

THE USE OF IPADS TO FACILITATE GROWTH IN READING COMPREHENSION SKILLS  
OF SECOND GRADE STUDENTS

by

Joy Lynn Reichenberg

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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### **ABSTRACT**

The increased accessibility of technological devices has made it easier for educators to make use of multimodal tools in the classroom. Although educational technology has been vastly researched, one area that is not reflected in the literature is the use of eBooks that are read on mobile digital reading devices and their impact on the performance of literacy skills of lower elementary age students. This quasi-experimental, nonrandom, pretest/posttest control group study examined the results of reading an eBook on an Apple iPad and its impact (if any) on reading comprehension skills of second grade students. This quasi-experiment included a treatment group who read eBooks on the Apple iPad for a series of six weeks, and the control group, who read the same books in traditional print for six weeks. The measurement for both pretest and posttest was the reading comprehension portion of the Curriculum Based Measurement (CBM). The research questions examined were: (a) What is the difference in the reading comprehension scores of second grade students on the CBM when using eBooks compared to students who use printed text? (b) What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks when compared to students who do not use the multimodal features each time? These data were analyzed using an Analysis of Covariance (ANCOVA).

### **Dedication Page**

I would like to thank several people for their contribution to making this endeavor possible. No great effort is accomplished alone, and this work is no exception. First, I would like to acknowledge my husband for his tireless support of my ambitions and goals. Without his consistent encouragement, this never would have come to completion. A special word of gratitude is given to my daughter and son for their patience and love when I had to do “homework” when it was not always most convenient. To my parents, family and friends who have been another source of encouragement throughout this process, thank you for being my cheerleaders. I am grateful to the school district, administrators, teachers and students that participated in this study for their willingness to go along with my ideas. And finally, thank you to my committee for having listening ears, gentle critiques, and providing consistent guidance.

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## **CHAPTER ONE: INTRODUCTION**

The field of educational technology is rapidly progressing, and technology is becoming readily available and accessible to educators. Yet, educational practices continue to reflect more traditional methods. There are many factors that contribute to this lack of technology usage: financial limitations, the lack of training, and the comfort level on the part of the teacher (Means, 2010). One of the areas where this shortcoming is an increasing problem is in the elementary school setting. Chen and Chang (2006) and Plowman and Stephen (2005) conducted studies that highlighted a lack of confidence and competence among early childhood educators in relation to new technologies. These early elementary level students are digital natives and are consistently immersed in multimedia opportunities in their lives outside of schools. With the increase of educational technology, these students have the potential to access a wide variety of reading technologies that provide age-appropriate learning experiences within their frameworks. Because of this growth in availability, proper training for teachers and effective implementation of these devices and programs are imperative to bridging the digital divide between teachers and their students.

Yet another challenge to educators is the widespread adoption of the Common Core State Standards (CCSS). This initiative, which was first organized in 1996, resulted in the development of a set of common standards for English Language Arts (ELA) and mathematics. These standards were officially launched in 2010 and adopted by 45 states and three United States territories. These standards are based on preparation for college and career readiness and are a clear set of goals and expectations for what knowledge and skills will help students succeed in the 21<sup>st</sup> century (Rust, 2012). A primary focus of the CCSS in English Language Arts is that students become capable of using and comprehending complex, informational texts. These expectations begin in kindergarten and follow all the way through grade twelve. These standards



will require students in early elementary school to develop reading strategies that go beyond rote recall and culminate in a much deeper level of reading comprehension (Hiebert, 2011). This deeper level of comprehension will require the reader to reflect on vocabulary and author's purpose in word choice and sentence structure, as well as actively question throughout the reading process (Boyles, 2013).

The use of multimodal features in electronic books is one way to assist in the achievement of deeper understanding of complex text. According to the New Media Consortium Horizon Report K-12 (2012), one of the six emerging technologies that will enter mainstream use within the next year is the mobile device. The use of these devices, along with the use of applications and computing tablets are rapidly becoming mainstream practices. Tablet computers provide advantages, such as applications, affordable solutions for one-to-one learning, and feature-rich tools for a variety of assignments (NMC, 2012). The purpose of this study was to examine the impact of the use of a mobile technological device on the reading comprehension skills of second grade students. The device of focus in this study was the Apple iPad. The iPad was used to access electronic books, or eBooks. Through use of the iPad, elementary-age students are empowered to function with independence on specific tasks with developmentally appropriate applications. Specific applications that can assist and support literacy skills include adjustment of font size, audio capabilities, note-taking via internal keyboard, integrated dictionary, and in some cases, video components. A tablet device such as the iPad has much more functionality for eBooks than other e-readers on the market (McClanahan, Williams, Kennedy, & Tate, 2012).

### **Background**

In their study on eBooks, Bayliss, Connell, and Farmer (2012) discuss the advent and history of eBooks as the beginning of Project Gutenberg in 1971. The purpose of Project

Gutenberg was to digitize texts. People then began reading eBooks using personal computers, and in 1998, the first eBook reader was designed for viewing digital text on a portable, book-like device. With the improvement and progression of mobile reading devices, competition among manufacturers and developers has lowered costs to make mobile reading devices more economical. Tablet devices, such as the iPad, offer more features, similar to that of a laptop computer, that make them even more appealing products. While this product has generated unprecedented levels of hype, it is still a relatively new technology medium that has generated little published research in the realm of education. Regardless, eBook readers and iPads in particular, are gaining popularity in the educational sphere – in addition to their popularity among the general public (Bayliss, Connell, & Farmer, 2012).

Research on eBook readers and mobile devices in academic settings has been primarily limited to secondary and higher education. While there are a copious amount of studies on eBooks, the focus has been on delivery via computer or e-reader. There is documented research on the effectiveness of commercially developed programs, often with text-to-speech and computerized learning games (Moody, Justice, & Cabell, 2010). Alternatively, few studies have addressed the use of eBooks via mobile device and its specific effects on literacy skills. When looking for the impact on lower elementary school students' reading performance, the field narrows even more.

What differentiates the iPad from other eBook readers are its multimodal, interactive features. The interactive capacity of the iPad to deliver text in an appealing format can enable students to activate prior knowledge as well as establish and clarify needed vocabulary for comprehension and contextual understanding. This new vocabulary can be presented in a variety of formats, including electronic glossaries, video samples, and Internet links. When looking at the needs of digital natives, traditional definitions of reading and writing are insufficient as

today's students encounter and interact with new digital media, including digital texts such as eBooks (International Reading Association, 2009).

Studies suggest that using eBooks with second grade students promotes new literacy practices and extends connections between readers and text. These connections are further enhanced through the manipulation of text features by internal electronic tools. These findings offer insight into the "meaning making" process that is encountered when using an eBook (Larson, 2010, p. 17).

The International Reading Association (2002) summarized findings from the National Reading Panel report that identified five key areas foundational to literacy skills and grade level in this study. Instruction in the first two areas, phonemic awareness and phonics, is said to be more beneficial to students in kindergarten and first grade. Instruction in the remaining three areas, fluency, vocabulary, and comprehension, are appropriate and necessary at the second grade level, or when students begin to read content material. This summary from the IRA (2002) also indicated that computer instruction increases vocabulary skills more effectively than traditional instruction. The second grade age group, usually 7-8 years of age, is typically capable of processing and following directions for the independent use of mobile devices for reading (Larson, 2010).

Many studies have also been performed in the area of best practices for reading instruction. According to Chambers, et al. (2011), success in school is virtually synonymous with success in reading. In their study, they generalize that "Children who finish elementary school with weak reading skills are at a very high risk of dropping out before they finish high school" (Chambers, et al, 2011, p. 625). To counteract and prevent the increase of dropouts, many types of interventions have been designed to bring struggling readers up to grade level. The majority of these interventions include some type of small group, targeted instruction that is either taught by

teachers or paraprofessionals. However, one-to-one tutoring by certified teachers appears to be the most effective method. While one-to-one instruction is preferred, few schools have the funding to provide these individualized services to all students who experience reading difficulties. This dilemma helps set the stage for researching the independent capabilities of the iPad. If a positive relationship can be established between the use of the iPad and the reading performance of students, then the iPad can serve as an acceptable alternative to one-to-one intervention for reading. The implications for further research would be abundant when examining the use of an iPad or other such device for one-to-one intervention possibilities with struggling students as well as for allowing the classroom teacher to reach more students efficiently. The ultimate benefit of academic gains made by students in less time is profound for the classroom in terms of teachers' time, academic success, and reintegration of the student back into general education. This efficient use of resources could ultimately lead to fewer unnecessary referrals for Response to Intervention (RTI) and special education testing (Casy, Robertson, Williamson, Serio, & Elswick, 2011).

### **Problem Statement**

While many studies include information about eBooks, much of this literature calls for further research on their effectiveness (Bayliss, Connell, & Farmer, 2012). Although early forms of eBooks have been available for almost two decades, studies of how students interact with and respond to eBook texts are still minimal and results are somewhat conflicting (Larson, 2010). Studies in language development in education rarely address the growing central role of electronic texts in daily life and the expertise gained through constant interaction with them (Meskill, 2007). In this study, the focus was on how the use of eBooks read on an iPad impact second grade students' performance in the specific literacy skill of reading comprehension.

### **Purpose Statement**

The purpose of this quasi-experimental, pretest-posttest nonequivalent control group study was to test the Theory of Metacognition (Flavell, 1979) and the Cognitive Information Processing Theory (Miller, Galanter, & Pribram, 1960) while comparing the use of multimodal features of eBooks read on an iPad and the reading of traditional, printed books on the reading comprehension skills of second grade students as assessed by the CBM. This study was conducted in six classes, three with eBooks delivered on iPads and three with printed text. The classes that received the iPad treatment were in a different school than the classes that read the text in a printed book. The classes came from schools in similar economic areas with similar demographics. The researcher performed a pretest using the reading comprehension portion of the easyCBM program. Both classes received a bookshelf of similar titles to read during the independent reading portion of their daily literacy block. The treatment group had a virtual bookshelf of titles to choose from, and those books included multimodal features, such as an interactive glossary, the ability to have the story read aloud, and comprehension questions throughout the stories. The control group had paper copies of the same titles from which to choose along with access to dictionaries, permission for peer read aloud, and posters and bookmarks with comprehension questions. The daily literacy block included 15 minutes per day of independent reading time. This segment of the daily schedule was the time of day that all students participated in either the treatment or the control. Due to the low amount of stamina for independent focus of second- grade-age children, the students read independently for a maximum of 15 minutes per day as a part of this study (Bouchey & Moser, 2006). The treatment group had access to iPads at a two-to-one ratio and was allowed to have reasonable individual

access to the virtual bookshelf via the Storia App. A posttest from the easy CBM program was given at the end of the six-week timeframe to determine the effectiveness of the treatment.

### **Significance of the Study**

This study contributes to the growing base of literature that examines the impact that the use of educational technology can have on student academic performance. There is an abundance of research that addresses the variety of technology programs available to educators. However, according to Lankshear and Knobel (2003), conducting meta-analyses of research in this field is problematic as technologies and associated practices evolve so quickly. Attempting to narrow the field of research for this study, the use of eBooks in educational settings was the refined topic. While there is much literature about the eBook product in academic scenarios, the focus is primarily on the areas of secondary education and higher education. There is little research that has examined the impact of eBook usage on basic literacy skills in the lower elementary classroom setting. Research on eBooks has primarily focused on the computer as the medium of delivery. This study focused on the use of eBooks delivered on a mobile device and in the lower elementary classroom setting.

Building on Flavell's (1979) Metacognition Theory, the choice of delivery medium for this study was the Apple iPad. Metacognition includes knowledge about the nature of people as cognizers, the nature of different cognitive tasks, and possible strategies that can be applied to the solution of different tasks. It also includes executive skills for monitoring and regulating one's cognitive activities (Flavell, 1999).

According to Miller's (1960) Information Processing Theory, the computer is a model for human learning. Like the computer, the human mind takes in information, performs operations on it to change its form and content, stores and locates it, and generates responses to it. The interactivity and usability of the iPad exemplifies both of these theories. Reading comprehension

can also be defined using this framework. Reading comprehension is not merely a rote recall of material, but rather an outcome that occurs when readers successfully make connections from a textual basis to a coherent mental representation of the text (Trabasso & van den Broek, 1985).

### **Research Question(s)**

The research questions for this study were:

**RQ1:** What is the difference in the reading comprehension scores of second grade students on the CBM when using multimodal features of an eBook read on an iPad and measured by the differentiated reading reports provided by the Storia App, compared to those of students who read a book with printed text?

**H<sub>1</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**H<sub>01</sub>:** There is no significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**RQ2:** What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks compared to those demonstrated by students who do not use the multimodal features each time?

**H<sub>2</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

**H<sub>0</sub>2:** There is no significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

For the purpose of this study, use of the multimodal features was considered consistent if the participant used at least one of the features during each reading session.

### **Identification of Variables**

The dependent variable in this study was the literacy skill of reading comprehension as measured by the multiple choice reading comprehension (MCRC) and Common Core State Standards (CCSS) portions of the Curriculum Based Measurement (CBM). Assessment of this skill was administered before and after the treatment in the study. According to Wolfe and Flewitt (2010):

Literacy is a communicative practice that is inherently social, grounded in the need to compile and share information between individuals or groups of every size. The purposes for which literacy is used range from expression of everyday needs through words, gesture and action, to the distant or future audiences” (p. 387).

Reading comprehension is formulated both in the active reading phase as well as the post-reading phase of the reading process and is typically indicated through recall of content in a variety of ways (Dowhower, 1999). The RAND Reading Study Group (2002) defines reading comprehension as a process that involves simultaneously extracting and constructing meaning through interaction and involvement with written language (p.11).

