that this intervention was initially introduced to increase a student's ability to read fluently. He conducted a study where students read a short passage to a teaching assistant four consecutive times. Each time the students read, the teaching assistant recorded the students' accuracy and speed of each reading. At the end of the study, he noted that many of the students' reading rates increased and their number of errors decreased.

Many researchers have used repeated reading strategies to augment the reading fluency of students. (Fuchs, Fuchs, & Burish, 2000; Koskinen & Blum, 1986; Koralek & Collins, 1997; Rashotte & Torgesen, 1985; Strickland, Ganske, & Monroe, 2002; Topping, 1995). Rashotte and Torgensen (1985) used repeated readings to enhance the fluency of students with disabilities. The researchers examined the effectiveness of the repeated reading strategies. Their main focus was to gain knowledge about the types of reading passages that were being utilized in the repeated reading studies. The researchers analyzed the use of non- repetitive reading versus repeated reading to see which had the greater impact on fluency. Participants in the studies also read different passages instead of reading the same passage over and over. Adams (1990) found similar findings. He reports that repeated reading of sentences and passages produce marked improvement in students' word recognition, fluency, and comprehension. Adams found that repeated readings over time of passages with a large overlap of words seem to be more effective than repeated readings of passages containing mostly different words. Dowhower (1987) conducted a study with a group of transitional second grade readers. He also used the repeated reading strategy. The participants in this study were reading at or above grade level in one area of reading but were below grade level in fluency. The 19 participants were assigned to either the assisted repeated reading group or the unassisted reading group. The study yielded several outcomes. There were significant increases in the students' fluency, accuracy, and comprehension scores for both groups. Although all participants were below grade – level at the beginning of the study, both groups made significant gains in reading and were on grade level at the end of the study. The results of the study also concluded that novel passages were a more accurate measure of fluency. Chall (1983) also stresses the importance of the opportunity to read familiar books with familiar stories or characters.

Repeated reading strategies have been refined since Samuels conducted the first study in 1979. Now researchers have developed repeated reading procedures to bolster students' comprehension. With the incorporation of error correction and multi-component methods, repeated reading augments students' fluency abilities, especially those students who are struggling readers.

Reading Problems

Perfetti (1985) considers weakness in basic decoding skills as the most common source of reading difficulties. The group-focused nature of the instruction and didactic approach used by basal reading programs can exacerbate that weakness. An individual student's need for explicit instruction in decoding skills and extensive practice on the appropriate level can be overlooked by the teacher, particularly when most other classmates show fully developed pre–reading strategies.

A considerable body of evidence from research indicates that approaches that combine systematic code instruction with meaningful connected reading result in superior reading achievements (Adams, 1990; Chall, 1967; Gough & Wren, 1998). This finding may, however, require further qualification given the findings of Juel and Minden–Cupp (2000). Drawing on extensive observations in four classrooms, they postulated that children who enter first grade with few literacy skills benefit from intensive instruction in phonics during the first months of teaching. On the other hand, children who enter first grade with more advanced pre-reading skills seem to benefit more from a less structured phonics curriculum and one that includes a great deal of connected text reading and writing (Blok et al., 2002).

Armbruster (2010) states that phonemic awareness is the ability to notice, think about, and work with the individual sounds in spoken words. Some students show a persistent lack of phonological skills or, more specifically, phonemic awareness. This is not always due to poor coordination between the individual's educational needs and the teachers' instructional strategies or reading basals. Unfortunately, many confuse phonemic awareness and phonics (Armbruster, 2010). One is the understanding that spoken language sounds make words- (phonemic awareness) while the other is the understanding that a relationship exists between graphemes and phonemes (phonics).

According to the phonological deficit hypothesis, the primary cause of dyslexia is an inefficient phonological processing system, which provides less clear sound representations (Shaywitz, 1996). This phonological deficit seems to affect not only reading but also skills such as the pronunciation of difficult words, which develops in an earlier phase. The evidence supporting this hypothesis is growing (Bruck, 1998; Metsala & Brown, 1998; Snowling, Goulandris, & Defty, 1998).

Phonemic awareness impacts other elements of reading (Charles & Charles, 2012). Strong phonemic awareness supports children's abilities to decode and comprehend what they read. Focusing on phonemic awareness instruction is reported to have the greatest impact on young readers- pre-kindergarten, kindergarten and the first semester first graders. Intensive phonemic awareness is instruction is a must for at- risk and struggling readers.

Achieving phonemic awareness has not been deemed easy for many children (Reading First in Virginia, 2010). Roughly 25% of middle-class children and substantially more children from less economically advantaged homes fail to develop phonemic awareness capabilities. However, research shows that phonemic awareness can be developed through instruction that will ultimately hasten students' reading and spelling development.

Longitudinal research indicates that students who struggle with fluency late in kindergarten or early first grade tend to have persistent problems with reading development (Speece & Ritchey, 2005). Bursuck and Damer (2011) argue another factor closely aligned with reading risk and oral reading fluency is reading growth rate. Reading growth analyses have determined that reading fluency gains were greater in the primary grades and materialize in the fall (Christ, Silberglitt, Yeo, & Cormier, 2010).

Traditional classroom instruction does not support the learning abilities of students who have one or more learning disabilities and struggle as readers (Rouse, Kreuger, & Markham, 2004). Thus the push for "help" is computerized assisted instruction to support student achievement. There also is some evidence – albeit less strong – to support the hypothesis that an automatization deficit plays a role in poor reading. Students suffering from dyslexia seem to have more problems than do other students in carrying out more than one task at a time (Nicolson & Fawcett, 1990; Yap & van der Leij, 1994). Wimmer, Mayringer, and Landerl (1998), however, could not replicate these results, possibly because they excluded students with attention deficit hyperactivity disorder from their experiment.

Children are also at risk for reading failure if they have less experience and skill using the alphabet ("Phonological Awareness", 2013). We have taught children whose only experience with the alphabet came while they were at school. They were not afforded opportunities to print at home or at the public libraries. We have seen a decline in the number of parents who read to their children (Bury, 2013). Parents stated that stress and a lack of time were two main reasons they don't read to their children. These circumstances have considerable effects in the classroom- children are not ready to become good readers. Is motivation a factor for reading failure? Why don't children like to read? Reading Is Fundamental (2013) points out that children don't like to read because they believe it is hard, no fun, boring, and unimportant. Some strategies suggested to bolster their desire to read were: having various types of literature around the home, letting them see adults read, playing reading related games, and scheduling a daily reading time.

Most Relevant Sub–Skills

Learning to read involves acquiring different forms of knowledge and skills. We have identified the following relevant sub–skills as the most important components in the phase of beginning reading instruction:

- Phonological awareness, including such phonemic sub–skills as blending and segmenting
- Letter identification and knowledge of letter-sound correspondence (orthographic cipher)
- Word identification and recognition skills, directed both at accuracy and speed
- Text reading, directed at increased speed and fluency and more efficient use of context (Blok et al., 2002).

Computer–Assisted Instruction and Student Achievement

Fletcher (1972) reports that computers have been used as a teaching tool since the early 1970s. Stanford University developed a computer- assisted reading program in the late 1960's (Fletcher & Atkinson, 1972). Individualized reading instruction was created for students in grades kindergarten through third. With the exception of one posttest, students who used the CAI scored higher than those students who did not use it.

Researchers became interested in computers in the mid-1980s. Marsh (1983) states that computers were so expensive and therefore were deterrence for using them. Now, that is quite the opposite! Several studies in the mid-1980s focused on the usability of computer software programs and not their effectiveness. Many studies published in the mid-1980s provided knowledge of different software programs that were designed to teach basic reading skills (Bradley, 1984; Candler & Johnson, 1984). The implementation of computer based reading interventions with preschool, fourth, and sixth grade students was the basis of two studies conducted in the late-1980s (Bass, Ries, & Sharpe, 1986; Gore, 1989). The study of the struggling fourth and sixth graders compared the math and reading scores of two groups. There was a control group and an experimental group. In addition to their regular classroom instruction, the students in the experimental group completed 10 to 15 hours of additional computer-assisted instruction. Students in the control group received regular classroom instruction and non-computerized supplemental instruction.

The results of the groups were mixed across the grade levels. The traditional classroom instruction and microcomputer groups of fourth graders showed improvement in their scores on both the reading and math post-tests. However, the groups of fifth and sixth graders had mixed results. The fifth graders improved their scores in reading but had split scores in math. The sixth graders results' mirrored those of the fifth graders in reading but fell slightly in math.

What effect did CAI have on diverse student populations? During the late 1980s and early 1990s, researchers began to ponder and explore that question. The primary population caught their attention. Researchers discovered that CAI was the difference between students being successful readers and at school.

Gore (1989) conducted an experiment with disadvantaged five-year old preschool students. He was interested in how well they could learn to read with the computer as a learning tool. The participants were administered a standardized reading test at the beginning of the school year. At the end of the school year, they were administered the standardized test again. During the study, each participant was taught specific pre-reading skills via computer software. Their respective teachers were not allowed to drill and practice the skills that were being taught by the CAI. The researcher was also interested in how well the participants could operate the computers without assistance from their teachers.

The results were favorable. First, the participants were able to operate the computers with almost little or no assistance from their teachers. A comparison of the pre and post tests revealed that the students were closer to grade level than at the beginning of the study.

Computer–assisted instruction (CAI) has been identified as an effective strategy to improve the achievement of at–risk students. With the advancement of technology, the use of computers in schools has rapidly increased over the last 20 years. By 1996, statistics showed that 70% of fourth graders and 50% percent of eighth and eleventh graders were using a computer at school at least once a week, while less than 20% did so 20 years ago (U.S. Department of Education, 2002). Accordingly, the use of technology to improve student learning has become one of the major emphases in the current education reform as expressed in the No Child Left Behind Act of 2001 (Barley et al., 2002).

Researchers have argued that computer–assisted instruction has the potential to alter the nature of teaching from the traditional, teacher–centered model to a more student-centered instruction approach which especially benefits students at risk (Waxman & Huang, 1996; Waxman et al., 2001). Given the current reform focus on low achievers in high–poverty schools and the promise of computer–assisted instruction to improve the achievement of this population, synthesizing the effectiveness of computer–assisted instruction based on the available empirical studies can provide important information for policymakers and educators.

The first way technology was used in the classroom was a surrogate teacher. Technology was used to teach the traditional curriculum and basic skills, operate as a means to deliver instruction, and supplement the teachers' classroom instruction (Fouts, 2000). Research from the last forty years has been reviewed and summarized many times in various avenues.