For the purpose of this study, the independent variables were the printed books and the multimodal texts of eBooks delivered on an iPad. An eBook is an interactive storybook that is multimodal in nature, providing the reader with a predetermined storyline but placing diversions



under the control of the user (Trushell, Burrell, & Maitland, 2001). Multimodal text allows for any combination of the following features to generate meaning: image, gesture, sound, music, speech, writing, and movement (Wyatt-Smith & Kimber, 2009). These features include elements such as non-linear progress through the text, cued animations, touch-sensitive material, voice, animated speech, and speech recognition (Baird & Henninger, 2011). The application used on the iPad for this study was the Storia App, which is published by the Scholastic Company. The Scholastic Company is the largest publisher and distributor of children's books in the world. Their Storia App has an ever-increasing library of their most popular titles (Robinson, 2014). Features of the Storia App include audio text, an interactive glossary, and a comprehension feature that targets key points on the page through a simple question or game. Differentiated reports for each participant that detail the usage of multimodalities are another important feature of this application. The stories chosen for this study (for both eBook and printed text) came directly from the second grade reading curriculum, which ensured that they were both developmentally appropriate and addressed topics of interest (Block, Cleveland, & Reed, 2004; Bridges, 2012). Furthermore, the stories chosen for this study fell within certain parameters based on reading levels as they appear on the gradient of text according to Fountas and Pinnell (2000). Students are given benchmark assessments throughout the year to determine their reading level. This alphabetical level correlates with the complexity of the types of the books the student can be expected to read independently, both fiction and nonfiction. These levels and benchmark assessments have been tested for validity and have been found to have a strong relationship in accuracy rates (.94 for fiction and .93 for nonfiction) when correlated to the Reading Recovery program, which is recognized by the U.S. Department of Education as an effective and scientifically based reading program (Viadero & Manzo, 2007). The grade level

expectations in reading for second grade are J through N, which correlate with the expectations of the school district used in this study.

The Apple iPad has emerged as a viable format for downloading and reading eBooks. It is a tablet computer that delivers much of the functionality of a laptop. It serves as an eBook reader but also has the ability to browse the web and to run numerous applications (Bayliss, Connell, & Farmer, 2012). Through its 2008 Mobile Learning Initiative to explore the value of mobile devices, Abilene Christian University (ACU) provided each student with a mobile device. ACU has most recently provided resources to faculty for examination of the efficacy of iPads in a paperless classroom. The findings from this research asserted that the iPad is a true mobile learning device, not just a novelty (Miller, 2012).

### **Definitions of Key Terms**

**Literacy:** Literacy can be defined as a multifaceted process of reading, comprehending what is being read and building vocabulary (Baird & Henninger, 2011). Literacy is used daily through words, gesture, and action, and for the human desire to participate in wider social and cultural practices (Wolfe & Flewitt, 2010). The literacy skill that will be assessed in this study will be reading comprehension. This is an age-appropriate skill that can be assessed for second grade students (IRA, 2002).

**Reading Comprehension:** Reading comprehension is the process of activating prior knowledge, generating questions, and constructing mental images while reading (Pressley, 2000). Students require skills in reading comprehension to access information and concepts in multiple curricula (Brown-Chidsey, Davis, & Maya, 2003).

**Digital Natives:** Digital natives are students from the Net Generation (born in the 1990s through the present day); they grow up with technology. These individuals have never known

life without the Internet (An & Reigeluth, 2011). Digital natives prefer receiving and processing information quickly, as well as receiving audiovisual rather than textual information. They are proficient in creating new multimedia by mashing up other sources (Lindquist & Long, 2011). The subjects in this study are second grade students, all of whom are digital natives.

**eBooks:** Electronic books, or eBooks, can be described as digital texts whose basic structure is similar to that of traditional books but are viewed on an electronic display (Felvegi & Matthew, 2012). Baird & Henninger (2011) describe electronic texts as interactive, multimodal in nature, and they incorporate many features, such as animations, voice text, and touch-sensitive material.

**iPad:** The Apple iPad is a tablet computer that can be used as a mobile digital reading device. A mobile digital reading device has the capability to store hundreds of books, newspapers, magazines, and blogs (Larson, 2010). Many of these devices include the ability to search the Web and some even have sophisticated features that include interactive applications. The iPad is most like a computer in its capacity to perform. The iPad will be the mobile device used in this study.

**Multimodal Features:** Multimodal features are interactive electronic resources such as audio text, images, video, and animations (Morgan, 2013).

**Common Core State Standards (CCSS) for English Language Arts:** The CCSS have been adopted by 45 states, the District of Columbia, four United States territories, and the Department of Defense Education Activity. These standards include reading, writing, speaking and listening, language, media, and technology (National Governors Association Center for Best Practice, Council of Chief State School Officers, 2010).

## **Research Summary**

This study was conducted using a quasi-experimental, nonequivalent control group, pretest-posttest design. According to Gall, Gall, and Borg (2007), this experimental design is the most common in educational research. It is appropriate as it causes the least disruption to the K-12 classroom environment. When studies are equated for crucial features (which is not always possible), nonrandomized experiments can yield a reasonably accurate effect size in comparison with randomized designs (Heinsman & Shadish, 1996). The study was conducted in six second grade classrooms in a small, diverse school district located in northeast Florida.

## **Assumptions and Limitations**

### **Assumptions**

Assumptions for the purpose of this study were as follows. All participants in the study received equitable time and access to the treatment. After instructing participants as to how the text was to be utilized on the iPad, the assumption was that all participants made use of these text-enhancing features when reading. Participants in the control group read only printed books during independent reading time over the six-week period. Students in the treatment group did not have additional exposure to the specific features of the iPad that were employed in the experiment beyond the classroom. Furthermore, it was assumed that students in the non-treatment group did not have exposure to the specific iPad application and eBooks that were being used in the experiment during the six-week timeframe.

### **Limitations**

Threats to internal validity include history and maturation; these involve either specific events happening or natural growth in ability between the pre- and posttest (Gall, Gall, & Borg, 2010). Because these are perhaps the greatest concerns of this research, these were mitigated by reduction of time between pre- and posttest as well as through the use of a control group.

Mortality, or participants dropping out, was treated through short-duration research. Use of statistical covariance also controlled for initial differences between groups before a comparison of the within-groups variance and the between-groups variance was made. This process made the two groups equal with respect to one or more control variables (Gall, Gall, & Borg, 2007).

Selection could also be considered a threat to the internal validity of the research. Due to the nonequivalent selection of the groups, any prior differences between the groups may have affected the outcome of the study. This threat was mitigated through the use of reliability-corrected analysis (Trochim, 2006). In this study, participating schools and classes were chosen on the basis of similarity of class population, school resources, and grade level in order to minimize this threat.

Threats to external validity included population validity. Population validity includes generalization (concluding that results may be generalizable to a wider population). Because this study was limited to two school populations, the threat would be the possibility that the results would not be generalizable to a larger population. This threat was controlled by heterogeneous groupings, settings, and times. The novelty effect, which states that a treatment may be effective simply because it is different from instruction participants normally receive, could be assumed as a threat in this scenario. To control for the novelty effect, the participants in this study came from classrooms that have iPads, and for these students, the iPad has been used in other subject areas.

## **CHAPTER TWO: REVIEW OF THE LITERATURE**

The twenty-first century has produced a new type of learner. Often dubbed a “digital native” (Palfrey & Gasser, 2008), this learner brings forth a fresh set of challenges for teachers and educational administrators. Having a constant immersion in multimodal technologies and experiences, these students have a need for teachers to address the discrepancy between the types of literacy experiences students encounter at school and those they practice in their daily lives outside the school environment (Lamb & Johnson, 2011; Larson, 2009).

Lindquist & Long (2011) describe today’s students as having a neomillennial learning style. This learning style is described as an affinity for fluency in multiple media and in simulation-based virtual settings, and communal learning, involving diverse, tacit, situated experience with knowledge distributed across a community and a context as well as within an individual. Although students are quite adept at using technology in their personal lives, they still seek guidance and approval from their teachers. The implications of this behavior are significant in that it is imperative for teachers to become better skilled in their own use of and comfort level with technology in order to better serve their students.

Teachers most frequently use technology for preparation, administration, and management purposes. It is rare that teacher use of technology facilitates student-centered pedagogy (Palak & Walls, 2009). While many educators are resistant to technological change in their methods of instruction (Means, 2010), the reluctance often comes from lack of confidence in their own ability to implement technology effectively. Strudler (2010) stated, “The fact is, though, nearly the entire field of technology and education is about change in some way. It’s about the dreams of what could be, the realities of what is, and the efforts to whittle away at the gap between the two” (p. 221).

Not only does technology provide engagement and relevance to young learners, it also provides efficient, effective, and financially prudent solutions that provide targeted support for struggling students. According to Chambers, Slavin, Madden, Logan, and Gifford (2011), of the many different types of interventions designed to assist struggling learners, one-to-one tutoring by certified teachers appears to be the most effective method. As this endeavor can be a costly and far-reaching ideal, educators have turned to computer-aided instruction (CAI) programs to fulfill the need to provide individualized instruction. Advances in educational technology programs enable teachers to diagnose areas of difficulty, provide engagement, increase implementation fidelity, provide instant and consistent feedback, and monitor progress through provision of ongoing reports.

Reading instruction is undergoing a tremendous transformation as new technologies demand new literacy skills (Leu, Kinzer, Coiro, & Cammack, 2004). Children are accustomed to multimodal experiences and therefore, will require a more elaborate skill set beyond the traditional linear method and model of reading text. Text has previously been perceived as written-down messages in the forms of books, magazines, and newspapers. Today, texts are viewed as much more than just written words (Larson, 2010). While the ability to read linear texts will continue to be the foundation for media instruction, new platforms of delivery will require development of specialized skills. Many interactive versions of well-known stories have been designed with specific developmental levels in mind (Lamb & Johnson, 2011). Just as students learn to decipher the most important elements of a narrative text, they must also learn to focus on audio, video, animation, and other elements connected to text in eBooks.

Au (2006) suggests that technology can be used to close the literacy achievement gap between students of diverse backgrounds and their mainstream peers if employed effectively.

These results can be attributed to features associated with electronic delivery of text, such as animations, provision of vocabulary, and audio capabilities.

While there is sufficient research to examine the use and effectiveness of eBooks, studies conducted to determine the eBook's value in the field of education have focused primarily on the use of e-books on a computer monitor. Although they are increasing in popularity, little research has been conducted to determine their effectiveness on a mobile device, such as a tablet or Apple iPad (Bayliss, Connell, & Farmer, 2012).

### **Theoretical Framework**

The process of reading is an academic skill that is required to be successful in all facets of the educational journey. One of the key components for achieving reading success is the ability to read fluently (IRA, 2002). Once reading fluency is intact, word recognition, comprehension, and even maintained interest and motivation are cultivated (Alber-Morgan, Rampo, Anderson, & Martin, 2007). Because the primary purpose of reading is to gain meaning from text (Wise et al., 2010), reading comprehension cannot be attributed to reading fluency alone, but rather as culmination of strategic cognition. Both Flavell's Theory of Metacognition, and Miller's Information Processing Theory apply to these stages of reading that lead to comprehension.

In his Metacognitive Theory, Flavell (1976) makes two differentiations of cognition. One is the awareness of one's personal knowledge, and the other refers to the control of personal cognition through the processes of checking and verification (Narvaja & Jaroslavsky, 2004). Rapp (2008) applies both aspects of this theory to readers' use of self-sufficiency and self-regulation to monitor their progress while reading. One of the challenges for successful reading comprehension is for readers to overcome initial propensities toward accepting everything they



read as inherently true. Employing Flavell's theory, the reader must make connections through personal knowledge, as well as employ control of his or her personal cognition by verification through prior or contextual knowledge, or through reconciliation of truth. When learners are equipped with this prior or contextual knowledge, there is less of a need for use of reading strategies. However, when that component is missing, general learning strategies are compensatory in bridging that gap (Garner, 1990).

Juliebo, Malicky, and Norman (1998) further this explanation of Flavell's two-pronged description of metacognition. Metacognitive knowledge involves the person, task, and strategy factors, which affect the outcome of cognitive enterprises, such as the personal capabilities and processes necessary to read successfully. Metacognitive experiences are described as "any conscious cognitive or affective experiences that accompany and pertain to any intellectual enterprise," which can involve evaluation or monitoring of ongoing cognitive processing (Flavell, 1979, p. 906).

Other theorists have brought forth different variations on the concept of metacognition. Schon (1996) distinguished between two types of metacognitive instruction – metacognition in action and metacognition on action. Raelin (2001) identified the stages of metacognition in action as (a) anticipatory, occurring prior to the learning experience (b) contemporaneous metacognition, occurring at the moment of the learning experience and (c) retrospective metacognition, or looking back at the experience. Metacognition on action takes place after the event has happened. It is when learning is constructed and evaluated.

While adults typically possess rather sophisticated metacognitive abilities, the developmental differences and stages cause difficulty in categorizing or defining when it comes to the capabilities and limits of children in this area. Hall and Myers (1998) conceptualize

metacognition as “thinking about thinking” (p. 8) and linking awareness of one’s own understanding with reading success. Although they state that children’s reading metacognition may include both accurate and inaccurate information about their own reading abilities and efforts, both types of information play a significant role in reading success. Their study found that children place more importance and emphasis on the role of effort rather than ability in reading. The perception of these children is that reading is one process that is heavily influenced by their own efforts and within their individual control. While the researchers found this ideology problematic, they also found that metacognitive strategies can be properly implemented in children by teacher modeling of the process of reading, as well as placing focus on causes of both success and failure rather than just performance praise.

The approaches of Jacobs and Paris (1987) and Cross and Paris (1988) follow a similar mindset when it comes to describing metacognition: self-appraisal and self-management. Similar to Flavell (1979), these two subcategories of metacognition focus on current and prior knowledge and capabilities, as well as planning, evaluation, and regulation. According to Jacobs and Paris (1987) metacognition is the conscious self-awareness of one’s own knowledge of task, topic, and thinking, and the conscious self-management of the related cognition. Self-regulation enables the reader to adjust to changing tasks and to successes and failures. When instructing students in reading skills, these factors are extremely important to facilitate successful self-regulated performance in reading.

Another interpretation of metacognition is the ability to know when one knows something and when one does not. Beran, Decker, Schwarz, and Smith (2012) conducted a study that monitored children from ages two and a half to five years as they performed a computerized task. Their research indicates that while full manifestation of metacognition is not

developed until adulthood, children are capable of incremental metacognitive monitoring at various stages of development. Older preschool age children in this study were able to monitor in a manner similar to that of adults in an equitable situation. In order to better develop these metacognitive skills and capabilities in young children, there must be repetition of strategic instruction, with the thinking that this procedural approach will eventually transform into automatic behavior.

Utilizing a similar viewpoint, Annevirta and Vaurus (2006) describe metacognition as the awareness that learners possess about their academic strengths and weaknesses, along with self-regulation abilities to optimize learning outcomes. They concentrate on the phases of young learners as they pertain to long-term performance in problem solving tasks. There is a differentiation in their work that categorizes the type of help that is sought at various stages of learning and development – and not all of them are conducive to successful learning or problem solving. Young learners may ask questions and somewhat self-regulate based on need for emotional support or encouragement. Low achievers were found to be more reluctant to seek academic help, either from misconception of understanding, or embarrassment over needing help. On the other hand, competent learners were efficient and had the tendency to seek academic assistance in such a way that it optimized their learning (Annevirta & Vaurus, 2006).

According to Pillow (2008), metacognition influences students' selection of learning strategies and monitoring of academic performance. His research indicates that there is a transition of cognitive development in the elementary years between the ages of four to five and six to seven. This transition evolves from believing exactly what one sees to grasping multiple interpretations of the same information (Pillow, 2008; Taylor, 1988). Further, children's knowledge about their cognitive activities increases greatly during the elementary school years,

to include memory, attention, inference, and interpretation. They are also able to consistently differentiate between imaginative pretending and reality by the age of eight.

Vernon-Feagans et al. (2010) suggest that to participate effectively in twenty-first century literacy practices, it is necessary to have access to human and material resources, such as people, books, computers, and Internet connections. People must have the ability to engage with these resources correctly. They also need a deep understanding of the potential of all of these literacy tools. This meta-level knowledge is crucial to young children's literacy success. Literacy skills are no longer relegated to decoding and simple processing skills but rather to be literate includes the ability to participate in literate thinking through the use of basic skills (including comprehension, word recognition and vocabulary) as well as critical thinking, writing and listening (Vernon-Feagans et al., 2010). There is a connection between how students interact with content text and their learning outcomes. Strategies such as Question Answer Relationships (QAR) and Questioning as Thinking (QAT) develop metacognition in readers. Readers must think about the cognitive processes required to achieve comprehension. These processes include tracking one's progress through self-regulation, and allow students to go from extracting information in the text that is rote and verbatim to constructing higher meaning through a framework that connects prior knowledge, inner dialogue, and analysis (Brozo & Simpson, 2003; Wilson & Smetana, 2011).

In their approach to describing metacognition, Schmidt and Sha (2009) present the idea that effective reading requires five characteristics. These include "continuous problem solving while reading using specific strategies, self-monitoring of comprehension, evaluation of the effectiveness of the processing and interpretation of the message, a possible shift in strategies, and continued monitoring until an acceptable interpretation of content is achieved" (Schmidt &

Sha, 2009, p. 254). This type of self-control is called metacognitive control. It describes how one is able to monitor one's comprehension, which in turn develops greater understanding or meaning-making, through continuous actions and planning. However it is not an inherent skill but rather one that must be taught. Training in metacognition helps not only improve students' metacognition but also their reading achievement (Schmidt & Sha, 2009, p. 257).

Metacognition is a construct that provides insights into learners' awareness and executive control of knowledge construction (Michalsky, Mevarech, and Haibi, 2009). Metacognition in reading involves a reader's thinking about the cognitive processes required to achieve comprehension. These processes include monitoring, understanding, and self-regulation. The motivation to initiate or activate this self-control or regulation is often achieved through providing students a perceived choice. Having control through choices in life facilitates proactive behaviors and is indicative of self-determining individuals (Deci & Ryan, 2008; Ryan, Deci, Grolnick, & LaGuardia, 2006; Vieira & Grantham, 2011). Because a child's attitude becomes more favorable when a task includes a sense of choice (Schraw, Flowerday, & Reisetter, 1998), it can be surmised that this extends to the task of reading. The perception of having a choice can influence reading engagement and success. The more young readers perceive control over their tasks, the greater the probability that these readers will become engaged in the act of reading (Guthrie, 2008).

Fountas and Pinell (2000) describe reading comprehension as a result of strategic thinking that enables information to be processed. However, all too often students are wrongly assumed to be cognizant of metacognitive strategies that enable successful reading comprehension. Instead, teachers should be giving explicit instruction in the strategies of questioning, visualizing, and synthesizing in order to better comprehend texts. While different

readers use different strategies for successful reading comprehension, it is also imperative that students receive explicit instruction in how to best implement these strategies. When modeled by the teacher in authentic ways, ownership of their learning can be turned back over to the students. Children develop metacognitive abilities and awareness regarding their intelligence at an early age, and it can be cultivated through proper feedback from both parents and teachers (Bingham, Holbrook, & Meyers, 2010).

Continuing this link between metacognition and successful reading comprehension is the process of monitoring comprehension. The acquisition of lower-level reading skills, such as word recognition and automaticity of oral reading fluency leads to a more rapid rate of accurate reading comprehension (Gorsuch & Tagachi, 2010). In studies by Pazzaglia, DeBenni, and Caccio (1999) and Kolic-Vehovec and Bajanski (2006), the relationship between metacognition and comprehension monitoring was examined. The results of these studies indicated a positive developmental trend in comprehension monitoring in upper elementary and middle grade students. This practice of comprehension monitoring has been found to produce higher academic achieving students (Kolic-Vehovec & Bajanski, 2006; Otero & Campanario, 1992; Zimmerman & Pons, 1986).

When cognitive monitoring is poor, students are not likely to seek remediation. With the misconception that they are comprehending, they will not engage in additional strategic learning to assist in valid construction of meaning. This behavior is particularly common with young learners, whose notions include that if they can make sense of the words, then they are reading successfully. Their internal vocabularies are incomplete, and they are much less likely than older learners to monitor cognition rigorously. They also often have a meager knowledge base and have a lower level of understanding of text structure. In these cases, deliberate instruction in and

modeling of proper reading strategies and cognitive monitoring can enhance learning (Garner, 1990).

Educational technology can provide cognitive tools that enhance cognitive powers during thinking, problem solving, and learning (Jonassen & Reeves, 1996). Use of these tools require that the device not serve as the teacher, or even a crutch for a struggling student. In fact, when computers carry out lower-level skills (such as decoding or defining words) the user is able to engage in a higher level of operation such as comprehension, making inferences or drawing conclusions. The implications of this research are that the use of educational technology has the possibility to enable struggling learners to overcome difficulties to help them achieve metacognitive monitoring processes (Ozcelik & Yildirim, 2005).

As educational technologies advance and become more prevalent, there will naturally be a shift to more Web-based learning. Web-based learning could encompass a range of learning choices to include student directed, externally directed, free choice, or a combination of all these (Hannafin, Hannafin, & Gabbitas, 2009). When looking at student-centered or student-directed learning, the cognitive demands shift from the structure and outline of instructor-directed learning to activities that include establishing individual learning goals, as well as seeking, anticipating, and assessing those individual needs and goals. While these advancements toward individualized and specialized educational opportunities are landmarks for helping reach multiple types of learners more effectively, the systems are not without problems. Emergent studies are finding that students often fail to enact metacognitive processes and are also unable to independently develop coherent explanations for their reasoning. The role of the instructor or facilitator is still a key factor in student success, even with the addition of technology (deJong &

van Joolingen, 1998; Hannafin, Hannafin, & Gabbitas, 2009; Land, 2000; Moos & Azevedo, 2008; Nicaise & Crane, 1999).

The Theory of Metacognition has been generalized as thinking about thinking. The instructions for the students in this study included strategic reading (CCSS, 2013) – questioning and word defining strategies for the control group and direct instruction for using multimodal features for the treatment group. This portion of the theoretical framework was assessed by the outcome of whether the use by the control group of strategic reading alone or the automaticity provided by the iPad device for the treatment group resulted in higher achievement in reading comprehension scores.

George Miller's Information Processing Theory (1960) involves two components. The first is the capacity of short-term memory, and how the capabilities of this memory are limited to between five and nine chunks of information at a time. The second consists of processing that information. After the chunks are taken into the short-term memory, then like a computer, the mind takes that information, changes its form and content, then stores, locates, and generates responses to it (Miller, 1960). Information processing theory is built into many instructional practices, such as helping students focus on the important details (so as not to occupy too much of the short-term memory capacity), assisting in the process by reminding students to make connections between new information and information they already know, presenting new material in an organized fashion, and once again focusing on meaning in order to further the process more efficiently. These practices almost perfectly align with the process of reading. A good reader uses strategies, such as noting details, making relevant connections, sequencing, and meaning-making (IRA, 2002).

Massaro and Cohen (1993) refer to information as representations derived by a person



from stimulation from the environment or from processing that influences selections among alternative choices for action or belief. They further theorize that information processing models describe a sequence of steps through which information processing is carried out. When processing information, one generally maps out a logical sequence, starting with stimulus decoding and response selection stages. Although information processing has taken on multiple specific identifiers since its inception, the overarching theme can be simplified as a study of how sensory input is transformed, reduced, elaborated, stored, retrieved, and used. When correlating these actions to reading, information processing makes sense, as over time it generally becomes a process where all of the stages seem to act at once (Hunt, 1980; Newell, 1980; Neisser, 1976; Swanson, 1987).

Kendeou, Muis, and Fulton (2011) define reading comprehension as the construction of a coherent mental representation of the text in the memory of the reader. Background knowledge, vocabulary acquisition, and oral reading accuracy are all components that lead to this ultimate goal of making that mental representation of text in the reader's memory. This explanation of the reading process is aligned with Miller's (1960) Information Processing Theory. Once the readers are able to decode with speed and accuracy with repeated practice, the words become a part of their stored memory, thus freeing up their cognitive capacity to concentrate on the next step or task. Continuing with the process, the greater the acquisition of vocabulary or word recognition, the more it becomes a part of the automatic stored memory continuing to free up cognitive capacity for higher-order thinking and processing (Lenhard, Baier, Endlich, Schneider, & Hoffmann, 2013).

LaBerge and Samuels (1974) also provide a connection between information processing and its relationship to reading success. They suggest that the journey taken by words from their

written form on the page to the eventual activation of their meaning involves several stages of information processing. By this connection they mean that a complex skill, such as reading, requires the coordination of many component processes in a short period of time. If the information process theory holds true, then good readers must reach a level of automaticity (fluency) in their ability to decode and process word recognition and meaning in order for a higher level of comprehension, or overall meaning within a passage or story, to take place. Also relying on the assumption that readers have a limited attention resource capacity that can be appropriated, reading fluency should be executed with minimal effort in order to achieve success in reading comprehension (Benjafield, 1997; Gorsuch & Taguchi, 2010).

This idea of automaticity is further supported by Gorsuch and Taguchi (2010), and Schrauben (2010). Automaticity in reading, or reading fluency, is critical for successful reading comprehension. The two components of fluency are accurate word decoding and word recognition. When readers have mastered these fluency skills, their information processing is concentrated on the higher-order skills that contribute to meaning-making from the text. Also referring to the influence of oral reading fluency on reading comprehension, Wise, et al. (2010) theorized that when the processing that occurs between the lexical and non-lexical route are more automated, the processing capacity for text comprehension is increased. Adding to this mindset, a componential analysis theory of reading conducted by Fredriksen (1982) contends that reading is not one single skill, but rather a combination of specific information processing components that work together to derive meaning from print. Frederiksen (1982) also states that skilled reading is automatic and involves executing the fundamental components with little conscious effort, allowing the reader to focus on more complex tasks such as comprehension.

The Information Processing Theory states that the capacity of short-term memory is limited to between five to nine pieces of information at a time before it is stored. The mind then takes that stored information, locates it, and generates responses (Miller, 1960). The Information Processing Theory correlates with the concept of reading comprehension in that reading comprehension is the result of the execution of multiple reading tasks including decoding, word recall or recognition, and the application of vocabulary knowledge. All of these work together to make meaning and allow for understanding of a passage or text. This portion of the theoretical framework will be assessed by whether the automaticity of these strategies provided by the multimodal features of the iPad result in higher achievement on reading comprehension assessments.

Taking an information processing perspective when examining reading includes both emotional and rational processing. Vieira, Jr. and Grantham (2011) posit that both reading interest and reading involvement and engagement include the activation of thoughts and feelings. This conceptualization means that reading includes both emotional and rational awareness, and that if there are high levels of emotional and cognitive processing, there is a high level of reading involvement (Buck, 1985, 2000). In this mindset, processing story text is part cognitive and part emotional. This type of reading leads to a deeper level of involvement wherein readers develop opinions about what they are reading and relate the story to their own experiences and perceptions. This type of participant involvement helps to develop long-term reading interest.

Educational technology integration has the capability to produce tremendous educative power in the classroom. Electronic books provide the critical element of engagement that allows students to interact with the text. This engagement has the potential to provide a more authentic reading experience and thus support young children's literacy and language development (Almaguer & Pena, 2010; Labbo & Reinking, 1999). Electronic books provide necessary

scaffolding for students with reading and processing difficulties. They also provide enrichment benefits for students who are already proficient in reading. Adding to these processing benefits, electronic books can also reach the most disinterested or reluctant reader through characters, situations, and settings that are connected to their lives (Brinda, 2011; Morgan, 2013).

Reading comprehension involves the integration of the unfolding of text with activation of reader's knowledge (Rapp, 2008). Both the Theory of Metacognition and Information Processing are relevant descriptors of the steps necessary to become a successful reader. The multimodal features of the Storia App that were used in this study provide the necessary components for this conceptual framework. Metacognition while reading calls for active thinking about the process including questioning and monitoring as well as vocabulary and fluency. The interactive glossary allows the user to immediately construct meaning of an unknown word. The audio text increases fluency by enabling quick decoding. The comprehension feature intersperses relevant questions throughout the text, thus increasing likelihood of understanding.

These scaffolding factors were also taken into consideration when looking at the Information Processing Theory as a component of the conceptual framework of this study. The automaticity of these multimodal features (interactive glossary, audio text, and comprehension questioning) provided the user with resources that could significantly reduce the amount of time often needed at this age level (second grade) for strategic reading.

### **Literature Section**

While thirty years ago reading comprehension was considered to be a passive process, the progression of research has led to the definition of reading comprehension as actually an active and deliberate practice (Bellinger & DiPerna, 2011, Yang, 2006). As reading is the basis for success in all other areas of learning, it is critical that children develop comprehension skills and

practical application skills of this knowledge (Cain & Oakhill, 2007). Students who do not learn to read within the first three years of school may experience extreme difficulties when they are expected to read to learn. Lack of development of reading skills during this early timeframe renders the concepts of history, mathematics, literature, and science inaccessible (Rader, 2010).

Reading comprehension is active and is the result of both cognitive and metacognitive strategies. Once students have learned to read, they must focus on reading to learn with a need to develop the ability to self-regulate their academic behaviors. As early as third grade, students are increasingly navigating through complex content-area texts. If students have not effectively learned to read (in the primary grades), they must focus their attention on the decoding and meaning of words rather than the overall meaning of the text (Davis & Neitzel, 2010).