At John Thorp Elementary School in Chicago, Illinois, 30 students participated in a study to measure the effectiveness of computer–assisted instruction (Arroyo, 1992). Half of the students received an intensive computer–assisted instruction for one school year. Their scores on the Spring Iowa Test of Basic Skills indicated that there was a significant increase in the achievement of those who used computer–assisted instruction. Fifth graders in Katy, Texas used Soloway's Go Know software last school year and outperformed other fifth grade students on standardized reading and math assessments ("Ed Tech Stats", 2010). The mobile learning allowed students to complete lessons that were created and individualized by their teachers to meet their needs.

Schools in other countries around the world also use computer–assisted instruction in their classrooms. At a primary school in Central Denizil, 253 students were a part of a study that wanted to determine the effect computer–assisted instruction had on the academic achievement of a seventh grade Physics science class (Kara & Kahraman, 2008). The students who used computer–assisted instruction had scores that were nearly two times higher than the control group.

Not all of the computer usage findings are favorable. A study was designed to determine whether children's text recall and comprehension was affected by presenting text on computer monitors (Kerr & Symons, 2006). The children read more slowly on the computer and were less efficient at comprehending what they had read. Computers have also been used to teach algebra to students. Walker and Senger (2007) conducted a study to determine the impact computers had on students learning how to solve linear equations. There was no significant difference between the groups. The Organization for Economic Co- operation and Development's Programme for International Student Assessment 2003 study found that students using computers most frequently at school did not necessarily perform better than students using technology less frequently (Lei, 2010).

Computer–Assisted Instruction and Learning Rate

Current reform efforts see technology as a vital component of a new educational paradigm in which the curriculum, teaching methods, and student concepts are reconceptualized (Means, 1994). Students make academic gains and acquire knowledge faster with computer–assisted instruction.

For example, students' learning rate is faster with computer–assisted instruction than with conventional instruction (Capper & Copple, 1985). Their research led to the conclusion that computer–assisted instruction users sometimes learn as much as 40% faster than those receiving traditional teacher directed instruction. Batey (1986) reported positive effects of all computer use for elementary school students. He researched computer–assisted instruction, computer games, and the use of computers in language arts. Kulik and Kulik (1987) reviewed 200 studies of computer–based instruction at the elementary, secondary, and university levels. They found favorable results for learning time and attitude towards computers.

On the other hand, there are results that state quite the opposite. Some studies suggested that technology use might even harm students and their learning (Healy, 1998). In a sixth grade science class, computer usage restricted inquiry instead of promoting it (Waight & Abd-El-Khalick, 2007). A study of the Trends in International Mathematics and Science Study (TIMSS) reported that technology use was negatively related to science achievement among eighth graders in Turkey (Aypay, Erdogan, & Sozer, 2007).

Lexia ® Reading

Lexia Reading v5 is a computer-delivered supplemental reading program (Doe, 2008). Reading can be taught and improved at all grade levels for students and offers a complete range of data collection and reporting features. This data can be used to guide and inform student instruction. Another great feature is the program can be accessed at just about anywhere- school, home, or libraries.

After students are given their initial assessment and placement, they begin working at their own level and pace. *Lexia Reading v5* combines three Lexia programs with several new features (Doe, 2008). First, *Lexia Early Reading* or Level 1, is where students practice basic phonemic skills which include rhyming, blending, segmenting, and identifying beginning and ending sounds. They begin to practice letter-sound correspondence for consonants, short vowels, and digraphs at Level 2.

Doe (2008) states that *Lexia Primary Reading* covers the reading levels of Pre-K through grade 3. Speed and accuracy is developed using phonics skills to foster automatic word recognition. This is also the primary goal of Headsprout to bolster students' fluency and thus comprehension abilities. Students work independently through the program's five levels of reading skill development. The program addresses: phonological awareness, phonics/phonological awareness, automaticity/fluency, vocabulary, and comprehension. All components are the ingredients the NRP says are needed for a balanced reading program (NRP, 2000).

Has Lexia Reading triggered any significant results in students' literacy skills? Three separate studies have shown that kindergarteners who used the Lexia Reading program saw an increase in their early literacy levels (Lexia Learning Systems, 2014). The first study was conducted at a school in an urban community outside of Boston, Massachusetts (Macaruso & Walker, 2008). Three teachers, who taught kindergarten- a class in the morning and a class in the afternoon, and their students participated in the study. A total of 38 students were in the treatment group while 45 students were in the control group.

The treatment group began using *Lexia Early Reading* in November 2003 and used it for six months. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) was given to assess their preliteracy and post literacy skills. At the end of the school year, the *Gates-MacGinitie Reading Test, Level PR(Pre-Reading)* was also given to assess their preliteracy skills. There were no significant differences in the two groups' pretest scores. However, on the *Gates-MacGinitie Reading Test,* there was a significant difference between groups on the oral language (phonological awareness) sub test. The treatment group's mean average was two points higher than the control group's mean average. Low performers' scores in the treatment group were also higher than low performers' scores in the control group.

The second and third studies conducted by Macaruso and Walker (2008) compared the early literacy gains of preschool and kindergarten students who used Lexia Early Reading and Group Reading Assessment and Diagnostic Evaluation (GRADE). The first grade test measured phonological awareness, early literacy skills, letter-sound correspondence, listening comprehension, and word reading. The treatment group's scores were significantly higher on the word reading component. The preschool test measured phonological awareness, visual skills, conceptual knowledge, and listening comprehension. Again, the treatment group's scores were significantly higher than those of the control group.

Read Naturally ®

*Read Naturally (*RN) is a computer assisted supplemental strategy that was designed to improve reading fluency (Read Naturally, 2014). To achieve fluency, RN employs three empirically-supported techniques: teacher modeling, repeated readings, and progress-monitoring. First, students' fluency levels are assessed using curriculum-based measurement procedures (Hasbrouck & Tindal, 1991). Results are used to place students in either the primary grades (reading 40 – 60 wcpm) upper grades (reading 60-80 or 80-100 wcpm). An achievable fluency goal is set with the teacher's input. Then, the instructional program begins.

The creator of RN, Candyce Ihnot, worked with students who scored below the 40th percentile on the Minnesota Spring standardized test (Hasbrouck et al., 1999). She collected Oral Reading Fluency (ORF) data for six years. Participants were 214 second and third grade students who used RN for approximately 32 weeks. The second graders showed gains of 1.68 wcpm/week. Third graders showed gains of 1.60 wcpm/week. The average ORF scores for these students in the fall of each year fell below the 25th percentile of the ORF norms (Hasbrouck & Tindal, 1991), but increased to between the 25th and 50th percentiles by the spring.

ORF in kindergarten and first grade depicts children's future reading proficiency levels (Baker et al., 2008). Another study used RN to ascertain if it would affect the reading of eight African American first grade students (Gibson, Cartledge, & Keyes, 2011). Participants were given the DIBELS winter benchmark for ORF and Nonsense Word Fluency (NWF) as a pretest and posttest. They participated in the program for 14-16 weeks. At the end of the study, the posttest results showed that all of the participants had made substantial gains in ORF.

Headsprout® Early Reading Program

Headsprout Early Reading is a supplemental beginning reading program for students in kindergarten through 2nd grade who are not yet reading or who are in the beginning stages of the reading process (Florida Center for Reading Research, 2003). It was designed to teach the critical skills needed to become a fluent reader. It captures the young readers' attention through the use of engaging and highly interactive activities. Because it provides one-on-one instruction, Headsprout Early Reading serves as an on-line tutor.

Schools receive access to Headsprout's on-line lessons, automated classroom and individual student progress reports, a teacher's guide, phonics-based flashcards, and a license to download and print all 70 Headsprout stories and progress maps from the Headsprout website. Students always have access to the latest software since upgrades for *Headsprout Early Reading* are automatic and free.

Headsprout Early Reading is comprised of two parts: *Headsprout Reading Basics*, which are lessons 1-40 and *Headsprout Reading Independence*, lessons 41-80 (Headsprout, 2007). Students are trained in all of the mouse movements and types of activities they will encounter in the program before they actually begin the program. Students work independently 3-5 times a week with animated, on-line lessons or episodes lasting that last approximately 20 minutes. Lessons, which begin with easier skills that eventually increase in level of difficulty, build upon each other through guided practice, repetition, and cumulative review. Instruction includes securing the alphabetic principle, beginning and advanced decoding strategies, developing fluent reading and deriving meaning from text. A snapshot view of what a student should accomplish at various points in the program is also detailed.

Many unique characteristics of *Headsprout Early Reading* facilitate the student's acquisition of early reading skills. First, in an attempt to reduce errors, the necessary skills and strategies of reading are broken into their component parts (Twyman, Layng, Stikeleather, & Hobbins, 2004). Students are successful with the lesson's objectives because each lesson is explicitly, sequentially and systematically designed to lead to student mastery. Another important aspect is the program's ability to adapt to the unique needs and pace of each student, allowing some students to move through lessons quickly while others who require extra practice are given more instruction. This is accomplished by the technology responding to a student's pattern of errors. A series of correction procedures exist that are sequenced by the intensity of support they offer students. Depending on the student's response, immediate feedback is given and a simple error correction is begun. If the student persists with the error, a more supportive correction routine is supplied, additional learning and practice opportunities are created, or, the skill is taught again and students are returned to the original task. The program adapts to a child's responses, providing additional instruction and review if a child does not choose the correct answer. Teachers may use stories based on the episodes to reinforce instruction provided in the lessons. The pedagogical framework within each episode of *Headsprout Early Reading* is designed such that students only exit after they have achieved mastery of the lesson's key objectives. This particular feature of *Headsprout Early Reading* increases a student's likelihood of success in the following lesson.

Headsprout Early Reading incorporates the National Reading Panel's and Reading First's five critical components of reading instruction: phonemic awareness, phonics, fluency, vocabulary and comprehension. Phonemic awareness instruction is interwoven throughout many of *Headsprout Early Reading's* teaching routines (Layng, Twyman, & Stikeleather, 2003). Students hear letter sounds in order to select visual stimuli, and then hear them again as confirmation of selections. Students say the sound and then listen to the animated characters say the sounds. Then, they select the character that said the sound they said. Students are given multiple opportunities to put the sounds together to make words. Students work with individual sounds or blends in isolation. Then they identify the target sounds in the context of a word. Students practice seeing, hearing, and saying individual sounds. In the meantime, they are being taught that the sounds they hear are part of words. The sound-letter association, or alphabetic principle, is established immediately through sound isolation, segmenting, blending, and manipulation exercises.