Well-developed literacy skills are correlated with higher levels of academic achievement. These skills must exceed pronunciation of text to comprehension of the text. Instruction in reading comprehension should have a balanced approach. There should be deliberate, explicit instruction as to specific reading strategies as well as ample time for actual reading, writing and discussion of the text (Duke & Pearson, 2009). Students need to have effective strategies modeled to them through teacher read-alouds or small-group participation. Summarization, visualization, schematic connections, and questioning are all deliberate and effective strategies that can produce good reading comprehension (Duke & Pearson, 2009; Gregory & Cahill, 2010). Students who experience difficulties when reading typically have weaker phonological or decoding skills. They tend to skim over or skip unrecognizable words, resulting in a lack of comprehension abilities with grade-level appropriate texts. These students may also be lacking in the area of background or contextual knowledge that helps to contribute to interaction and engagement with text. Technology is seen as a solution that can help bridge those gaps. Although features offered by digital texts could potentially cause distraction or decreased reading

speed, the benefits of instantaneous reading resources outweigh those concerns (Wright, Fugett, & Caputa, 2013). In addition, according to the National Center for Education Statistics (2004), there is a nationwide insufficiency in reading that occurs within the transition from the lower elementary grades (grades 1-3) to the upper elementary grades (grades 4-5). About 30 percent of students nationwide did not achieve proficiency levels on standardized tests of literacy. This unfortunate situation weakens student learning outcomes across all curriculum and content areas. However, a reasonable and attainable solution is that of Information Communication Technologies (ICTs) that can potentially help bridge these crucial academic deficits (Safar & AlKhezzi, 2012).

ICTs are comprised of computers (both desktop and laptop) and handheld devices, such as tablets, eReaders, iPods, and iPads (Lamb & Johnson, 2011; Power & Thomas, 2007). The International Reading Association (IRA, 2009) has emphasized the necessity of utilizing ICTs in literacy programs. This utilization is primarily implemented through digital text and eBooks. Digital texts and eBooks have the overall appearance of text written in a traditional, linear format. However, many tools and features within these texts allow for physical interaction and manipulation in order to obtain deeper meaning and understanding from the text (Larson, 2010).

The advent of electronic books, or eBooks, can be traced back to 1971 as a result of Project Gutenberg, an organization that was the first to digitize texts. These books were read on computer monitors. By 1998, the first eBook reader was developed that enabled eBooks to be read on a more portable device (Bayliss, Connell, and Farmer, 2012). While eBooks have gained popularity over the last decade, researchers have only recently begun to evaluate the quality and benefits of this reading format (Shamir & Korat, 2006). Much of the research completed to date has been on the use of eBooks that are read on computer monitors, rather than on mobile devices (Larson, 2010).

Available to children today is a plethora of educational software that has great potential for supporting young students' literacy and language development. The features of eBooks enhance a strong print-based curriculum because they not only replicate storybooks, but add multimedia effects to facilitate student understanding of the literature (Shamir & Korat, 2006). Along with the engagement factor, these technologies also provide a privacy for failure that printed texts do not allow. In their study of children using electronic books on computers compared to peers that read printed books, Greenlee-Moore and Smith (1996) found that although children with printed books had similar vocabulary help from their teachers, there was no use made of this service. These researchers suggest that the privacy afforded by electronic texts to pronounce and define words provide an appealing alternative for young children to seek help while reading (Grimshaw, Dungworth, McKnight, & Morris, 2007).

Meskill (2007) proposes that the reading skills used in screen reading mimic those behaviors used in print reading and are based upon reader choice or preference. Readers of both media are able to manipulate the intent of the author by how they work their way through the text. Readers of print can either read in a traditional left-to-right, top-to-bottom format or scan and seek information that interests them. Likewise, those who prefer reading on screens can also use the approach of their choice. The difference lies in the creation and layout of the screen media. By anticipating the multiple ways a reader can seek information from a screen-based text, the author can set up the information in such a way that it serves his or her aims. Readers have grown so accustomed to being able to access meaning and information as they read that authors are finding more creative ways to impart their information through multimodal features within their texts (Meskill, 2007).

The 2010 Kids and Family Reading Report (Scholastic, 2010) states that one-third of children ages nine through 17 would read more books for pleasure or fun if they had access to

eBooks. This report also included both groups of children who read five to seven days per week as well as those who read less than once a week. Children's considerable interest in e-book reading stresses an importance for educators to better understand how to effectively integrate this technology into educational settings (Larson, 2012). The rapid pace at which technologies emerge causes the relationship between literacy and technology to be continuously transitional and transactional. Although an e-reader or e-book does not physically change print text, some forms of eBooks or e-texts can literally change when used in a digital format. These changes can include hyperlinks, audio, images, and video. While these emerging technologies provide an abundance of reading experiences for children, challenges arise when teachers try to integrate these technologies into reading instruction. Devices, such as the Kindle or Nook offer e-book texts that are relatively linear – similar in format to traditionally printed books. However, multimodal digital text that is accessed on a tablet computer device, such as the Apple iPad, requires a different strategic skill set than when reading a traditionally printed book (Larson, 2012).

Oakley and Jay (2008) also insinuate that students in the eight to -11 age group are a prime target group for utilizing electronic reading media. At this age, children transition from a concrete to a more complex and abstract mode of thinking or learning. Children in this age group who perceive that they have control over what they are reading are engaged and have confidence in their abilities to produce positive outcomes from their reading. They argue that at this age level, there can be a slump or reluctance in reading if a child has difficulties or does not have access to material that is of interest. It is at this age that electronic books can provide motivation through a variety of contexts to students, especially boys, who may perceive that books are not as engaging as other interests. Using electronic texts at this age can also open up access to higher-level texts. Readers who lack confidence can concentrate on comprehension skills because the



features of electronic books mitigate the hindrances of decoding and fluency problems (McKenna, 2002). Adding to this line of thinking, Csikszentmihalyi and Schneider (2000) state that the enjoyment and engagement associated with student choice of reading material, and in particular the reading of fiction, will extend to other genres that can facilitate learning and growth (Vieira & Grantham, 2011).

The age group for this study was elementary students in the second grade. Students in this age group were chosen because at this stage of development, reading fluency transitions from a simple decoding of words to rapid word recognition. The strengthening of this fluency allows for processing to occur, thus increasing a reader's ability to understand and comprehend text (Burns et al., 2011). The structure of curriculum at this grade level does not often allow for deviation into books of personal choice for school-based reading. However, the autonomy of using a mobile device for reading, combined with a personal bookshelf of age-appropriate texts could give students a perception of control. According to Cordova and Lepper (1996) when students are given meaningful options in a digital task, their intrinsic motivation levels are higher, resulting in higher levels of engagement. This motivation will in turn produce deeper-level learning in a shorter amount of time.

Of the research done on electronic books, the medium of delivery has typically been electronic books delivered via the computer. Because mobile technology devices are relatively new, the research on these devices is emergent. Of the research that has been done on mobile devices, many of these studies have been performed at the secondary and higher education level (Bayliss, Connell, & Farmer, 2012; Broadhurst & Watson, 2012; Cummins & Stallmeyer-Gerard, 2011; Beard & Dale, 2008; Larson, 2009). However, studies that have been done on eBooks read on mobile devices in the primary grades have been either qualitative in nature, with minimal subjects (Larson, 2010; McClanahan, Williams, Kennedy, & Tate, 2012), or a broad

generalization of the product and its capabilities for this age group (Baird & Henninger, 2011; Lamb & Johnson, 2011).

The mobile device that was utilized in this study was the Apple iPad. While studies have shown that the iPad device is a tremendous resource for working with students that have special needs (McClanahan et al., 2012; Price, 2011), there is little to no quantitative research on the use of iPads as a mobile reading device for growth in literacy skills of elementary-age students – particularly those in the second grade.

The Apple iPad enables a reader to access books through the iBooks application. Features of this device include interaction through image galleries, videos, audio text capabilities, 3D images, and Internet access. Users can manipulate images, videos, and audio features as needed for clarification and understanding (Apple, 2014). Unlike other mobile eReader devices, the iPad is actually a tablet computer that approaches the functionality of a laptop (Bayliss, Connell, & Farmer, 2012).

Despite the increase in availability and popularity of eBooks, research on their effects is scant (Bayliss, Connell, & Farmer, 2012). While digital learners are anxious to read more books on electronic devices, educational administrators are more likely to invest scarce budget dollars in technologies that are proven to deliver results (Lamb & Johnson, 2011). Larson (2008) stated that “additional research is needed to realize the full potential of eBooks and their impact on reading behaviors” (p. 124). eBooks are motivating to young readers and promote comprehension and literacy development (Baird & Henniger, 2011; Bayliss, Connell, & Farmer, 2012).

Supporting the idea that using a medium other than traditionally printed books can be engaging and motivating to a younger audience, McLuhan (1964) made some rather forward thinking predictions over forty years ago. He stated that “the medium is the message” (p.23).

These words ring true even in today's multimedia society. In other words, there is a symbiotic correlation through which the medium affects how the message is recognized and understood (McLuhan & Gordon, 2003, Safar & AlKhezzi, 2012). Current research adds to the thought that the medium is the message. Although the medium does foster engagement and interaction, equally important are the content carried out through the medium as well as the pedagogical approach that facilitates learning through the use of the medium (Safar & AlKhezzi, 2012).

Mobile and educational technologies are still considered to be in an emergent state. However, as they are becoming more prevalent, these technologies are becoming more affordable options for schools to meet the growing demand for meeting the needs of digital learners. Castells and Cardoso (2005) state that our society has transformed from an industry-centered society to an information-centered society over the past two decades. Along with these changes, it is expected that educational systems would change to reflect society although the current educational system does not completely reflect the needs of its society. Often, many educational organizations operate with the mindset for meeting the needs of an industrial society. However, if the major goal of education is to prepare students to successfully operate in society, then there is a much-needed paradigm shift with regards to the implementation of educational technology in the classroom. As it stands now, there is currently a discrepancy between what is taught in schools and how students are expected to operate in society (Aslan & Reigeluth, 2013). If the problem does not lie with the availability of technology in the classroom, then there must be other barriers to bringing education to a standard where it meets the current needs of society.

Having grown up immersed in a multimedia, multisensory environment where every source of information is available via an electronic screen, and entertainment comes in the form of television, video games, movies, portable computers, and smartphones, many younger students have developed learning styles that are largely visual. The common use of sound bites

and snippets of video clips as an accepted form of information transmission in news media and other entertainment outlets has resulted in limited attention span of viewers, which trickles down to the younger generation. Students raised in these environments of visual stimulation can be expected to have significantly different expectations when it comes to pedagogies for learning. Whereas most students probably perceive technology integration in their schooling as necessary, their teachers may perceive it to be an enhancement or enrichment opportunity – beyond the curriculum (Jackson, Helms, Jackson, & Gum, 2011).

In previous generations, the teacher was the sole interpreter of knowledge for students, and books were the primary resource of information. The current tenor of education includes a desire to embrace educational technology but requires a certain shift on behalf of teachers in order to modernize the teaching-learning process (Singhal, 2013). A common theme among researchers when looking at barriers to educational technology integration is that of teacher compliance. Although almost every school has Internet access and generally a 1:4 computer-to-student ratio, this availability to technology resources does not always translate into improved classroom teaching practices or remarkable increases in student achievement (Inan & Lowther, 2010). Whether it is due to lack of knowledge, comfort level, or even differing beliefs, the teacher is often the catalyst for change within the classroom setting (Aslan & Reigeluth, 2013; Kurt & Ciftci, 2012; Lu & Overbaugh, 2009). The state of education is at a crossroads where its seasoned veteran teachers are digital immigrants and have to learn new methods and technologies at a point in their careers when they should be the experts in their field. The younger generation of teachers have had the advantage of growing up within a digital society and are much more adept at learning and integrating new technologies. In either scenario, the effective use of technology in the classroom is closely related to the amount and types of training that teachers are provided. In fact, teachers who spend more time in targeted professional

development are better prepared and generally more likely to utilize technology in the classroom than their lesser-prepared colleagues (Atkins & Vasu, 2000; Ertmer, 1999; Lu & Overbaugh, 2009; Smerdon et al., 2000; U.S. Department of Education, 2000).

Overall, school climate will also contribute to success in educational technology integration in the classroom. Wong et al. (2008) describe a positive school climate as the quality of a school that fosters creativity in teachers, and inspires enthusiasm as well as a sense of ownership. Teachers that work in a supportive environment where they can take risks without fear of retribution are often more willing to embrace new methods of instruction afforded by educational technology. To better able bring students up to the standards of learning they need to meet in order to be successful 21<sup>st</sup> century workers, teachers must go beyond using technology as a supplement to education. They need to employ it as a means of education. Providing support through training and realistic expectations of administrators can go a long way toward providing an effective school climate that is receptive to such a shift change (Ertmer & Offenbreit-Leftwich, 2010).

Proper teacher preparation and training will fall in the hands of school administrators. Lu and Overbaugh (2009) attribute successful integration of educational technology in schools in their region of mid-southeastern Virginia primarily to administrative support. They state that support of administration is the gateway to the other multiple factors that contribute to successful technology integration. Teachers are on the front lines with regards to implementation, and that requires an investment of time and resources that cannot be allotted without the direct approval of administrators. Reigeluth and Duffy (2007) argue that this type of investment or change must not be piecemeal. With the need to deviate from a piecemeal type of change to a full-blown systemic transformation, it is important for school district personnel and administrators to make strategic technology planning a priority (Vanderlinde & Van Braak, 2013). As schools are often

under increasing scrutiny to present change, often via underfunded or unfunded mandates, school systems can tend to make superficial changes without true reform or adoption. Too often, a change is presented, teachers are given an afternoon of professional development, and then expected to take the tools and effectively implement change in their instruction. Shamir-Inbal et al. (2009) offer an option that could feasibly provide an affordable, attainable, and meaningful alternative to professional development for technology integration. By scaffolding training over a three-year period, they first trained a percentage of enthusiastic and willing teachers who were trained in not only website development and organizational tools but also instructional technology methods. These teachers then became mentors to another percentage of teachers, helping them to build their own websites and integrate instructional technology into their lessons. This method provided less proficient teachers an in-house resource for questions, concerns, and troubleshooting. The findings of their research enabled schools to obtain meaningful results. The climate among teachers created collaboration, motivation, and ultimately, creativity.

School systems are beginning to embrace technology methods to offer information and professional development for teachers through cloud-based methods, such as Google Apps, Google Docs and Dropbox. Other online programs, such as Adobe Connect provide an affordable way to disseminate a common message to an entire school system. Adobe Connect allows for the delivery of a videoconference with the capability for real-time feedback. Use of these types of web-based technologies provides attainable and realistic possibilities for meaningful professional development. (Morrison, 2011; Robertson, 2013). These technologies also lay the groundwork for the deluge of content that is forthcoming with the nationwide adoption of the Common Core State Standards. (Morrison, 2011; Robertson, 2013).