Students learn 84 carefully chosen phonetic elements which mainly appear in nearly 85% of the words in which they appear. This is critical in ensuring the transfer of segmenting and blending skills which are learned in the program. This facilitates the natural outcome of reading in a social environment to become the critical consequence for reading.

Headsprout has also addressed the student and teacher concerns about English language rules. Students are expected to learn to read by memorizing rules that dictate sound/letter associations. The English language uses 26 alphabet letters that symbolize 44 sounds that can be written in over 400 ways. *Headsprout Early Reading* begins with consistent sounds and letters such as "v", "cl", "ee", and "an". Students will learn the word correctly because the sounds that students are taught are read the same way.

A critical foundation for learning early vocabulary is also a part of *Headsprout Early Reading*. The program teaches that words are made of sounds and when the sounds are put together, they have meaning. These sounds make sentences which eventually turn into stories. Students add words to their spoken vocabulary as they sound out new words and selected sight words. The animated characters' names enable the students to learn that words they may have likewise never encountered. Once the students have mastered the sounding out skills and all of the sound elements, they should have amassed a reading vocabulary of over 5,000 words.

A vital facet to all *Headsprout Early Reading's* activities is fluency. LaBerge and Samuels (1974) point out that fluency at the skill level is critical to fluency at the composite skill level. Beginning at Episode 1, students engage in oral fluency building activities for discriminating sounds in words (Layng et al., 2003). By Episode 4, students are building oral fluency on words made up of the sounds they have learned in earlier lessons. Students read their first story by Episode 5. Before long, students have many opportunities to practice reading entire passages in precisely designed oral fluency activities. Over 50 oral fluency building opportunities are embedded throughout *Headsprout Early Reading's* 80 Episodes. Students will have read 70 individual stories in about 30 instructional hours. Most of the stories, which are narrative and expository, consist of as few as three sentences and grow into chapter books.

Throughout the *Headsprout Early Reading* program, strategies are in place to monitor the students' levels of comprehension. Indicators teach the students to self-observe as well as story and sentence comprehension. After completing the reading exercises, students must identify one of three pictures that go with the sentence (Headsprout, 2007). The pictures are carefully selected to determine if the students have read and understood the stories. Episode 5 initialized the concept that sentences are more than words and that they have meaning. Eventually students will transition to more challenging reading comprehension activities which include constructing meaning by building sentences that result in an animated picture that represents the sentence, completing sentences that best describe a picture by selecting a missing word from four alternatives, and reading a text passage and selecting the best answer to a written question from among three written alternative answers.

The prekindergarten curriculum is made up of forty 20-minute animated episodes (the first half of the 80 episode K – 2 curriculum), 30 stories, and 100 printable flashcards. Animated cartoon characters guide children through interactive episodes in locations such as outer space, under the sea, or the land of the dinosaurs (Headsprout, 2007). Children use the mouse to navigate through the episode; for example, helping a worm get home by identifying from among four pairs of letters, the letters that represent a sound they learned. The worm moves closer to his hole with each correct answer. The curriculum provides individualized, adaptive instruction, and students work through the lessons at their own pace. The program responds to a child's pattern of errors with tutorials and reviews to provide extra assistance to children struggling to comprehend the material. Children must meet specific performance criteria in order to progress to the next lesson. Cumulative review is built into the curriculum to help ensure retention. Printed versions of stories in the episodes are found in six *Headsprout®* Readers. The stories only contain material that children have learned up to that point in the curriculum.

The Readers serve to reinforce the skills taught during the series and provide children with the opportunity to practice basic reading. The program generates performance reports, allowing teachers to monitor their students' progress.

What are the *Headsprout® Early Reading Program*'s results? Has *Headsprout® Early Reading* been successful in its endeavor to ensure that it helps to eliminate illiteracy in young non–readers and struggling readers around the world? Let's examine what the literature has to say about the effectiveness of the *Headsprout® Early Reading Program*.

Several studies have investigated the efficiency of *Headsprout® Early Reading Program*. The laboratories of *Headsprout® Early Reading* completed the first developmental and validation testing of the program in 2001- 2002 (Florida Center for Research, 2003). Participants were 241 beginning readers who had little or no understanding of the alphabetic principle. During the program, they answered 94% of the responses correctly.

In 2002, the Seattle School District used the *Headsprout® Early Reading Basics Program* in one Title I kindergarten class (Layng et al, 2003). All of the students scored above grade level and 82% of the students scored early to mid-first grade. In 2003, 16 kindergarteners at that same school participated in 12 – 15 weeks of *Headsprout® Early Reading* instruction. This occurred during the ninth and tenth months of kindergarten. The students' scores on the Woodcock –Johnson Word Identification subtest showed pretest scores of .4 and post test scores of 1.3.

Subsequently, Huffstetter (2005) examined the effect of *Headsprout® Early Reading* instruction on 31 kindergarten students' academic progress. At the end of her study, she concluded that *Headsprout® Early Reading* created a positive statistical outcome on the students' oral language development and print knowledge.

During the 2003-2004 school year, PS 106 Elementary School in Brooklyn, NY also used the *Headsprout® Early Reading Program* as a supplemental reading program (Headsprout, 2007). Half of the kindergarten and first grade classes received 180 minutes of reading instruction daily while the other half received 180 minutes of reading instruction daily plus *Headsprout® Early Reading* instruction 3 – 5 times a week. Students who used the program made significant gains in letter word identification, word analysis, reading words, and reading comprehension.

At Budlong Elementary School in Los Angeles, five kindergarten teachers used *Headsprout® Early Reading* in addition to their curriculum while one kindergarten teacher only used the curriculum and its resources. Both groups had the same amount of reading instruction time. The five kindergarten classes used the *Headsprout® Early Reading Program* 3 – 5 times weekly for about 20 minutes each session. Results from the Gates–MacGinitie Reading Test given in Spring 2005 showed that the *Headsprout®* group made significant gains than their counterparts.

First grade students at Budlong Elementary School also used the *Headsprout® Early Reading Program*. Four first grade classes used *Headsprout®* while the other eight classes did not. Pre and post test scores from the Gates–MacGinitie were analyzed. Once again, the students who used the *Headsprout®* program had made significant gains than those who had not used the program.

Another success story comes from a private elementary school in New York that used *Headsprout®* during the 2002 – 2003 school year and ensuing school years. They saw their students scoring well above grade level on the Iowa Test of Basic Skills. However, before *Headsprout® Early Reading* became an enhancement to their instructional program, their first grade students had been scoring below grade level on the Iowa Test of Basic Skills.

Students with disabilities and special needs students have benefited from exposure to *Headsprout® Early Reading*. ADHD students also used *Headsprout®* as an intervention for beginning reading instruction (Clarfield & Stoner, 2005). *Headsprout® Early Reading* improved the students' levels of task engagement and oral reading fluency. At the Judge Rotenberg Educational Center in Massachusetts, *Headsprout® Early Reading* usage significantly decreased the disruptive behavior and improved the reading skills for five autistic students (Headsprout, 2007).

During the summer of 2003, 13 students who had scored below their grade level on Woodcock Johnson III Tests of Achievement and Iowa Test of Basic Skills began using *Headsprout® Early Reading* under parental supervision at their prospective homes. After summer use, they were all retested. Results showed substantial growth for eleven of those thirteen students on those same tests (Headsprout, 2007).

Several kindergarten students from a school that did not meet AYP were selected to participate in another Headsprout study (Hammond, 2012). These students were selected based on their DIBELS data and AIMSWeb winter benchmark scores. The students engaged in Headsprout lessons five times a week and classroom instruction too. All students showed progress on their sound and word assessments. They also showed gains in prereading and reading skills.

Not all *Headsprout® Early Reading* studies have been favorable (Cavanaugh et al., 2007). The effectiveness of *Headsprout® Early Reading* was analyzed when it was used as a supplemental online reading program to bolster five struggling third graders' decoding skills. Although they mastered reading skills with *Headsprout® Early Reading* with a 97% mastery rate, it did not impact their reading ability or alter their reading level at all. The researchers did note that they believed that *Headsprout® Early Reading* would have improved the students' abilities if it had been implemented earlier or at the beginning of the school year.

The review of the literature shows positive results for implementing *Headsprout® Early Reading* as a supplement or intervention strategy. Although one study was found that didn't show any growth, researchers believe that the students might have shown more growth if the program had been used for a longer period of time. There is a correlation between *Headsprout® Early Reading* instruction/usage and positive student oral reading fluency/reading achievement gains.

Teachers' Perceptions about Technology

Technology integration has been thrust upon teachers for several years. Technology is a component of a good lesson. However, how do teachers really feel about technology integration? Are they comfortable using technology in their daily teaching? Li and Ni (2010) conducted a study that compared students' and teachers' beliefs about technology. Amazingly, the students welcomed using technology! On the other hand, teachers seemed to possess a negative attitude towards using technology in the classroom. This standpoint was attributed to being replaced by computers as the teacher.

Teachers' beliefs about the role technology plays in teaching and learning augmented technology integration (Garthwait & Weller, 2005). Mathematics and science teachers were more receptive to using technology because they believed that using the Internet and its resources motivated students to learn and kept them engaged. It also promoted more meaningful student interactions and communication.

Novice teachers embraced using technology in the classrooms (Yuen & Ma, 2002). Although this was based on how often they personally used computers and technology, many thought that technology should be a part of their teaching routine. They made great efforts to include technology in their lessons.

Pelgrum (2001) realized that there are many obstacles that deter teachers from integrating technology in the classrooms. First, schools have an insufficient amount of computers to serve a real purpose. Many teachers encounter difficulty integrating technology in the content areas. Third, there is an inadequate number of technical support staff to meet the needs of every school.

Technology and Student Motivation

Technology integration has been thrust upon teachers for several years. Students become bored if learning tasks are too easy and frustrated if they are too difficult (Lumley, 1991). When students use technology, it increases their motivation to learn. Research has shown that the effective integration with classroom practices will impact student achievement and motivation.

Sivin-Kachala and Bialo (1994) found that students' attitudes toward learning and student concepts were both found to be consistently increased in a technology-rich environment in 176 studies conducted between 1990 and 1994.

Cotton (1997), in an extensive literature review, found that computer-assisted instruction results in improved student attitudes in a variety of areas. These areas included improved attitudes towards themselves as learners, the use of computers in education, and towards computers in general, course subject matter, quality of instruction, and school in general. Studies cited by Cotton also indicate that computer-assisted learning results in higher levels of self–efficacy, higher school attendance rates, increased time on task, and increased social behavior.