Along with meeting the learning demands of students in the 21<sup>st</sup> century, many teachers nationwide have been tasked with implementing an entirely new set of standards, K-12. The

Common Core State Standards (CCSS, 2010) are an initiative that seeks to ensure that students are college-and career-ready by graduation. The standards were first implemented in lower elementary levels and have worked their way through the higher grade levels via a blended approach. Many states are looking to have fully implemented with the standards in all grade levels by 2014. The benefit the CCSS affords is that states can all be on the same page with regards to what content is taught and when it is taught. These standards emphasize rigorous methods of instruction, combined with an emphasis on informational and complex text in all content areas.

With the introduction of the Common Core State Standards Initiative (2010), teachers will now have to reassess how reading instruction is delivered. Students will have to go from basic text extraction to meaning construction through thinking, problem solving, and supporting their answers with evidence from the text (Lamb & Johnson, 2012). Going beyond the basic textbook, the CCSS emphasize the use of a variety of informational resources to assist in learning. Multimedia and multimodal features of educational technology are prime factors in helping extract meaning from almost any subject. Although with access to such a wide variety of information, students will need to develop the analytical skills necessary to determine the accuracy of the information they are seeking.

Strategic reading, such as close reading, is considered the key to comprehending more complex texts that will be the focus of the CCSS. Close reading is actively seeking thoughtful engagement with high-quality literary and informational texts (Morrow, Shanahan, & Wixson, 2013). Students will be expected to go beyond literal meaning to an inference. As student populations continue to grow in diversity, this expectation or assumption of background knowledge on the part of the reader becomes increasingly complex (Mills, 2009). In a study by Lapp, Fisher, and Grant (2008), strategic reading was achieved through fostering student

independence in comprehension monitoring through guided modeling. The researchers found that guided modeling helps provide needed scaffolding as well as practice in independent comprehension monitoring. Educational technology, such as the multimodal features that are embedded in electronic texts, are not only effective but greatly efficient in facilitating strategic reading through an approach that is both timely and better understood by students of the 21<sup>st</sup> century (Jewitt, 2006).

The CCSS are designed to set the stage for college and career readiness (Wixson & Lipson, 2012). While the CCSS do not include a specific standard for technology and media, the assumption of the standards is that being literate is synonymous with being digitally literate (CCSS, 2010). Under these standards, students will be expected to critically read a range of print and non-print texts, as well as multiple forms of media. These standards also emphasize the need to produce savvy digital composers through evolving familiar print-based literacies into multimedia-style projects. Kress and VanLeeuwen (2001) state that all meaning-making in literacy is multimodal and is inclusive of linguistic, visual, audio, gestural, and spatial components. These emphases imply that a shift toward more digital immersion and integration is imperative even in the early elementary grades (Dalton, 2012).

Another pronounced change in the CCSS that is a shift from current expectations is that of a curriculum that reflects an equitable mix of both literary and informational texts. This shift reflects the need for students to master the types of text that they will encounter at the college and career levels. The expected emphasis for elementary grades K-5 now involves 50 percent literary and 50 percent informational texts. The complexity of informational text at any given level is more likely to contain technical and higher-level academic vocabulary (Neuman & Roskos, 2012). These conditions provide a much greater lexical challenge to students than ever before. Shanahan, Fisher, and Frey (2012) indicate that the biggest challenge for students when



tackling these informational texts is that of vocabulary knowledge. Without understanding the ideas and words introduced by authors, little meaning is derived. They further elaborate that while domain-specific terms are important to foster comprehension, there must also be a blended approach that includes general academic terms that can be recognized in other settings and subject areas.

While teachers can teach specific strategies to assist in the area of vocabulary knowledge and acquisition, the automaticity provided by the multimodal features of digital text can expedite the process. Informational texts often contain features such as the glossary or index to assist in vocabulary acquisition. However, if a young and/or a struggling reader has the ability to instantaneously synthesize the text, she/he will increase comprehension through understanding and even enjoying the text (Bromley, 2012).

### **Summary**

This study encompassed the use of the iPad mobile reading device for eBooks in a second grade classroom. Using the Theory of Metacognition and the Information Processing Theory, this study examined the impact on the reading comprehension scores of second grade students. Although eBooks have been around in some form or another for well over two decades, more studies are needed to examine how students interact with these texts (Larson, 2010). While eBooks on mobile devices have shown promise in supporting struggling readers through their multiple unique features, further research is needed to enable increased use of these devices in the instruction of students in all grade levels.

### **CHAPTER THREE: METHODOLOGY**

This quantitative quasi-experiment compared the reading comprehension scores of second grade students in two groups. This experiment was conducted using nonrandom, convenience sampling and used both a treatment and a control group. Students in the treatment group read books on an iPad with access to multimodal features during their daily literacy block for approximately fifteen minutes per day, four days per week. The control group read traditional printed books during their daily literacy block for approximately fifteen minutes per day, four days per week. Participants were second grade students from two different schools in a small, diverse school district located in northeast Florida. Statistical analysis using an analysis of covariance (ANCOVA) was performed for all research questions.

An ANCOVA tests the hypothesis that the population means for the dependent variables are the same for all levels of a factor. The ANCOVA investigates group differences among several dependent variables while controlling for factors that may influence those dependent variables. This analysis evaluates a hypothesis that includes both equality among group means on the dependent variables and equality among group means on linear combinations of the dependent variables (Gall, Gall, & Borg, 2007; Green & Salkind, 2011).

#### **Design**

A quasi-experimental, nonequivalent control group, pretest-posttest design was used to determine the difference in the reading comprehension scores of second grade students when reading eBooks delivered on an iPad as compared to students who read the same books printed in traditional format. According to Gall, Gall, and Borg (2007), this experimental design is the most common in educational research because it causes the least amount of disruption to the K-12 classroom environment. Shadish and Ragsdale (1996) state that while the randomized

experiment is the most desirable design, in many situations it is not feasible. These situations include working with intact groups, such as classes and schools and provide reasoning for choosing this design for this particular study. While quasi-experimental design lacks the strength of random assignment, it can actually present the experimental situation in real-world conditions, which increases the external validity (Henrichsen, Smith, & Baker, 1997). With legislation, such as the No Child Left Behind Act (2001) as well as Race to the Top (2009), there is a need for scientific study in the field of education. Quasi-experimental research fits this need in that it takes relevant questions, investigates those questions, correlates them to a conceptual framework, and through reasoning produces findings.

The label quasi-experimental describes an approach that can produce much knowledge if correct steps are taken to create group equivalency upon selection for participation. These steps include working with school personnel to select schools, teachers, and students who are willing to try the experimental program and then selecting other schools with characteristics similar to those of the experimental schools. These steps help affirm that observed differences between the experimental and control groups can be attributed to the treatment (Gall, Gall, & Borg, 2010). Although true, controlled experimental design is ideal, quasi-experimental design can serve the purpose when threats to validity have been identified and eliminated (Campbell & Stanley, 1963; Borg & Gall, 1989). This study consists of a pretest, treatment and posttest and is examining the reading comprehension scores of students in an elementary school setting. The minimal impact on the elementary students' instructional schedule, combined with the use of current curriculum as well as the convenience of intact groups indicate that the quasi-experimental design is highly appropriate for this particular study.

### **Questions and Hypotheses**

The research questions for this study were:

**RQ1:** What is the difference in the reading comprehension scores of second grade students on the CBM when using multimodal features of an eBook read on an iPad, and measured by the differentiated reading reports provided by the Storia App, compared to those of students who read a book with printed text?

**H<sub>1</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**H<sub>01</sub>:** There is no significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**RQ2:** What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks compared to those demonstrated by students who do not use the multimodal features each time?

**H<sub>2</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

**H<sub>02</sub>:** There is no significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

For the purpose of this study, use of the multimodal features was considered consistent if the participant used at least one of the features during each reading session.

## **Participants**

The participants in this study were the students of six second-grade classes.

Three classes participated in the iPad eBook delivery group. The other three classes participated in the printed text group. These participants were selected using a nonrandomized, convenience sample. According to Gall, Gall, & Borg (2007), although it is more difficult to make valid inferences through the use of nonrandom sampling, this method is used prevalently in the social sciences because of the ease of studying individuals in their natural environment. Because this study involved elementary-age students, this type of sampling seemed most appropriate.

Both treatment and control groups contained similar representations of gender, ethnicity, and socioeconomic status. There were three classes included in each of the treatment and control groups with a population size of 80.

## **Setting**

This study was conducted in six second-grade classrooms. The treatment group was located at one school, and the control group was at a different school. These classes were located in a small public school district that currently serves approximately 32,000 students. This district serves a diverse population of students who live in rural, urban, suburban, and beach communities. The population is 87% White, 8% African American, 2.5% Hispanic, and 2.5% Asian and other minorities. Approximately 25% of students in this district are on the free and reduced-price lunch program. There were three participating classes each from two elementary schools. The classes have all received reading instruction using the same literacy curriculum. All classes in the study have had a similar literacy block procedure (whole group and guided reading instruction), as well as a similar time of day in which literacy instruction has taken place. These two schools have also followed the same curriculum pacing guide, so the participants have been exposed to the same path of reading instruction up to this point in the academic year. This

common curriculum pacing added to the fidelity and validity of the study. The three treatment classes were located at Elementary School P, in northeast Florida. The surrounding neighborhood is comprised of both affluent suburban residential communities and several multifamily residential rental communities. The second school, Elementary School L, is located approximately twelve miles from Elementary School P. It also serves several affluent suburban residential communities as well as some multifamily rental communities. All classes were comprised of the same number of students (due to Florida's class size regulation), and not one of the classes was specialized for gifted or other alternative instructional services.

### **Instrumentation**

Unlike other reading competencies, such as fluency and vocabulary, the active processes of reading comprehension cannot be directly observed. Also, because comprehension is actually the result of multiple skills, assessment can be difficult (Bellinger & DiPerna, 2011). The CBM is a widely used curriculum-based assessment that has been designed to assess students in the areas of reading, spelling, writing, and math. The CBM includes having students complete brief, standardized tasks that are drawn from the local curriculum. Because they are standardized, the CBM tasks fulfill the aims of evaluating all students' progress using common assessment methods (Brown-Chidsey, Davis, & Maya, 2003, p.364). According to Hale and others (2007), the CBM is a commonly used and well-researched method for assessing students' reading. The CBM has strong psychometric properties and is considered to be a valid and reliable measure of assessment for reading (Marston, 1989). Hintze and Silberglitt (2005) state that using the CBM as a diagnostic tool can effectively enable educators to screen for students (sometimes as early as first grade) who are at risk for failing high-stakes state testing programs.

The easyCBM program is an online assessment tool that was designed by researchers at the University of Oregon as an integral part of a Response to Intervention (RtI) model. Launched

in 2006 and currently distributed by the Houghton Mifflin Harcourt Publishing Company, easyCBM is an approved tool by the National Center for Response to Intervention. The online assessment system provides both universal screener assessments for fall, winter, and spring administration, as well as multiple alternate forms of progress monitoring measures that are designed for the K-8 setting (University of Oregon, 2011).

The assessment that was used in this study consisted of the Multiple Choice Reading Comprehension Measure (MCRCM) and the Common Core State Standards (CCSS) reading measure. The easyCBM database contains 20 reading passages for the second grade level of the MCRCM. Each of the passages contains 12 comprehension questions – seven literal and five inferential. Questions were written to include a range of difficulty from easy to moderate to difficult in each of the two types of questions on each test. The MCRCM has been analyzed using a Rasch analysis, which examines a test's reliability. This Rasch analysis provides a reliable reporting of adequacy because it reports the range of difficulty of each item on the test. Because the most reliable estimation of a test-taker's ability can be obtained from tests that are representative of the fullest difficulty range for its population, the Rasch analysis is a valid and reliable source of evaluation for this assessment. The acceptable fit range for questions as determined by the Rasch model is 0.50 to 1.50. Mean square outfits that do not fall within this range indicate a need for further evaluation. All items in the pilot testing of the MCRCM passed the acceptable fit requirements for the Rasch model, with the exception of two questions that were considered poor-fitting out of the seven versions of the assessment that were tested. Further analysis of distractors in these two questions was performed, resulting in retention of the two items without revisions (Alonzo, Liu, & Tindal, 2008).

The CCSS reading measure was designed to address the literacy standards of Literature, Informational Text, and Literacy in Science and Technical Subjects. Each assessment consists of

four short reading passages (three to five paragraphs each), and one diagram or informational chart. Each passage has five multiple-choice questions, for a total of twenty-five questions. Having been designed with a universal accessibility for the majority of students (to include the lowest 20th percentile), the third grade portion of this assessment will be more appropriate for this study. The combination of the twelve questions of the MCRC and the twenty-five questions of the CCSS should provide a robust assessment for the purposes of this study (Alonzo, Park, & Tindal, 2011).

A study performed by Nese, Park, Alonzo, and Tindal (2011) examined the use of several easyCBM reading measures and their diagnostic accuracy and predictive validity with regards to high-stakes testing. According to the findings of this research, the vocabulary and multiple choice comprehension reading measures were strong indicators for success on high-stakes, standardized testing. The bivariate correlations between the easyCBM measures and the criterion measure were in the moderately high range (.59 to .72).

### **Procedures**

After IRB approval was obtained, two schools and three second grade classes within each of these schools were selected to participate in the study. The iPads and the printed texts were prepared for implementation, including loading the Storia App, building the virtual bookshelves, and loading the student tracking information within the app. Because the Storia App can generate a record of time spent reading a text as well as how often a student accesses the multimodal features of the app, there were identification numbers assigned to each participant to organize these data. These identification numbers also allowed for privacy and confidentiality and were used for the duration of the study. For the control group, book baskets were compiled with the same titles that were on the virtual bookshelves.



Teachers sent permission forms home with all students in their classes. Upon return of these forms, meetings were set with participating teachers to train for the experiment. There was training was conducted by the researcher that included a script for all teachers to follow when administering the CBM assessments. There was also a script for teaching the students about the features of the Storia App in the treatment group. The script for the control group included instructions for guiding the students to the three reading strategies of dictionary use, peer reading, and questioning. Use of a script for each of these processes was another step to foster fidelity and inter-rater reliability among each of the groups.

Inter-rater reliability refers to the degree to which different observers give consistent estimates of the same phenomenon (Trochim, 2006). This study relied on six teachers to both administer the pretests and posttests as well as implement the independent reading sessions. In order to increase inter-rater reliability, the researcher observed each teacher administering the directions. These observations allowed for clarifications and uniformity of administration. Further adding to the reliability, the researcher also checked in with the teachers every two weeks to ensure that the treatment and control groups were receiving equitable exposure as indicated by the instructions. The reports from the Storia App were also immediately accessible to the researcher and were one more tool with which to monitor involvement by the treatment group.