Coley, Cradler, and Engel (1997) discovered that computer-based instruction can individualize instruction and give instant feedback to students and even explain the correct answer. (Kulik, 1994) determined that students develop more positive attitudes toward computers when they receive help from them in school and that students usually learn more in classes in which they receive computer-based instruction. Students' increased motivation for learning with technology is related to ease of error correction, semi-private environment, increased self-esteem, active control of their immediate environment, and ability to work at their own pace (Underwood & Brown, 1997).

Long (2007) conducted a study with a first-grade teacher that involved 16 students. Reading instruction was delivered using a sound field amplification system. The purpose of the study was to determine if using the sound field amplification system to deliver reading instruction would result in phonemic awareness and phonics achievement. Posttest results indicated a small increase in phonemic awareness and a larger increase in phonics skills over pretest results. Student and teacher interviews revealed positive effects on student attitudes and engagement from the intervention.

Amolo and Dees (2007) investigated the influence of interactive whiteboards on student learning of social studies. It also examined students' perceptions of instructional technology. Twenty-six students from a fifth grade class participated in the study. Both qualitative and quantitative data collection methods were used to assess student perceptions and student learning during the intervention. Results of the research indicated that student perceptions of technology were positively influenced. Additionally, student learning and engagement increased when the interactive whiteboard was used.

Brown and Schmertzing (2007) examined the learning experiences of 8 third through fifth grade elementary students in a media-rich after-school program designed to increase reading skills through enrichment instead of remediation. The use of technology to enhance and accelerate lower achieving students provided an increase of interest in technology, an increase in perceptions of after-school programs, an increase in reading skills, and an excitement to participate and remain in the program. Students used technology to create stories, take photographs, learn reading skills, and review classroom instruction.

Moody (2007) investigated the use and impact of a computer-assisted instruction (CAI) program, MySkillstutor. It was used during directed teaching lessons and during independent practice sessions in a voluntary after-school tutoring program. It focused on increasing students' proficiency in these reading skills: main idea, inference, and cause and effect. Twelve students from either third or fourth grade participated in the 4-week study. Student experiences while using the CAI program were observed and documented, as was student and teacher interaction. Student preconceptions and perceptions about the use of computer-assisted instruction were identified through pre- and post-opinion surveys. Reading comprehension skills improved and students showed interest in additional after-school tutoring programs involving computer use.

Summary

This chapter reviewed literature connected to the process of beginning reading, prereading skills, acquiring fluency, and computer- assisted instruction. Research has shown that children who lack a strong foundation in phonemic awareness, phonics, and fluency are at risk of being labeled a poor reader or a reading failure risk. Technology has evolved to support children in overcoming their reading deficiencies. Many examples in this chapter attest to that.

Technology has often been regarded as the "silver bullet" in resolving important concerns in the U.S. educational system today. School districts spend a substantial amount of their budgets purchasing and maintaining various types of instructional technology. Instructional technology informs teaching and engages students. Instructional technology has become the “teacher’s assistant.” Technology is expected to make the difference in children’s academic learning. Thus, the importance of having well trained teachers and staff to ensure that the CAI are implemented with fidelity.

According to Kulik, Bangert, and Williams, (1983) programs for computer–assisted instruction have come a long way since they were developed over 20 years ago. There are favorable results for using computer–assisted instruction. All of the CAI mentioned in this chapter have gotten proven results. A review of the research has supported those findings (Fouts, 2000). The positive outcomes cannot be only attributed to the CAI. Other factors such as teacher preparedness, availability of CAI, and unwavering support have contributed to the success of CAI. However, one barrier may be the main reason many schools and school districts deter from using CAI to boost student achievement and motivation. They simply cannot finance CAI.

Computer–assisted instruction does increase students’ learning of the basic skills. The immediate feedback provided by interactive terminals keeps students interacting and eager to keep trying (Sen, 2014). Computer–assisted instruction plus traditional instruction yields higher student achievement. Even weaker students are obliged to participate actively (Sen, 2014). Computer–assisted instruction promotes learning retention and allows students to learn information quickly. The computer will wait patiently for an answer and does not express annoyance with wrong response (Sen, 2014). Computer–assisted instruction helps students develop a positive attitude toward learning. Computer–assisted instruction appears to be a promising strategy to use with struggling and low achieving students. In essence, computer–assisted instruction can be used to support all students!

CHAPTER 3

Methodology and Procedures

Overview

This Regression- Discontinuity Data (RDD) research study was designed to investigate the effects of *Headsprout® Early Reading*, a computer–assisted instruction program (CAI), for students in the second grade who were struggling with oral reading and grade level comprehension skills. It was anticipated that this study would show that *Headsprout® Early Reading* instigated statistically significant growth and improvement in students' oral reading and comprehension abilities. The enactment of the No Child Left Behind Act (2001) has focused attention on accountability for student performance, especially in the areas of Reading and Mathematics (U.S. Department of Education, 2006).

The use of technology in classrooms has changed the way students learn. Technology has saturated the majority of their instructional day. This research study served as a platform for school administrators, teachers, parents and other stakeholders to answer questions about whether computer–assisted instruction, traditional instruction, or a combination of both types of instruction fosters student achievement. This chapter is divided into the following sections: research approach and design, pilot study, participants, consent procedures, instrumentation, procedures, data collection and recording, data process and analysis, methodological assumptions, and limitations.

Research Approach and Design

Research Approach. This Regression- Discontinuity Data design (RDD) research study was designed to provide information regarding whether computer–assisted instruction, traditional instruction, or a combination of both types of instruction fosters student achievement. By evaluating the school data on reading scores, the researcher developed data collection instruments and did not inject personal bias in the data collection process or in the results of data collected. The ultimate goal of the research was to determine if the use of *Headsprout® Early Reading* improved the development of reading skills and problem solving skills that will improve student performance and achievement.

Design. This research study design incorporated the components of *Headsprout® Early Reading Program*, a computer–assisted instructional program. The researcher used a Regression-Discontinuity Data (RDD) design method. The regression discontinuity data design (RDD) is a quasi- experimental design with the defining characteristic that the probability of receiving treatment changes discontinuously as a function of one or more underlying variables (Hahn, Todd, & van der Klaauw, 2001). The goal is to determine the effect that variable x has on the outcome y. The evaluation problem arises because people either receive or do not receive the treatment. More importantly, no one participates in both settings. Regression-discontinuity provides a means of characterizing how the mean treatment influences a subgroup under minimal assumptions.

Regression discontinuity design can be effective as long as certain ideas are satisfied (Stanley & Robinson, 1986). First, students who meet the pre-intervention cut score are not placed in the program and those who do not meet the cut off score are the treatment group (Matthews, Peters, & Housand, 2012). The intervention, in this case *Headsprout Early Reading*, would be given over a period of time. At the end of the study, the dependent variable or benchmark assessment, will be administered again to both the control and treatment groups. A full range of data would be collected to assess a discontinuity in the area around the cut off score. It also would show a comparison of similar individuals but received different treatments. This design also included the Headsprout early literacy curriculum which consists of eighty 20–minute animated episodes, scores from the placement assessments and benchmark interventions.

Pilot Study. A pilot study using *Headsprout® Early Reading* was conducted during the 2010 – 2011 school year at the selected school. Participants were 106 second graders. The *Headsprout®* Placement Assessment, designed by *Headsprout®*, was administered to all participants. Participants were placed in two categories. Category 1 or Treatment Group was participants that did not meet the cut–off criterion set by the program. Category 2 or Control Group was participants that met the cut–off criterion set by the program. Participants that did not meet the cut–off criterion were identified as participants who needed additional intervention and support in Reading. The treatment group was comprised of these participants.

The instructional components of *Headsprout® Early Reading* were implemented by the teachers, the computer lab instructor and the grade level interventionist. Formal and informal assessments were used to monitor the progress of the treatment group. Instruction, intervention strategies, and benchmark assessments were utilized for a period of 12 weeks. The control group was comprised of those students who met the cut–off criterion of the program. Components of *Headsprout® Early Reading* were not accessed by them at any time during this study. At the end of the study at the selected school, teachers readministered the *Headsprout® Early Reading* Placement Assessment. The researcher analyzed the results to compare the differences of the scores between the initial placement assessment and post instruction placement assessment of the treatment group and control group.

There was a significant difference in the initial placement assessment and post instruction placement assessment scores in fluency for male and female participants. There were more female participants in the treatment group (n = 5 = 15%) who showed little or no oral reading fluency gains than male participants in the treatment group. Participants who received *Headsprout® Early Reading* instruction plus traditional instruction (n = 59 = 87%) showed a significant gain in oral reading fluency than those participants who only received traditional classroom instruction without *Headsprout®* instruction (n = 26 = 69%). Overall in both groups, more female participants (n = 13 = 12%) than male participants (n = 8 = 7%) showed little or no oral reading fluency gains.

Statement of the Problem

In an effort to improve reading skills for primary grade students, the school district purchased *Headsprout® Early Reading*. The focus of this study is to determine if *Headsprout® Early Reading*, an animated, online program and basis of this study, can support its guarantee statement: second graders who were initially identified as being struggling readers will become skilled and fluent readers. In other words, will *Headsprout® Early Reading* increase students' abilities to read fluently and on grade level?

Purpose of the Study

The purpose of this study is to determine if *Headsprout® Early Reading* technology is an effective tool in assisting second (2nd) grade students who are experiencing difficulties with oral reading fluency. This study will also determine Headsprout's proficiency ability to support those students in attaining grade level comprehension capabilities especially fluently. Currently, *Headsprout® Early Reading* is the only computer–assisted reading software program chosen by the selected schools and district to enhance the oral reading fluency of elementary (K-2) school students.

Research Questions

In order to investigate the concepts of *Headsprout® Early Reading*, computer–assisted instruction and oral reading fluency, the following research questions will guide this study:

1. Do students who participated in Headsprout evidence significant growth in reading fluency when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

2. Do Headsprout participants' pattern of growth in reading fluency differ significantly by their cohort (year of participation) or by their tier-level (grouping for instruction) when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

3. After controlling for differences on a literacy pretest, do students who participated in Headsprout evidence significantly greater growth in reading fluency than students not participating in Headsprout, when their scores on a literacy posttest are compared?

Importance of Study

As previously stated, the school district in this study had purchased *Headsprout® Early Reading* to enhance K-2 students' reading fluency and comprehension abilities. Major funding has been spent on professional development, equipment, and materials to ensure teachers and students have a successful experience with the program. *Headsprout® Early Reading* also guaranteed that the students who used the program would see growth.

Limitations

This research study had several limitations. Limitation 1: There were three teams of second grade teachers in three different school settings. Limitation 2: Two teams had had at least one teacher who was new to teaching the second grade curriculum. Limitation 3: Although all teachers had used the *Headsprout® Early Reading* curriculum, at least one teacher on the team was not familiar with the benchmark assessment used in second grade. Limitation 4: Not all teachers were convinced that the *Headsprout® Early Reading* would be beneficial to their students. Limitation 5: One school did not have a sufficient number of computers or a computer lab. These limitations may impact the validity of the benchmark scoring.

Population and Sample

The first school at the center of this study is a public, urban, Title 1 school in a large, urban, public school district in southwest Tennessee. The school is accredited by the Southern Accreditation of Colleges and Schools (SACS), and is funded by local, state, and federal funds. The school has been designated a Target School by No Child

Left Behind because it did not meet Adequate Yearly Progress (AYP) on the last state achievement test.

The school opened on its present site in 1959 to serve students in and around an historic African American community in southeastern part of the city. Due to changes in the school's boundary lines, the school now serves approximately 100 more students. The grade span is Pre-Kindergarten through fifth. Student enrollment averages 790. Although there are 40 classrooms, the average classroom enrollment is 22 students. The student body is composed of 99.4% African Americans, 0.3% Caucasians, and 0.3% Hispanics. Free or reduced lunch is served to 87.5% of the students.

Unfortunately, the school did not fully meet the goals designated by NCLB in Math. It was noted that there was an achievement gap between Students with Disabilities (SWD) and other learners. The school also did not meet the goals designated by NCLB in Reading. There was a 9% decrease in the number of students who scored proficient or advanced on the latest Spring state achievement test. The promotion rate was 99%.

The core curriculum consists of reading, mathematics, language arts, composition, handwriting, science, social studies, health, and spelling. Support classes include physical education, music, art, computer, and library. The school employs a full-time computer teacher who manages a computer lab for students in grades K-5 and three full-time personnel who maintain and manage a second computer lab for kindergarten – second usage. This main purpose of this lab was geared towards optimizing student learning with computer–assisted instruction (CAI). All classrooms have a minimum of three computers. The principal stated that additional plans are in place to open a computer lab for primary grades in early 2012. Unfortunately, this did not come into fruition.

Teachers and staff also have accumulated numerous hours of professional development and training on the various computer- assisted instructional programs and are expected to incorporate and implement them rigorously and with fidelity in their classrooms and instructional schedule.

The study was conducted two years at the first school. Cohort 1 was comprised of 109 participants from five second grade classrooms. On the other hand, Cohort 2 had 87 participants from four classrooms. An administrator monitored the assessment and usage process throughout the study. Both research sessions lasted approximately 12 weeks.

The second school, which is also the focus of this study, is a small, public neighborhood Title I school located in the northern part of a large urban city. It too is located near another historic African American community. The school, built in the summer of 1968, was designed for 400 students. The initial enrollment at the school's opening was 300. The two-story rectangular-shaped building is comprised of a total of 22 rooms available for classroom use. Due to yearly population increases, several portable buildings were added to the school's campus. This provided for four more classrooms to meet the needs of the increased size of the student body. Currently 330 students are enrolled at the school.

The school serves students in grades pre-kindergarten through sixth grade. Every classroom is equipped with three to five computers connected to the instructional network and the Internet to provide for maximum technology integration. Every K-6 classroom has a SmartBoard. The students attending the school are residents of an urban (inner city) community and most live within walking distance.

The school has a mobility rate of 5% and a high percentage of single parent/guardian homes. Because of these factors, the enrollment figures at the school vary from day to day. The attendance rate is 92.5% and the promotion rate is at 97%. Of the 330 students at the school, 94% receive free or reduced meals. The following shows a breakdown of ethnicity of the students at the school. Of the 330 students attending the school, 89.1% are of African American descent, 9.2% are Hispanic, and 1.7 % is Caucasian. In breaking down the gender of students, 48.6% are male while 51.4% are female. Of the English Language Learner (ELL) student population, four are English proficient.

Seventy-seven percent of all students scored proficient or advanced in Reading/Language Arts and Writing on the last Spring state achievement test. Because the school did not meet the required benchmark, the school did not make AYP in the area of Reading and was designated a “Target” school for Reading. On that same state achievement test, 80% of students in grades 3-6 scored proficient in Math. The school made AYP through Confidence Interval although the Federal Benchmark was 86%.

Cohort 3 participants for this research study were 35 second grade students, 2 teachers and 1 administrator. The participants in the selected school included general education classes and special education (CLUE) classes. The socio–economic backgrounds varied from low income to middle income levels. Average general education class size in elementary schools was 25 students. The researcher believed that the implementation of *Headsprout® Early Reading Program* strategies would improve reading skills and student achievement for all participants.

Consent Procedures

Permission has been granted by the Department of Research, Evaluation, and Assessment of Memphis City Schools System and the IRB Board at the University of Memphis.

Instrumentation

Initially, *Headsprout® Early Reading* introduces letters and sounds to the students. In Headsprout introduces letters and sounds by using fluency exercises and segmenting and blending strategies. (Kresky, 2012). In the first nine episodes, students are taught sounds and have to match the sounds to the correct letter (Headsprout, 2007). Three activities occur: hearing and seeing the sounds and letters together, clicking the letters that represent the sounds, and identifying the letters from other letters. By Episode 5, students begin to read sentences and answer questions about characters he has seen in the program. Beginning at Episode 10, students are taught to say the sounds that match each phonetic element. Then, they are taught to say sounds that make words they recognize- a crucial strategy in sounding out words. By Episode 42, students are able to create sentences and use their comprehension skills to express the meaning they see in pictures. Episode 53 introduces students to the type of questions they will see on standardized tests. Students begin reading longer passages and can complete comprehension activities when they begin working on Episode 72. Students are benchmarked after every six episodes. This means they are given a Headsprout reader which contains the words and sounds they have learned through the program. The students read the book aloud to an adult who listens and scores their reading. If they pass, they continue to the next episode. If they are not successful, they repeat the episodes and are tested again. This cycle continues until the students complete Episode 80. The participants' benchmark score determined their beginning episode.

Kindergarten and first grade classes are given the DIBELS assessment three times a year. DIBELS (Dynamic Indicators of Basic Early Literacy Skills) is a set of standardized, individually administered measures of early literacy development. They are designed to be short (one minute) fluency measures used to regularly monitor the development of pre-reading and early reading skills.

The measures were developed upon the essential early literacy domains discussed in the National Reading Panel (2000) reports to assess student development of phonological awareness, alphabetic understanding, and automaticity and fluency with the code. Each measure has been thoroughly researched and demonstrated to be reliable and valid indicators of early literacy development and predictive of later reading proficiency to aid in the early identification of students who are not progressing as expected.

The data was used to evaluate individual student development as well as provide grade-level feedback toward validated instructional objectives. Students are identified as Struggling, Emerging or On Track. Struggling students and emerging students are identified and monitored throughout the school year. Students' DIBELS score could have been used to qualify them for Headsprout usage. However, most of the struggling and emerging students were identified as participants for this study.

DIBELS Scores for All Three Cohorts

COHORT	Intensive/Struggling	Strategic/Emerging	Benchmark/On Target
A	6.2%	33.5%	60.3%
B	9.0%	23.0%	62.0%
C	20.9%	27.9%	51.2%

To measure the reading fluency levels of participants, the researcher and participants (students and teachers) used the components of *Headsprout® Early Reading Program* including placement assessments, early literacy curriculum consisting of eighty 20–minute animated episodes, and benchmark assessments. All components of this study were designed by *Headsprout®* or the researcher. All components of this research study were facilitated under the instruction of the researcher. Parts of the research study were administered by the second grade teachers, grade level interventionist, and administrator of the selected school.

Data Collection

Procedures for data collection began after gaining approval for the research study from district level administrators from the school district located within the city limits of southwest Tennessee and the administrators from the attending university.

Cohort 1-During the weeks of October 4- 8, 2010, the researcher scheduled and facilitated the initial placement assessments to student participants during the school day. During the school year, the researcher facilitated and monitored the instruction of the components of the *Headsprout® Early Reading Program* and collected scores from the placement assessments, instructional curriculum and benchmark assessments. At the end of the 12 weeks' instruction period, the researcher scheduled and facilitated the post instruction placement assessments to student participants during the school day. The data was analyzed and a comparison was made between initial pretests and posttests.

Cohort 2-During the weeks of October 10 – 14, 2011, the researcher scheduled and facilitated the initial placement assessments to student participants during the school day. During the school year, the researcher facilitated and monitored the instruction of the components of the *Headsprout® Early Reading Program* and collected scores from the placement assessments, instructional curriculum and benchmark assessments. At the end of the 12 weeks' instruction period, the researcher scheduled and facilitated the post instruction placement assessments to student participants during the school day. Again, the data from the pretests and posttests were compared.

Cohort 3-During the weeks of October 18 – 29, 2012, the researcher scheduled and facilitated the initial placement assessments to student participants during the school day. During the school year, the researcher facilitated and monitored the instruction of the components of the *Headsprout® Early Reading Program* and collected scores from the placement assessments, instructional curriculum and benchmark assessments. At the end of the 12 weeks' instruction period, the researcher scheduled and facilitated the post instruction placement assessments to student participants during the school day. Data from the pretests and posttests were analyzed.

As the researcher researched and developed the needed materials for this research study, the researcher did not foresee any potential risks, harm or bias to participants as data were being gathered for this research study. The participants were kept free from harm. To ensure confidentially, a system of alphabets and numbers was used in lieu of names. The researcher handled the research with the highest level of confidentiality by locking all data information in a filing cabinet. All information such as data and the results was kept confidential and will be destroyed within a year after the end of the research study.

Procedures

Participants, students from the second grade, in this research study were administered the *Headsprout® Early Reading Program* Placement Assessment. This was a timed two- minute fluency assessment. Participants who did not meet the cut–off criterion of the program were identified as the participants who needed additional intervention strategies and reading support. The treatment group was comprised of those participants. The control group was comprised of those students who met the cut–off criterion of the program. *Headsprout® Early Reading Program* was not accessed by them at any time during this research study.

Participants were instructed with the Scott Foresman Reading Street curriculum. All classroom teachers adhered to the district's 90-minute reading block. The reading block consisted of whole group, small group, and center instruction. Participants usually completed their Headsprout instruction during center rotations or during instruction during computer lab support classes. Students were expected to complete three 30-minute Headsprout episodes weekly. Teachers and teacher assistants monitored the participants' progress weekly. Adjustments were made if participants encountered difficulty on any skill (episode) during Headsprout usage.