Once participating classes were chosen, the CBM assessment was assessment. Once the pretest was given, the experimental group used the Storia App on their iPads in a one-to-one format for their independent reading time - approximately 15 minutes a day, four days a week. The students in the control group read from the selected bookshelf of print books for their independent reading time – approximately 15 minutes a day, four days a week. Both groups engaged in this activity for a total of six weeks. Students who were using the iPad were

instructed on the multimodal features of the eBook but were not directed as to when to use these during reading. The tracking feature of the Storia App allowed the researcher to generate individual reports for each participant's independent use of the app. The reports included time spent reading as well as how often the participant accessed the multimodal features of the app, such as the interactive glossary, the read-aloud feature, and the comprehension quizzes. These reports enabled the researcher to verify that the features of the app were used during the study and their effect on the participant's reading comprehension scores. The students in the control group were provided general instructions at the beginning of the six-week period to include the specific reading strategies of dictionary use, peer reading, and questioning to assist them when reading. This reading strategy instruction was included for the control group to provide equal opportunity to have physical access to similar strategies that were provided to the treatment group through the use of the Storia App. Students in the control group also received a bookmark with the strategies listed as well as dictionaries in their book baskets for access to word definitions. At the end of the treatment, the posttest was administered, and data were collected and analyzed for results.

### **Data Analysis**

The Analysis of Covariance (ANCOVA) is a statistical technique that is used to control for initial differences between groups before a comparison of within-groups variances and between-groups variance is made. As Gall, Gall, and Borg (2007) explain, "The outcome of the ANCOVA is to make the two groups equal with respect to one or more control variables" (p. 320). The ANCOVA equalizes the treatment and control group by adjusting each participant's posttest score (either up or down) by accounting for their pretest score. Since there is one dependent variable (reading comprehension) in this experiment, this analysis is appropriate (Gall, Gall, & Borg, 2010; Green & Salkind, 2011). The ANCOVA was chosen for this study

because of the pretest-posttest design. Use of the pretest as the covariate in the analysis adjusted for differences between the groups. It also increased statistical power by reducing the bias and statistical error.

Before the ANCOVA was conducted on both research questions, assumption tests had to be conducted. With nonrandom assignment, there are some difficulties to overcome with the use of ANCOVA. Because ANCOVA analysis can have biased results when used for a nonequivalent control group, certain tests of reliability must take place in order to remove the bias. In order to be thorough, Descriptive Statistics, the Test of Linearity, and the Assumption of Homogeneity of Regression Slopes – which has a high estimate of reliability - were used when conducting the analysis (Trochim, 2006). In their study of the appropriate use of ANCOVA as a statistical analysis for nonrandom assignment of subjects, Dalton and Overall (1977) state that “while ANOVA (analysis of variance) and ANCOVA are very similar in their basic general linear models, important differences in the precision of control over extrinsic sources of variance are present. Thus a blanket injunction against nonrandom assignment in ANCOVA appears unwarranted” (p. 59). Although the use of ANCOVA in nonrandom assignment is sometimes an issue among researchers, it can be used in research among existing groups, such as classes of students. ANCOVA may not be ideal because it cannot control for all possible differences; however, it does help reduce systematic bias (Bickman & Rog, 1998, Pallant, 2010).

In order for ANCOVA to be used appropriately, there are specific assumptions that must be met. A first assumption to examine is that the independent variable is comprised of two or more categorical, independent groups. There should be no overlap of group members within another group. The assumption of normality is that the dependent variables have a multivariate normal distribution of scores for each population. While removal of outliers can help ensure that this assumption is met, a violation of this assumption can lead to an increase in Type I errors.

Another assumption is that variances of the dependent variable for the conditional distributions described in the first assumption are equal. Yet another is the homogeneity of variances. This is tested using the Levene's test for homogeneity of variances. The relationship between the dependent variable and the covariate should be linear. Scatter plots can be used to test for this linearity but should be checked separately and should result in a straight line. Any curved lines must be corrected either by transformation of the variable or dropping the offending covariate from the analysis. There must be homoscedasticity, or having equal statistical variances. There should also be homogeneity of regression slopes with no interaction between the covariate and the independent variable (Green & Salkind, 2011; Pallant, 2010).

Once all assumptions were met, the Statistical Package for the Social Sciences (SPSS) software was used to conduct each analysis. For the first research question, the pretest served as the covariate. The dependent variable was reading comprehension, and the independent variables analyzed were the use of traditional printed books and the use of multimodal features on the iPad during reading. For the second research question, the pretest again served as the covariate. The dependent variable was reading comprehension and the independent variables were the use of multimodal features of the iPad during each reading session and nonuse of the multimodal features of the iPad during each reading session.

## CHAPTER FOUR: FINDINGS

This quasi-experimental pretest-posttest design study focused on the use of multimodal features of an iPad during reading and its effect if any on reading comprehension. The study was conducted at Elementary School P and Elementary School L, both located in a moderately sized, economically and ethnographically diverse school district located in northeast Florida. Three second grade classes from each school participated in the study. The classes at Elementary School P served as the treatment group, and the classes at Elementary School L served as the control group. Due to Florida's class size requirements, each class contained no more than 18 students. Of the possible 108 students in these classes, 78 students actually participated in and completed the study. There were exactly 39 participants in each group. After all students took a pretest, the treatment group read multimodal texts on the Storia App on an Apple iPad and the control group read similar titles of printed books for a total of six weeks. At the end of the six-week period, a posttest was administered to all participants. The research questions and corresponding hypotheses in this study were:

**RQ1:** What is the difference in the reading comprehension scores of second grade students on the CBM when using multimodal features of an eBook read on an iPad, and measured by the differentiated reading reports provided by the Storia App, compared to those of students who read a book with printed text?

**H<sub>1</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**H<sub>01</sub>:** There is no significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to those

demonstrated when processing a printed text as measured by the reading comprehension portion of the CBM.

**RQ2:** What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks compared to those demonstrated by students who do not use the multimodal features each time?

**H<sub>2</sub>:** There is a significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

**H<sub>02</sub>:** There is no significant difference in the reading comprehension skills of second grade students when using the multimodal features of an eBook consistently when they read the text as measured by the reading comprehension portion of the CBM.

For the purpose of this study, use of the multimodal features was considered consistent if the participant used at least one of the features during each reading session.

The Analysis of Covariance (ANCOVA) is a statistical test that is used to test the null hypothesis that two or more population means are equal. This test includes a dependent variable, an independent variable, and a covariate – which is most likely aligned or correlated with the dependent variable. The ANCOVA also adjusts the treatment effect estimate and reduces bias that could be caused by pretreatment differences between groups. The ANCOVA is appropriate for nonrandom groups to reduce the confounding between the dependent and independent variables. This design levels the field of nonequivalent groups and is a common analysis for pretest-posttest nonrandom group design (Huitema, 2011). The ANCOVA was chosen for this study because of the pretest-posttest design. Use of the pretest as the covariate in the analysis adjusted for differences between the groups. It also increased statistical power by reducing the bias and statistical error.

Before conducting the ANCOVA in this study, there were certain assumptions that had to be met. In order to do this, several tests were run on the data. In order for the covariate in this analysis to be appropriate, it should have a reasonable correlation with the dependent variable and should not have significant interaction with the factor, or independent variable. The assumption tests run in this analysis include Descriptive Statistics, the Test of Linearity, and the Assumption of Homogeneity of Regression Slopes. For the first research question, the pretest served as the covariate. The dependent variable was reading comprehension, and the independent variables analyzed were the use of traditional printed books and the use of multimodal features on the iPad during reading.

Using SPSS software to run the analysis, assumption tests were run for the first research question: What is the difference in the reading comprehension scores of second grade students on the CBM when using multimodal features of an eBook read on an iPad, and measured by the differentiated reading reports provided by the Storia App, compared to those of students who read a book with printed text? The first test run was that of the Descriptive Statistics. The results of this test are as follows:

Table 1

*Between-Subjects Factors*

|        |      | <u>Value Label</u> | <u>N</u> |
|--------|------|--------------------|----------|
| Method | 1.00 | Traditional/Books  | 39       |
|        | 2.00 | Multimodal/ iPads  | 39       |

Table 2

*Descriptive Statistics*

| Dependent Variable: Comprehension |         |          |    |
|-----------------------------------|---------|----------|----|
| Method                            | Mean    | SD       | N  |
| Traditional/Books                 | 67.4615 | 26.88166 | 39 |
| Multimodal/iPads                  | 58.3077 | 25.08843 | 39 |
| Total                             | 62.8846 | 26.23866 | 78 |

Table 3

*Tests of Between-Subjects Factors*

| Dependent Variable: Comprehension |                         |    |             |        |      |
|-----------------------------------|-------------------------|----|-------------|--------|------|
| Source                            | Type III Sum of Squares | Df | Mean Square | F      | Sig. |
| Corrected Model                   | 29275.037 <sup>a</sup>  | 2  | 14637.519   | 46.249 | .000 |
| Intercept                         | 6336.517                | 1  | 6336.517    | 20.021 | .000 |
| Pretest                           | 27641.076               | 1  | 27641.07    | 87.336 | .000 |
| Method                            | 290.555                 | 1  | 290.555     | .918   | .341 |
| Error                             | 23736.924               | 75 | 316.492     |        |      |
| Total                             | 361461.000              | 78 |             |        |      |
| Corrected Total                   | 53011.962               | 77 |             |        |      |

a. R Squared = .552 (Adjusted R Squared = .540)

These data show that there were 78 participants in the study, 39 in the treatment group and 39 in the control group. Due to the amount of participants in this study, alpha should be set to  $p < .05$  (Green & Salkind, 2010; Huitema, 2011).

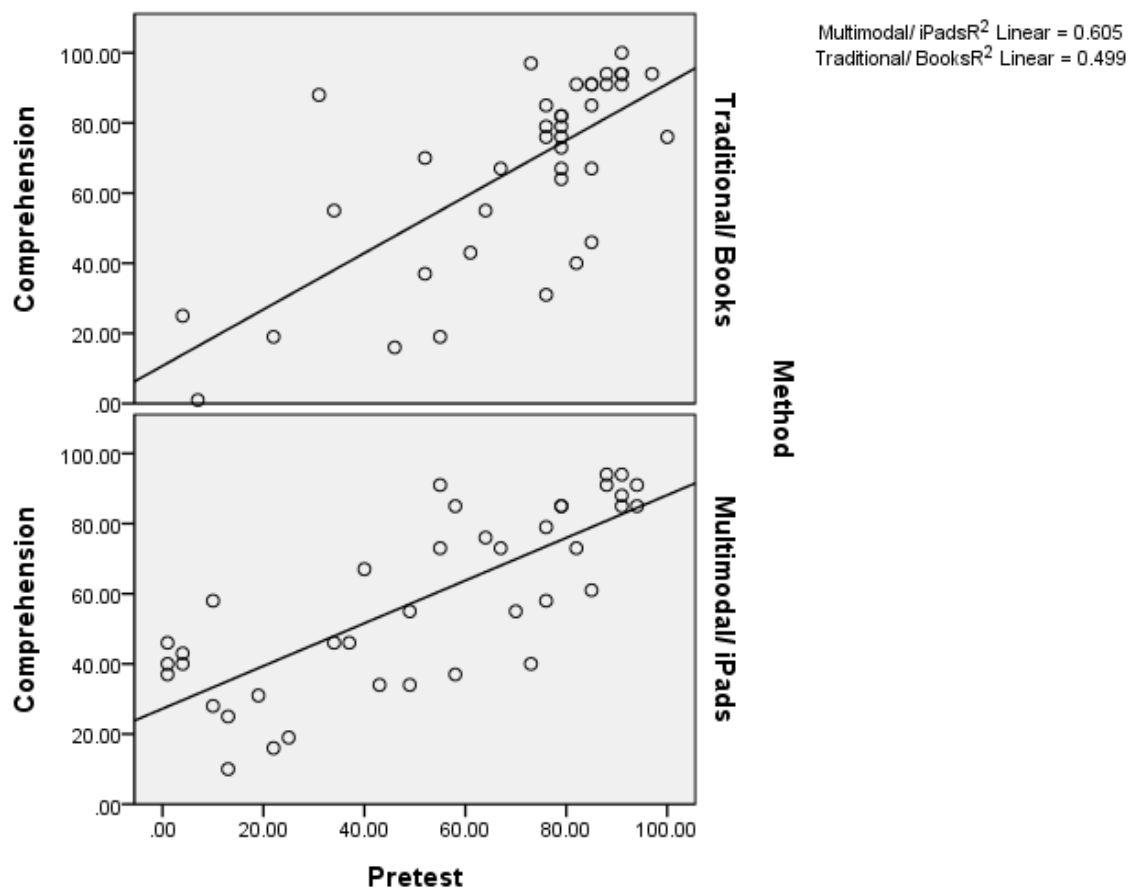


The next test run was the Test of Linearity. The null hypothesis of this test is that there is not a linear relationship between the pretest and reading comprehension. Based on this test, the relationship between the pretest and reading comprehension was linear at a statistically significant level,  $F(1, 46) = 101.3$ ,  $p < .001$ . (Table 4). Because the probability of the test statistic is less than alpha (0.05), then the null hypothesis that there is not a linear relationship is rejected.

Table 4

*ANCOVA Table*

|                           |                   |                             | Sum of Squares | Df | Mean Square | F       | Sig. |
|---------------------------|-------------------|-----------------------------|----------------|----|-------------|---------|------|
| Comprehension*<br>Pretest | Between<br>Groups | Combined                    | 39850.533      | 31 | 1285.501    | 4.493   | .000 |
|                           |                   | Linearity                   | 28984.483      | 1  | 28984.483   | 101.303 | .000 |
|                           |                   | Deviation<br>from Linearity | 10866.050      | 30 | 362.202     | 1.266   | .231 |
|                           | Within Groups     |                             | 13161.429      | 46 | 286.118     |         |      |
|                           | Total             |                             | 53011.962      | 77 |             |         |      |



After testing for linearity, the test for homogeneity of regression slopes is administered. This test looks for significance of an interaction term in the model made up of the covariate and the factors, or independent variables. In this study, the test for homogeneity of regression slopes examined the null hypotheses that there is a significant interaction between the pretest and the method of reading either traditionally printed books or multimodal texts on the iPad. The probability associated with the interaction of pretest and method of reading that tests whether the assumption of homogenous regression slopes,  $F(1, 74) = 1.66$ ,  $p = .2$  is greater than alpha (0.05) (Table 3). Therefore, the null hypothesis that there is a significance of interaction between the pretest and method of reading (traditionally printed books or multimodal texts) can be rejected.