Data Collection and Recording

Placement assessment and routine benchmark assessments were determined by administrators of the *Headsprout® Early Reading Program* to monitor the progress of the development of reading fluency skills. The scores of the placement assessment, benchmark and instructional curriculum of the participants were recorded in the

Headsprout® Early Reading data bank and by the researcher. A total of 156 students used the program. This daily data collection process continued for a period of 12 weeks.

Data Analysis Method

At the end of the 12 week period, the curriculum was completed and the study ended. The researcher scheduled and facilitated the administration of the *Headsprout® Early Reading* placement assessment to participants. The researcher analyzed the results in an Excel spreadsheet and added additional demographic information. Then, the researcher compared the score differences between the initial placement assessment and the post curriculum placement assessment of the treatment group and control group by using a Regression-Discontinuity Data (RDD) design method. The goal of this study was to determine the effect that *Headsprout® Early Reading* had on students' fluency and comprehension. Seventy-five students did not receive Headsprout instruction while 156 students completed at least three Headsprout episodes weekly.

After collecting and recording the benchmark data from participants, the researcher organized, examined, and evaluated the data to determine if the treatment group or control group increased their level of fluency and comprehension. Because fluency was measured multiple times for every participant, a Repeated Measures Analysis of Variance (R-ANOVA) was used to compare the data. To analyze the differences in reading fluency between the three Cohorts and the two Tiers, the researcher used a Mixed ANOVA. A Regression-Discontinuity Data (RDD) approach tested the differences between the three Cohorts.

Data Collection Instruments

Early Literacy Curriculum. The researcher scheduled and facilitated Internet–based supplemental early literacy curriculum. The students' benchmark scores determined their beginning remediation episode number. The curriculum provided individualized, adaptive instruction, and the students worked through the lessons at their own pace. The program responded to the student's pattern of errors with tutorials and reviews to provide extra assistance to them if they were struggling to comprehend the material. The students had to meet specific performance criteria in order to progress or move on to the next lesson.

Placement Assessment. The researcher scheduled and facilitated the initial and post curriculum placement assessment.

Benchmark Assessment. The researcher scheduled and facilitated various benchmark assessments according to the schedule given by *Headsprout® Early Reading*.

Methodological Assumptions

All *Headsprout® Early Reading* curriculum, placement assessments, and benchmark assessments were conducted in the appropriate testing manner and setting.

Summary

This chapter discussed the methodology that was used in this study. A Regression- Discontinuity Data approach was described along with a Repeated Measures Analysis of Variance. The settings for the study and background of the participants chosen to participate in this study were also outlined. Data collection was recorded in an Excel bank and analyzed to determine the fluency growth for all participants.

CHAPTER 4

Results

Overview

In this chapter, the findings for each research question will be presented. The research questions for this study were:

1. Do students who participated in Headsprout evidence significant growth in reading fluency when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

2. Do Headsprout participants' pattern of growth in reading fluency differ significantly by their cohort (year of participation) or by their tier-level (grouping for instruction) when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

3. After controlling for differences on a literacy pretest, do students who participated in Headsprout evidence significantly greater growth in reading fluency than students not participating in Headsprout, when their scores on a literacy posttest are compared?

To enable answering Research Questions 1 and 2, means and standard deviations were computed for all Headsprout students with respect to their entry, mid-year, and exit benchmark test scores and for important subgroups of these students at these same three assessment intervals. Shown across the topline in Table 1 are the descriptive statistics pertinent to all 156 students that were used to answer Research Question 1. Below the topline figures are descriptive statistics for Headsprout students categorized by year into three cohorts and by instructional grouping into two tiers. These two sets of descriptive statistics were employed in responding to Research Question 2.

Table 1
Benchmark Test Scores, Means and Standard Deviations for All Students, Students by Cohort, and Students by Tier

Group	*n*	Entry		Mid		Exit		λ	*F*	*df*	*p* =
		M	*SD*	*M*	*SD*	*M*	*SD*				
All	156	78.0	25.5	80.7	21.9	95.5	8.42	0.63	44.6	2,154	0.000
Cohort 1	69	78.1	25.8	80.0	22.5	96.7	8.08	0.88	5.1	4,304	0.001
Cohort 2	55	68.3	25.9	73.5	22.2	93.2	9.62				
Cohort 3	32	94.6	13.0	94.5	11.8	97.1	5.94				
Tier 1	70	95.1	10.6	94.3	11.7	98.6	4.25	0.72	30.1	2,153	0.000
Tier 2	86	64.1	25.6	69.6	22.0	93.1	10.04				

Research Question 1 was phrased as follows: “Do students who participated in Headsprout evidence significant growth in reading fluency when their entry level-, mid-treatment, and exit-level benchmark test scores are compared?” In response to this question, a Repeated Measures Analysis of Variance (R-ANOVA) was conducted on the three sets of with outcomes shown in Table 1 and Figure 1. As presented in the table and suggested by the figure, there was a highly significant difference observed between the benchmark means ($F(2, 154) = 44.6$, $p < .000$), with follow-up testing indicating no significant difference between entry and mid-year benchmark means, but highly significant differences between entry and exit means and the midyear mean and the exit mean. Computing effect sizes that correct for the correlation between means indicates only a slight effect of Headsprout on reading fluency from entry to midyear benchmark scores (g = 0.16) but a much more robust effect from midyear to exit benchmark scores (g = 1.37) and from entry to exit benchmark scores overall (g = 1.45).

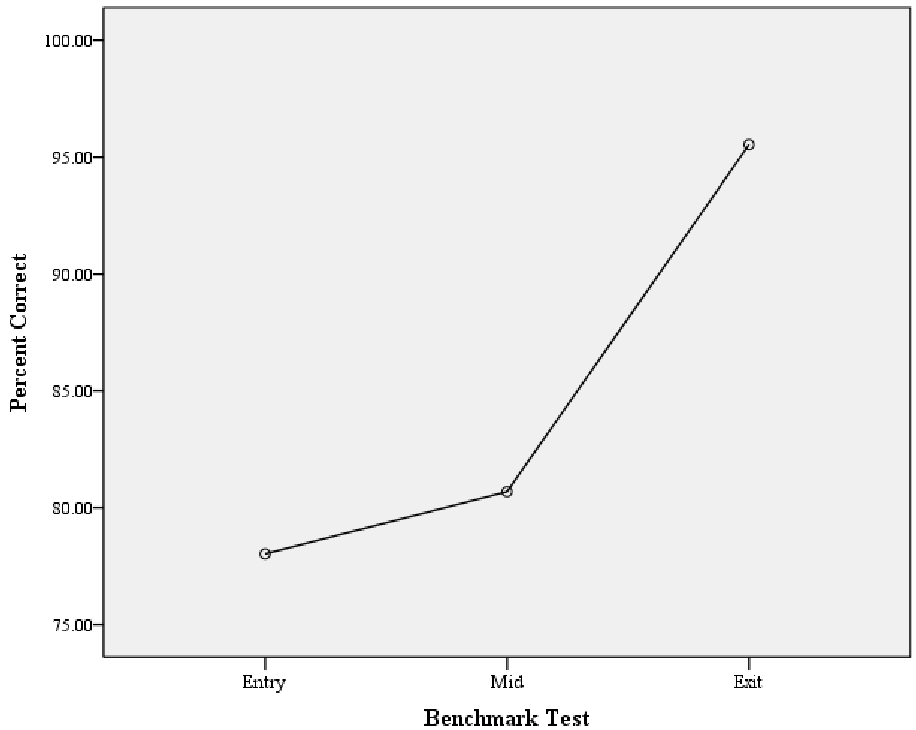


Figure 1. Graph of three benchmark scores for all treatment students

Research Question 2 was phrased as follows: “Do Headsprout students’ pattern of growth in reading fluency differ significantly by their cohort (year of participation) or by their tier-level (grouping for instruction) when their entry level-, mid-treatment, and exit-level benchmark test scores are compared? In response to this question, a “mixed” Analysis of Variance was conducted on the three sets of scores as a “between-groups” factor—“cohort” in one analysis, “tier” in the other—was added to the “within-groups” R-ANOVA conducted previously. As it has already been established that all Headsprout student's fluency changed significantly over time, what is shown in Table 1 for the two subgroups of Headsprout students is whether there was a different pattern in the change in fluency scores contingent on the student's group (in other words, fluency by group "interaction").

As shown in the results for cohort, there did appear to be a significant interaction of growth in fluency by the year in which a student participated in the program ($F(4, 304) = 5.1$, $p = .001$). As depicted in Figure 2, there was less overall change from entry to exit benchmark scores for Cohort 3 ($g = .37$) than there was either for Cohort 1 ($g = 1.54$) or for Cohort 2 ($g = 1.97$). While there was little change for Cohort 3 between entry and mid- benchmark scores and between mid- and exit benchmark scores, differences in the benchmark test scores observed at the three points in time were much more pronounced for the other two Cohorts. Summarized in Table 2 are the effects sizes computed across all three cohorts at each of the three time points.

As shown in the results for tier, there also appeared to be a significant interaction of growth in fluency by a student's instructional placement ($F(2,153) = 30.1$, $p < .000$). As depicted in Figure 3, while the overall fluency gains made by Headsprout students in Tiers 1 and 2 were robust ($g = 0.66$), they were even more pronounced for students in Tier 3 ($g = 2.28$), the group of Headsprout students most challenged by reading.

Table 2

Effect Size Differences in Mean Benchmark Scores for Headsprout Students by Groups, by Cohort, and by Tier at Entry, Mid-Treatment, and Exit

Group Comparisons	Entry Score Difference Effect	Mid-Treatment Score Difference Effect	Exit Score Difference Effect
	g	*g*	*g*
Cohort 1 vs. Cohort 2	0.38	0.29	0.40
Cohort 1 vs. Cohort 3	0.72	0.73	0.05
Cohort 2 vs. Cohort 3	1.18	1.09	0.46
Tiers 1 and 2 vs. Tier 3	1.52	1.36	0.69

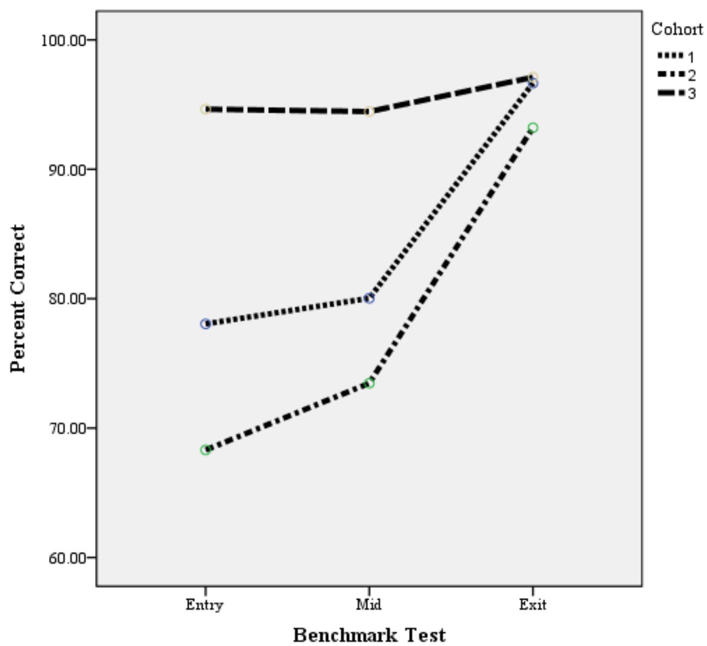


Figure 2. Graph of three benchmark scores for Headsprout students by cohort.