Because the null hypothesis in this test was rejected, it was appropriate to continue with the ANCOVA.

Table 5

*Descriptive Statistics*

Dependent Variable: Comprehension

| Method             | Mean    | SD       | N  |
|--------------------|---------|----------|----|
| Traditional/ Books | 67.4615 | 26.88166 | 39 |
| Multimodal/ iPads  | 58.3077 | 25.08843 | 39 |
| Total              | 62.8846 | 26.23866 | 78 |

Table 6

*Tests of Between-Subjects Effects*

Dependent Variable: Comprehension

| Source             | Type III<br>Sum of Squares | Df | Mean Square | F      | Sig. |
|--------------------|----------------------------|----|-------------|--------|------|
| Corrected<br>Model | 29796.537 <sup>a</sup>     | 3  | 9932.179    | 31.659 | .000 |
| Intercept          | 4084.609                   | 1  | 4084.609    | 13.020 | .001 |
| Method             | 771.553                    | 1  | 771.553     | 2.459  | .121 |
| Pretest            | 27416.240                  | 1  | 27416.240   | 87.390 | .000 |
| Method*<br>Pretest | 521.499                    | 1  | 521.499     | 1.662  | .201 |
| Error              | 23215.425                  | 74 | 313.722     |        |      |
| Total              | 361461.000                 | 78 |             |        |      |
| Corrected<br>Total | 53011.962                  | 77 |             |        |      |

a. R Squared = .562 (Adjusted R Squared = .544)

An ANCOVA was carried out using SPSS. The covariate (pretest) was included in this analysis to control for differences on the independent variable (method of reading: traditionally printed texts and multimodal texts). The ANCOVA evaluated the null hypothesis that there is no significant difference in the reading comprehension scores between students who read traditionally printed texts and students who read multimodal texts on an iPad. First was the Levene's test of Equality of Error Variances. The probability for this test is shown in Table 4.

Table 7

*Descriptive Statistics*

Dependent Variable: Comprehension

| Method             | Mean    | SD       | N  |
|--------------------|---------|----------|----|
| Traditional/ Books | 67.4615 | 26.88166 | 39 |
| Multimodal/ iPads  | 58.3077 | 25.08843 | 39 |
| Total              | 62.8846 | 26.23866 | 78 |

Table 8

*Levene's Test of Equality of Error Variances<sup>a</sup>*

Dependent Variable: Comprehension

| F     | df1 | df2 | Sig. |
|-------|-----|-----|------|
| 1.091 | 1   | 76  | .300 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pretest + Method

The probability for Levene's Test for Equality of Variances,  $F(1, 76) = 1.09$ ,  $p = .3$ , is greater than alpha (0.05). The assumption of equal variances has been satisfied. Next is an examination of the main effect for reading comprehension based on method of reading. This main effect was not statistically significant,  $F(1, 75) = .918$ ,  $p = .34$ , partial eta squared = .01. The group with the

highest adjusted mean was the group that used the multimodal text method ( $M = 64.93$ ,  $SE = 2.94$ ) as compared to the group that read traditionally printed text ( $M = 60.84$ ,  $SE = 2.94$ ) (Table 5). Because the results were not statistically significant, the null hypothesis that there is no significant difference in the reading comprehension skills of second grade students when using multimodal features of an eBook read on an iPad compared to a printed text was not rejected.

Table 9

*Tests of Between-Subjects Effects*

Dependent Variable: Comprehension

| Source             | Type III<br>Sum of Squares | Df | Mean Square | F      | Sig. |
|--------------------|----------------------------|----|-------------|--------|------|
| Corrected<br>Model | 29796.537 <sup>a</sup>     | 3  | 9932.179    | 31.659 | .000 |
| Intercept          | 4084.609                   | 1  | 4084.609    | 13.020 | .001 |
| Method             | 771.553                    | 1  | 771.553     | 2.459  | .121 |
| Pretest            | 27416.240                  | 1  | 27416.240   | 87.390 | .000 |
| Method*<br>Pretest | 521.499                    | 1  | 521.499     | 1.662  | .201 |
| Error              | 23215.425                  | 74 | 313.722     |        |      |
| Total              | 361461.000                 | 78 |             |        |      |
| Corrected<br>Total | 53011.962                  | 77 |             |        |      |

a. R Squared = .562 (Adjusted R Squared = .544)



Table 12

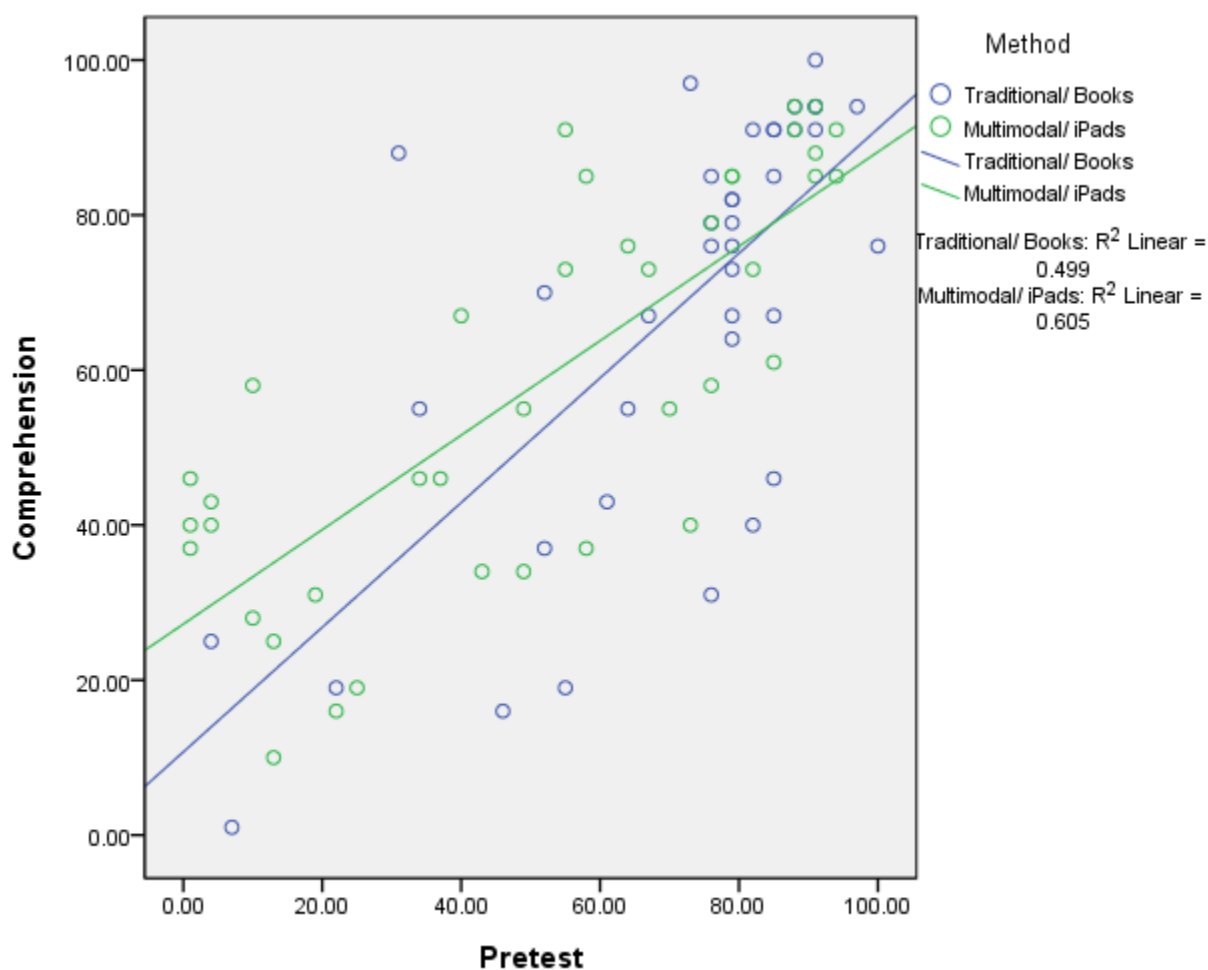
*Univariate Tests*

Dependent Variable: Comprehension

|          | Sum of Squares | df | Mean Square | F    | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power <sup>a</sup> |
|----------|----------------|----|-------------|------|------|---------------------|--------------------|-----------------------------|
| Contrast | 290.555        | 1  | 290.555     | .918 | .341 | .012                | .918               | .157                        |
| Error    | 23736.924      | 75 | 316.492     |      |      |                     |                    |                             |

The F tests the effect of Method. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05



The second research question that was examined was as follows, What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks compared to those demonstrated by students who do not use the multimodal features each time? For the second research question, the pretest served as the covariate. The dependent variable was reading comprehension, and the independent variables were the use of multimodal features of the iPad during each reading session and nonuse of the multimodal features of the iPad during each reading session.

The first test run was that of the Descriptive Statistics. The results of this test are found in Table 13.

Table 13

*Between-Subjects Factors*

|            |      | <u>Value Label</u>                        | <u>N</u> |
|------------|------|---|----------|
| Multimodal | 1.00 | Used multimodal features each time        | 26       |
|            | 2.00 | Did not use multimodal features each time | 13       |



Table 14

*Descriptive Statistics*

| Dependent Variable: Comprehension         |         |          |    |
|---|---------|----------|----|
| Multimodal                                | Mean    | SD       | N  |
| Used multimodal features each time        | 60.6538 | 23.58125 | 26 |
| Did not use multimodal features each time | 57.7692 | 28.60406 | 13 |
| Total                                     | 59.6923 | 25.02226 | 39 |

These data show that there were 39 participants in this portion of the study, 26 participants used multimodal features each time they read, and 13 participants did not use the multimodal features each time they read. Due to the amount of participants in this study, alpha should be set to  $p < .05$  (Greene & Salkind, 2010; Huitema, 2011).

The next test was for linearity. The null hypothesis of this test is that there is not a linear relationship between the pretest and reading comprehension of the participants who read multimodal texts. Based on this test, the relationship between the pretest and reading comprehension was linear at a statistically significant level,  $F(1, 15) = 58.58$ ,  $p < .001$ . (Table 15). Because the probability of the test statistic is less than alpha (0.05), then the null hypothesis that there is not a linear relationship is rejected.

Table 15

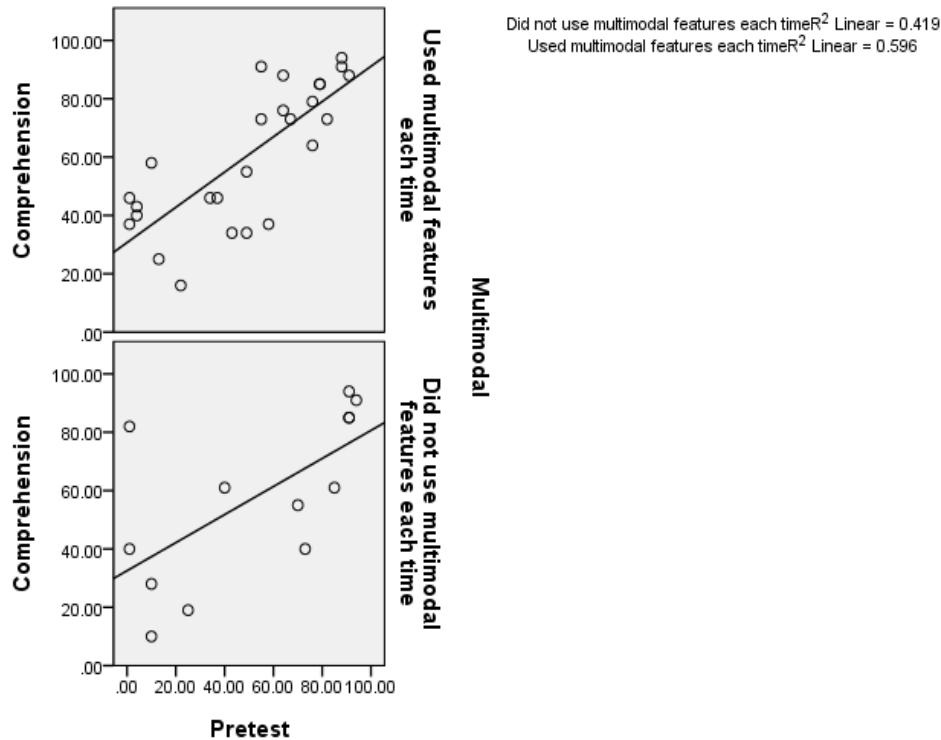
*ANCOVA Table*

|                           |                   |                             | Sum of Squares | Df | Mean Square | F      | Sig. |
|---------------------------|-------------------|-----------------------------|----------------|----|-------------|--------|------|
| Comprehension*<br>Pretest | Between<br>Groups | Combined                    | 20683.558      | 23 | 899.285     | 4.339  | .003 |
|                           |                   | Linearity                   | 12139.570      | 1  | 12139.570   | 58.575 | .000 |
|                           |                   | Deviation<br>from Linearity | 8543.988       | 22 | 388.363     | 1.874  | .107 |
|                           |                   | Within Groups               | 3108.750       | 15 | 207.250     |        |      |
|                           | Total             |                             | 23792.308      | 38 |             |        |      |

Table 16

*Measures of Association*

|                       | R    | R Squared | Eta  | Eta Squared |
|-----------------------|------|-----------|------|-------------|
| Comprehension*Pretest | .714 | .510      | .932 | .869        |



When running the test for homogeneity of regression slopes, the findings that the probability that tests whether the assumption that the regression slopes are homogenous,  $F(1,35) = .468$ ,  $p = .498$ , were greater than alpha (.05). The assumption of homogeneous regression slopes was satisfied (Table 17). Therefore, the null hypothesis that there is a significance of interaction between the pretest and use of multimodal texts can be rejected. Because the null hypothesis in this test is rejected, it is appropriate to continue with the ANCOVA.