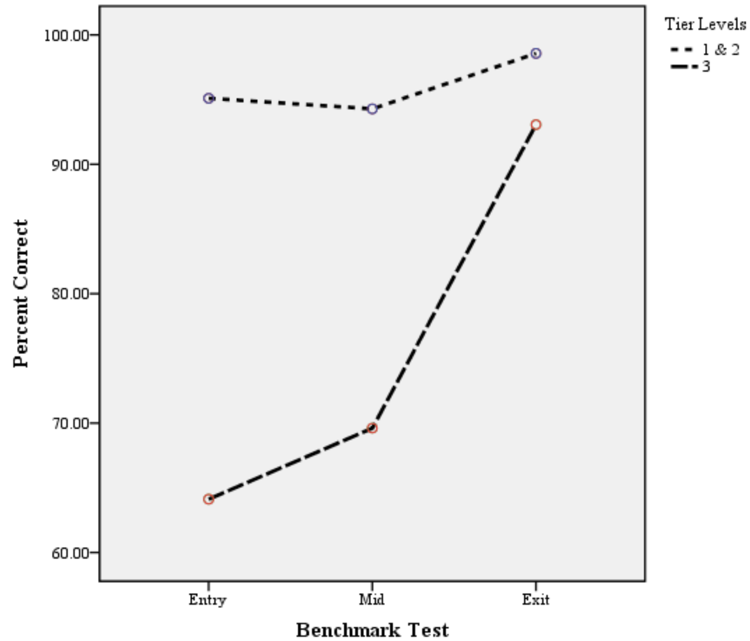


Figure 3. Graph of three benchmark scores for Headsprout students by tier.

Research Question 3 was phrased as follows: "3) After controlling for differences on a literacy pretest, do students who participated in Headsprout evidence significantly greater growth in reading fluency than students not participating in Headsprout, when their scores on a literacy posttest are compared? In response to this question, both a "mixed" Analysis of Variance and a Multiple Regression were conducted on the pre-test and post-test scores described in Table 3. While both statistical procedures yields similar conclusions, the two procedures highlighted the between-group outcomes in different ways, as seen in Figures 4 and 5.

Table 3
Fluency Pretest and Posttest Means and Standard Deviations for Treatment and Control Group Students

Group		Pretest Score		Posttest Score		Difference Score		Centered Pretest Score	
	n	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Control	75	168.0	44.5	185.3	46.7	17.4	8.5	62.5	44.5
Treatment	156	75.4	41.6	112.1	44.6	36.7	10.7	-30.0	41.6
Totals	231	105.5	60.8	135.9	56.7	30.4	13.5	0.0	60.8

The multivariate statistics observed for the "mixed ANOVA" approach indicated that while signficant gains were made by both control and treatment group students (λ = .594, $F(2, 153) = 52.53$, $p < .001$, $\eta_p^2 = .406$), significantly greater gains were made by one of the two groups (λ = .713, $F(2, 153) = 30.10$, $p < .001$, $\eta_p^2 = .282$). As suggested by the group means for the difference score, the treatment (Headsprout) students made over twice the number of points gained by the control group. In the line graph depicting the relative performance of the two groups (Figure 4), the line associated with the treatment group has a much steeper slope compared to that associated with the treatment group. Graphed in Figure 5 are the results of a multiple regression approach to analyzing the data using a "regression discontinuity" approach to the data. After obtaining a "centered" pretest value for all students by substracting the student's score from the mean pretest score (*M* = 105.5), these scores were graphed and a line of best fit obtained for the two groups. As depicted in Figure 5, there is an observable "discontinuity" between the two lines such the intercept (mean) for the treatment is larger than that for the control group. These observations are confimed by the results of the regression preocedure in which students' centered pretest score and their group membership are regressed on their posttest score. As can be seen in Table 4, the effect of group memberhip is both statistically significant (t (155) = 11.4, p < .001) and positively signed, the latter indicating an advantage for the treatment group that is predicted to amount to a difference of 22.8 points.

Table 4
Multiple Regression Summary of Students' Centered Pretest Score and Group Membership on Students' Posttest Scores

Source	*B*	*S.E.B*	*t*	*p* =
Pretest (centered)	1.0	0.0	67.4	.000
Group Membership	22.8	2.0	11.4	.000

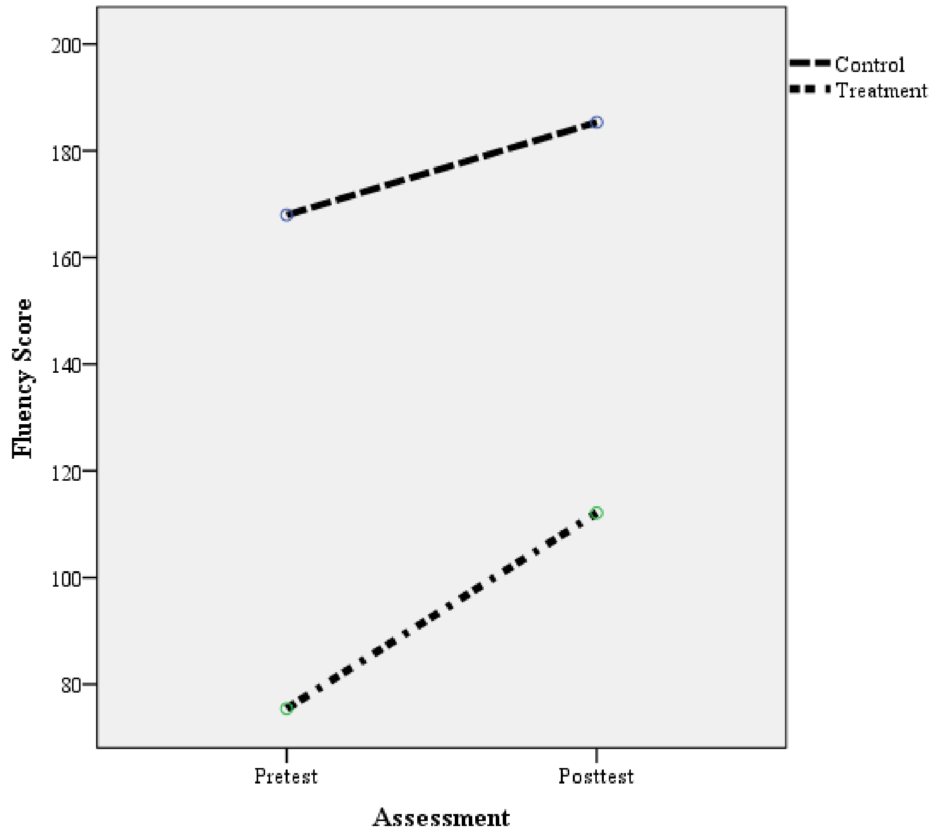
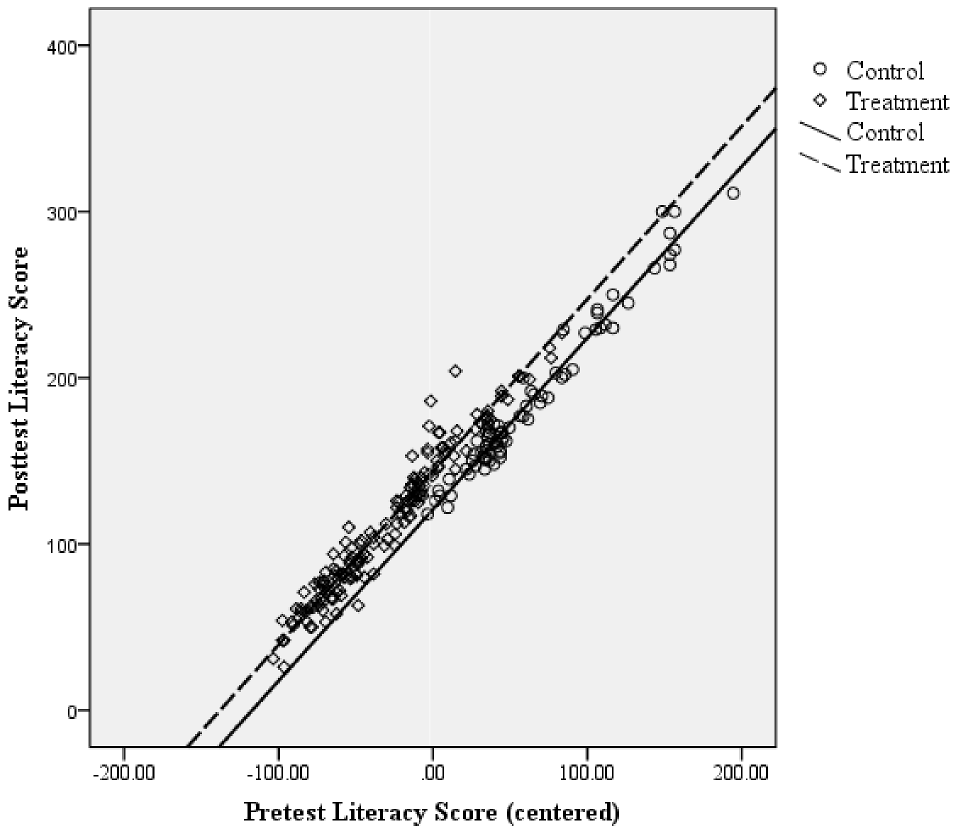


Figure 4. Graph pre- and posttest performance in literacy by control and treatment groups of students.



Report of Findings

The data shows significant findings. First, in Table 1, Cohort 2 participants showed the largest fluency growth between the Entry and Exit benchmarks (24.9 mean gain). Cohort 3 participants saw very little gain in their mean scores (2.5 mean gain). Tier 2 participants saw a 29.0 mean increase while Tier 1 participants only saw a mean gain of 3.5. In Table 2, Cohorts 1 and 2 participants had the greatest growth in fluency. Cohort 3 participants had little change in fluency growth. Tier 3 participants had the greatest overall fluency growth than both Tier I and Tier 2 participants. Table 3 shows that both the control group and treatment group made significant reading fluency gains. However, greater gains were made by the treatment group (36.7).

Summary

The primary goal of this research was to determine if the *Headsprout® Early Reading* curriculum enhanced struggling second graders' reading fluency abilities. This occurred by comparing the fluency growth of second grade students who received traditional reading instruction plus *Headsprout® Early Reading* instruction and the fluency growth of second grade students who only received traditional reading instruction. The data proved that *Headsprout® Early Reading* does enhance students' fluency abilities. Supporting evidence is categorized with each research question presented in this chapter.

CHAPTER 5

Conclusions

Overview

The purpose of this research was to determine if *Headsprout® Early Reading* technology is an effective tool in assisting second (2nd) grade students who are experiencing difficulties with oral reading fluency. *Headsprout® Early Reading'*s instructional scope and sequence goals are:

- Phonemic Awareness-To establish the ability to hear, identify, and manipulate the individual sounds-phonemes in spoken words
- Phonics-To establish an understanding of the predictable relationship between phonemes and graphemes
- Fluency-To fluently recognize sounds and words and to accurately and quickly read text
- Vocabulary-To establish print and spoken words needed to communicate effectively
- Text Comprehension-To establish an understanding of what is learned
- Print Awareness-To become familiar with print and text conventions, and the relationship between spoken and printed language (Headsprout, 2007).

All of the goals are part of the National Reading Panel's recipe for effective reading instruction (NRP, 2000).

This study compared the oral reading fluency growth between second grade students who used *Headsprout® Early Reading* and received traditional classroom instruction and second grade students who only received traditional classroom instruction. Both the control and treatment groups were similar in terms of age, socioeconomic status, and race. This final chapter will present a discussion of the findings and recommendations for further study.

Significant Findings

The findings of this study contribute to the existing body of literature in two significant ways. The findings support the literature that states that students' learning rate is faster with computer–assisted instruction than with conventional instruction. (Capper & Copple, 1985). It also validates *Headsprout® Early Reading* as being a catalyst in the academic gains students make. The treatment group in all three Cohorts achieved greater fluency gains than the control group.

The findings also support *Headsprout® Early Reading* being part of diagnostic assessments schools use to evaluate students' reading abilities. Because schools must identify struggling readers immediately upon their entrance in school, *Headsprout® Early Reading* can provide valuable information that determines who is on track to becoming a successful reader. Being able to gauge how well students develop reading fluency skills over time can also be a great predictor to how well students will read and comprehend in future years.

Conclusions

The students who participated in this study were identified as struggling readers. At the end of the study, there was a highly significant difference observed between their benchmark means ($F(2, 154) = 44.6$, $p < .000$). Most of the growth occurred between the entry and exit benchmarks which is a testament to Headsprout's "guarantee" that students will become grade level readers if they use the program.

According to Arnold (2000), CAI can dramatically increase a student's access to information. The program adapts to the abilities and preferences of the individual student and increases the amount of personalized instruction a student receives. In this case, *Headsprout® Early Reading* afforded participants opportunities to benefit from immediate feedback and self-paced learning. This study shows that there is substantial evidence that *Headsprout® Early Reading* can enhance the learning of second grade students who are struggling with reading fluency and comprehension.

There is divided literature on using Computer-Assisted Instruction (CAI) to enhance literacy for struggling readers (Blok et al., 2002). In fact, there are mixed reviews. This study supports using *Headsprout® Early Reading* to impact student learning and achievement-especially the reading skills needed to be a successful reader. However, further studies are needed to determine the overall efficacy of *Headsprout® Early Reading.*

Although Cohort 1 had the largest number of participants of all three Cohorts, its participants did not achieve the most significant gains (g = 1.54). Cohort 3 was the smallest Cohort and its participants had the least fluency growth (g = 0.37). Cohort 2 participants showed the most growth from pretest to posttest (g = 1.97).

Students who are at risk of reading failure require extensive instruction and remediation (Huffstetter, King, Onwuegbuzie, Schneider, & Powell-Smith, 2010). Computer – Assisted Instruction (CAI) programs that address instructional strategies that are necessary for reading acquisition would benefit struggling readers and their quest to become a successful reader.

Summary

The findings of this study suggest that the implementation of *Headsprout® Early Reading* for struggling second grade readers did result in increased growth in reading fluency. The findings will be presented in the context of the three research questions.

1. Do students who participated in Headsprout evidence significant growth in reading fluency when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

The results from the statistical analysis of Question 1 appear to indicate that the weekly completion of three 30 minute *Headsprout® Early Reading* episodes increased the reading fluency achievement of Tier 3 students. A comparison of the mean gain scores validates this (see Table 2). There was a much more robust effect from midyear to exit benchmark scores (g = 1.37) and from entry to exit benchmark scores overall (g = 1.45). This supported the findings of earlier studies which stated that computer – assisted instruction enhanced student achievement (Capper & Copple, 1985; Kulik & Kulik, 1987).

2. Do Headsprout participants' pattern of growth in reading fluency differ significantly by their cohort (year of participation) or by their tier-level (grouping for instruction) when their entry-level, mid-treatment, and exit-level benchmark test scores are compared?

The second finding addressed if Headsprout participants' pattern of growth in reading fluency differed significantly by their cohort (year of participation) or by their tier-level (grouping for instruction) when their entry-level, mid-treatment, and exit-level benchmark test scores are compared. A Repeated Measures Analysis of Variance (R-

ANOVA) statistical analysis of Question 2 showed that Cohort 3 (g = .37) had the least fluency overall growth from entry to exit benchmark scores unlike Cohort 1 (g = 1.54) and Cohort 2 (g = 1.97). This is summarized in Table 2. Figure 3 shows that Tier 3 students' over all fluency gains (g = 2.28) were greater than both Tier 1 and Tier 2 (g = 0.66). These results are consistent with the results of earlier studies that examined the effects of CAI on early primary and at-risk students (Gore,1989; Waxman & Huang, 1996; Waxman et al., 2001).

3. After controlling for differences on a literacy pretest, do students who participated in Headsprout evidence significantly greater growth in reading fluency than students not participating in Headsprout, when their scores on a literacy posttest are compared?

The results from the final research question were derived from both a "mixed" Analysis of Variance and a Multiple Regression of the pre-test and post-test scores described in Table 3. This finding validates Headsprout's guarantee that students will become more fluent readers if they use the program. The "mixed ANOVA" approach denoted that while the treatment and control group both made significant gains, it was the treatment group that doubled the gains made by the control group (Table 3). The results in the Regression –Discontinuity approach graph show that the mean for the treatment group is greater than the control group. Thus, there is a discontinuity or a 22.8 point difference in their pretest and posttest scores. Several Headsprout studies mirror the results from Research Question 3 (Florida Center for Research, 2003; Headsprout, 2007; Huffstetter, 2005; Layng et al., 2003).

Recommendations for Future Research

The first area future research should focus on is teacher's beliefs that *Headsprout® Early Reading* is valuable. Some of the teachers involved in this study did not regard *Headsprout® Early Reading* as an important component of their students' instructional day. Once students were trained on how to use the program, they basically controlled their access and progress. Teachers' instructional time was protected. Teachers were only required to monitor their progress and administer benchmark assessments. The district had provided many hours of professional development and support personnel.

The literature states that *Headsprout® Early Reading* is beneficial for struggling readers (Blok et al., 2002). Existing literature suggests that there are reasonable ways to potentially increase the effectiveness of CAI (Cheung & Slavin, 2011). They maintain that CAI is most effective when it is an integral part of the reading curriculum. They do not advocate using CAI as a supplement to the curriculum. The findings of this research study contradict their beliefs. Therefore, the second focus for future research is continuing to use *Headsprout® Early Reading* as supplemental instruction to reading.

The third area focus for future research is student engagement. Technology has evolved greatly over the last 10 years. These changes may have altered the positive views most students had regarding technology. However, do we really know what components of technology stimulates student engagement? Additional studies are warranted in this area.

The fourth area of focus for future research is teacher experience. During this study, the majority of the teachers who used *Headsprout® Early Reading* had been teaching for 5 or more years. With the exception of Cohort 3, the students who showed growth had an experienced teacher as their homeroom teacher.

Finally, the fifth area of focus is the effect *Headsprout® Early Reading* has on different student populations. All three Cohorts in this study were at Title I schools that did not meet Adequate Yearly Progress. *Headsprout® Early Reading* should be used as supplemental instruction at schools that are in “good standing” or who have students that are on “grade level” to determine if it can boost students’ fluency comprehension.

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Memphis City Schools

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Reply to the office of:
John R. Barker, Ph.D.
Executive Director

Phone (901) 416-5633
FAX (901) 416-7535
Barker.JohnR@mcsk12.net

January 25, 2010

Sharlese James
jamessharlesel@mcsk12.net

Ms. James,

After consideration of your proposal, *Investigating Computer Assisted Instruction and the Reading Achievement of Urban Students*, we have approved your request to conduct a research study in the Memphis City Schools. You should use this letter as official notification of approval for your study.

I look forward to working with you in the completion of this project.

Please direct any inquiries to me via email at barkerjohnr@mcsk12.net.

Regards,

John R. Barker, Ph.D.
Executive Director

Cc: Judy Paris,
U of M

2597 Avery Avenue • Room 304 • Memphis, TN 38112 • (901) 416-5300 • www.mcsk12.net

THE UNIVERSITY OF MEMPHIS

Institutional Review Board

To:	Sharlese Louise James Instruction and Curriculum Leadership
From:	Chair, Institutional Review Board for the Protection of Human Subjects Administration 315
Subject:	Investigating Computer Assisted Instruction and the Reading Achievement of Urban Students (E10-240)

Approval Date: February 15, 2010

This is to notify you that the Institutional Review Board has designated the above referenced protocol as exempt from the full federal regulations. This project was reviewed in accordance with all applicable statutes and regulations as well as ethical principles.

When the project is finished or terminated, please complete the attached Notice of Completion and send to the Board in Administration 315.

Approval for this protocol does not expire. However, any change to the protocol must be reviewed and approved by the board prior to implementing the change.

Chair, Institutional Review Board
The University of Memphis

Dr. L. Allen