Table 17

*Descriptive Statistics*

Dependent Variable: Comprehension

| Multimodal                                | Mean    | SD       | N  |
|---|---------|----------|----|
| Used multimodal features each time        | 60.6538 | 23.58125 | 26 |
| Did not use multimodal features each time | 57.7692 | 28.60406 | 13 |
| Total                                     | 59.6923 | 25.02226 | 39 |

Table 18

*Tests of Between-Subjects Effects*

Dependent Variable: Comprehension

| Source              | Type III Sum of Squares | Df | Mean Square | F      | Sig. |
|---------------------|-------------------------|----|-------------|--------|------|
| Corrected Model     | 12463.968 <sup>a</sup>  | 3  | 4154.656    | 12.836 | .000 |
| Intercept           | 10564.950               | 1  | 10564.950   | 32.641 | .000 |
| Multimodal          | 8.937                   | 1  | 8.937       | .028   | .869 |
| Pretest             | 11735.894               | 1  | 11735.894   | 36.259 | .000 |
| Multimodal* Pretest | 151.445                 | 1  | 151.445     | .468   | .498 |
| Error               | 11328.340               | 35 | 323.667     |        |      |
| Total               | 162756.000              | 39 |             |        |      |
| Corrected Total     | 23792.308               | 38 |             |        |      |

a. R Squared = .524 (Adjusted R Squared = .583)

An ANCOVA was carried out using SPSS. The covariate (pretest) was included in this analysis to control for differences on the independent variable (participants in the treatment group who used multimodal features each time they read, and participants who did not use multimodal features each time they read). The ANCOVA evaluated the null hypothesis that there is no significant difference in the reading comprehension scores between students who used the multimodal features each time they read and students who did not use multimodal features each time they read. First was the Levene's test of Equality of Error Variances. The probability for this test is shown in Table 19.

Table 19

*Levene's Test of Equality of Error Variances<sup>a</sup>*

Dependent Variable: Comprehension

| F   | df1 | df2 | Sig. |
|---|-----|-----|------|
| 1.943   | 1   | 37  | .172 |
| Tests the null hypothesis that the error variance of the dependent variable is equal across groups. |     |     |      |
| a. Design: Intercept + Pretest + Method   |     |     |      |

The probability for Levene's Test for Equality of Variances,  $F(1, 37) = 1.94$ ,  $p = .18$ , is greater than alpha (0.05). The assumption of equal variances has been satisfied. Next is an examination of the main effect for reading comprehension based on method use of multimodal features. This main effect was not statistically significant,  $F(1, 36) = .54$ ,  $p = .47$ , partial eta squared = .02. The group with the highest adjusted mean was the group that used the multimodal features each time ( $M = 61.18$ ,  $SE = 3.5$ ) as compared to the group that did not use the multimodal features each time ( $M = 56.71$ ,  $SE = 4.96$ ) (Table 10). Because the results were not statistically significant, the null hypothesis that there is no significant difference in the reading comprehension skills of

Second grade students when using the multimodal features of an eBook consistently when they read the text was not rejected.

Table 20

*Estimates*

| Dependent Variable: Comprehension |                     |            |                         |             |
|-----------------------------------|---------------------|------------|-------------------------|-------------|
| Method                            | Mean                | Std. Error | 95% Confidence Interval |             |
|                                   |                     |            | Lower Bound             | Upper Bound |
| Traditional/Books                 | 61.183 <sup>a</sup> | 3.503      | 54.078                  | 68.287      |
| Multimodal/ iPads                 | 56.712 <sup>a</sup> | 4.956      | 46.661                  | 66.762      |

a. Covariates appearing in the model are evaluated at the following values

Table 21

*Pairwise Comparisons*

| Dependent Variable: Comprehension |                       |                       |            |                   |   |             |
|-----------------------------------|-----------------------|-----------------------|------------|-------------------|---|-------------|
| (I)Multimodal                     | (J) Multimodal        | Mean Difference (I-J) | Std. Error | Sig. <sup>a</sup> | 95% Confidence Interval for Difference <sup>a</sup> |             |
|                                   |                       |                       |            |                   | Lower Bound   | Upper Bound |
| Used each time                    | Did not use each Time | 4.471                 | 6.071      | .466              | -7.842  | 16.784      |
| Did not use each time             | Used each time        | -4.471                | 6.071      | .466              | -16.784   | 7.842       |

Based on estimated marginal means

a. adjustment for multiple comparisons: Bonferroni

Table 22

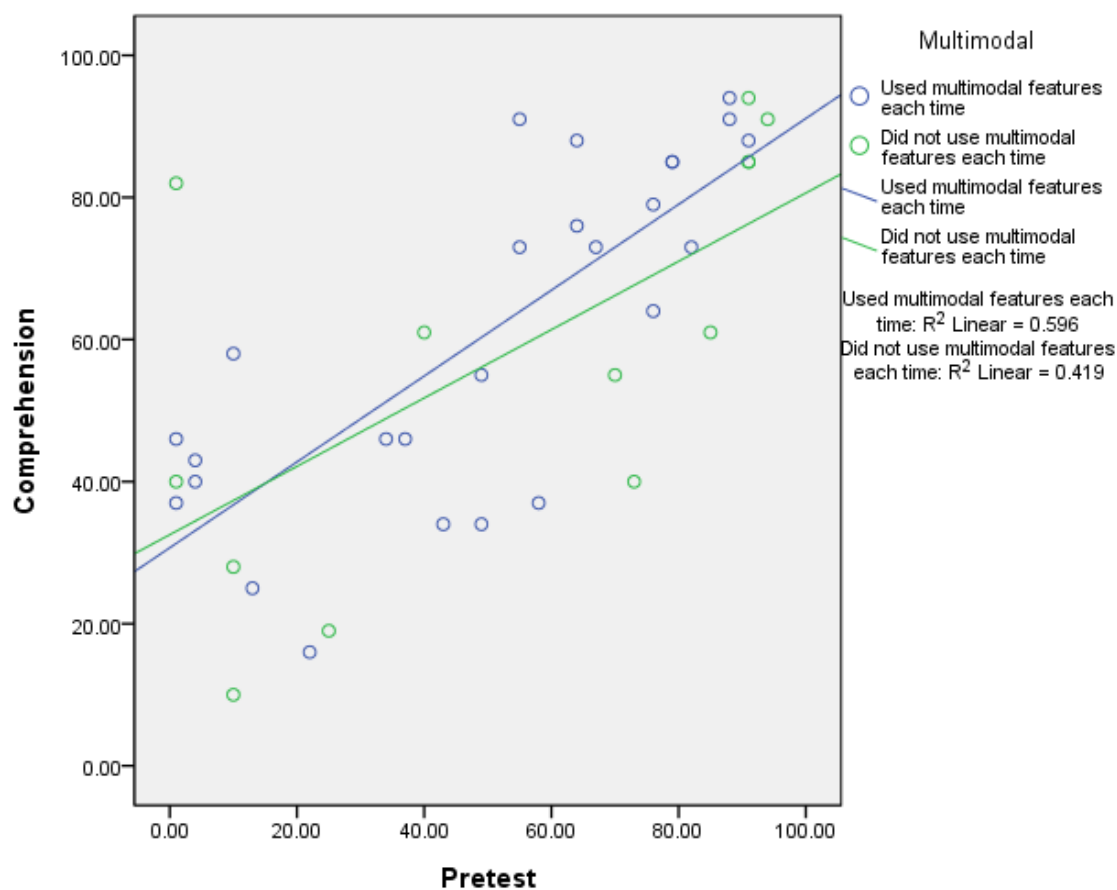
*Univariate Tests*

Dependent Variable: Comprehension

|          | Sum of Squares | df | Mean Square | F    | Sig. | Partial Eta Squared | Noncent. Parameter | Observed Power <sup>a</sup> |
|----------|----------------|----|-------------|------|------|---------------------|--------------------|-----------------------------|
| Contrast | 172.953        | 1  | 172.953     | .542 | .466 | .015                | .542               | .111                        |
| Error    | 11479.785      | 36 | 318.883     |      |      |                     |                    |                             |

The F tests the effect of Multimodal. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05



### **Summary**

The ANCOVA was used for both research questions in this study. ANCOVA is considered a robust and appropriate method when conducting a study using pretest-posttest design. It gives a uniformity to all groups in order to reduce bias and experimental error. The covariate (pretest) in these analyses equalized the two groups according to their roles in both research questions. For the first research question, the pretest served as the covariate, the dependent variable was reading comprehension, and the independent variables were the use of traditional printed books and the use of multimodal features on the iPad. While the group that used multimodal features did have higher scores on their posttests, the results were not enough to be considered statistically significant and thus the null hypothesis was not rejected. For the second research question, the pretest served as the covariate, the dependent variable was reading comprehension, and the independent variables were the use of multimodal features during each reading session and the nonuse of multimodal features during each reading session. While the group that used the multimodal features each session did have higher scores on their posttests, the difference in scores was not statistically significant and thus the null hypothesis was not rejected.



## CHAPTER FIVE: DISCUSSION

This quasi-experimental study examined the effect of using the multimodal texts offered on an Apple iPad versus traditionally printed text. This study was conducted at two elementary schools in three second grade classes at each school. Participants took the multiple choice comprehension assessment of the Curriculum Based Measurement (CBM) as a pretest. For the following six weeks, both groups spent their daily independent reading time (approximately 15 minutes per day) on their designated method of reading. Classes at one school read books on their iPads using the multimodal texts of the Storia App. Classes at the second school read traditionally printed books. At the end of the six-week period, all participants took a post assessment using the multiple choice comprehension portion of the Curriculum Based Measurement.

The first research question for this study was: What is the difference in the reading comprehension scores of second grade students on the CBM when using multimodal features of an eBook read on an iPad, and measured by the differentiated reading reports provided by the Storia App, compared to students who read a book with printed text? An ANCOVA was the statistical analysis used with this research question. The results of this analysis showed that there was not a statistically significant difference in the reading comprehension scores of students who used multimodal texts on the iPad versus the students who read traditionally printed texts. However, when looking at the differences between the means, the students using multimodal texts had a higher mean than that of the student group that read traditionally printed books.

The second research question in this study was: What is the difference in the reading comprehension skills of second grade students who use the multimodal features of the iPad consistently when they read eBooks when compared to students who do not use the multimodal

features each time? An ANCOVA was the statistical analysis used with this research question. The results of this analysis showed that there was not a statistically significant difference in the reading comprehension scores of students who used multimodal features every time they read versus the students who did not use the multimodal features every time. However, when looking at the differences between the means, the students using multimodal texts each time they read had a higher mean than that of the student group that did not use multimodal features each time they read.

### **Discussion of the Findings**

According to Korat and Shamir (2007) and Ciampa (2012), young children's emergent literacy can benefit from reading eBooks. Students are growing up in a world that is technology-driven and children are accessing the Internet at an increasingly younger age. Because digital natives have grown up with continuously changing technologies, they are likely to have different expectations and behaviors towards the use of digital media than their teachers (Huang et al., 2012). In an effort to keep up with current trends as well as meet diverse student needs, policy makers and administrators alike are seeking appropriate, yet realistic alternatives for educational technology integration. The autonomy and differentiation provided by educational technology devices, such as the Apple iPad make it a viable and even affordable option for educators to provide one-to-one educational opportunities for students. With this device, teachers are able to track student progress and make instantaneous adjustments as needed to facilitate student learning. Students are under a perception of control, which provides intrinsic motivation to read. The multimodality of the device facilitates automaticity on behalf of the reader, leveling the playing field for easier decoding and leading to better reading comprehension (vanLoon, Ros, & Martens, 2012).

It may seem at first glance that eBooks do not greatly differ from traditionally printed books except for method of delivery. However, even without taking into consideration the amount of multimodal features an e-book has, one element that can be agreed upon by multiple researchers is that books delivered in a technological format provide instant engagement for students (Wolfe & Flewitt, 2010). Presenting reading material in an electronic format as opposed to traditional print has the potential to increase interest in reading and be an effective solution to promote literacy in the educational setting and at home. Although the students in the iPad group who used multimodal features each time they read had a higher rate of comprehension than those who simply used the iPad as a reading device, both groups had increases in their post assessment scores, adding to the possibility that engagement of technology is a solid way to reach reluctant readers.

### **Limitations of the Study**

There were some limitations to this study. One of these limitations was the sample size. In order to make the results more generalizable to the population, a large sample size is always preferred (Gall, Gall, & Borg, 2010). The population in this study consisted of 78 participants in six classes at two schools. With the potential for 108 possible participants, there were some students in the classes who did not have permission to participate. Contributing to threats against internal validity of the initial set of participants, mortality occurred when some participants dropped out of the study due to moving away from the schools. Selection could also be perceived as a threat to internal validity in this study. Selection is when groups possibly possess different characteristics and these differences may affect the results. However, the pretest served as the covariate in this study and was an equalizer for abilities among groups.

When looking at threats to external validity with regards to this pretest-posttest design study, one area of concern was the testing effect. The testing effect refers to when the administration of a test affects the performance of participants in a study. Most commonly, this occurs when there is a pretest involved in the study. Steps taken to maximize external validity included using a pretest and posttest in the same format, but with different reading passages for each administration. According to Alonzo, Park, and Tindal (2012), using the succession of the easyCBM multiple choice comprehension measures is a valid and reliable method of testing student progress.

### **Implications of the Research**

The impact of society's total immersion in technology and its related devices has been a source of decline in the voluntary reading time of children (Wright, Fugett, & Caputa, 2013). Rather than suppress the inevitable trend toward technological integration, educators should embrace the positive elements that technology can provide. Not only does it engage digital learners in a way that traditional methods cannot, but it also has an abundance of methods for providing differentiated instruction and remediation in an effective, efficient, and often affordable, manner. Elementary age school children have never known a world without electronic screens serving as a primary source of information. The interest of children in the United States is more often captured digitally than with any paper-based alternatives (Huang, Liang, Su, & Chen, 2012; Wright, Fugett, & Caputa, 2013). While it is a concern that the pendulum of change may shift too far towards technology immersion and contribute to an already increasing deficit of attention span for today's students, educators have the opportunity to embrace new innovations while also providing structure and opportunities to build stamina (Laura & Chapman, 2009).

This early elementary school timeframe is also critical in the development of children's reading abilities. Successful reading comprehension at this age requires a simultaneous decoding of words, following of sentence structure, and organization of ideas into a mental model. Reading comprehension requires direct instruction of strategic thinking in which the student must be conditioned to perform all of these actions. At the early stages of reading development, reading for comprehension must be a deliberate act.

This type of cognitive processing instruction and subsequent ongoing monitoring offers a major challenge in the classroom setting where there is typically one teacher to dozens of children (Kim, 2012). Multiple factors can impact student learning, and important differences have been observed in that learning when instruction is managed and monitored by the teacher. Giving teachers technological tools that effectively and efficiently assist them in managing the instruction of all students on an equitable basis can enable them to monitor all students consistently and intervene as soon as problems arise rather than depend on the availability of an elapsed schedule (Connor, Jakobsons, Crowe, & Meadows, 2009). Use of digital devices embedded with programs like the Storia App that offer individualized feedback and accountability in a kid-friendly, usable format could potentially close the gap between teachers' traditional methods and the needs of a new generation of students (Wright, Fugett, & Caputa, 2013).

The nationwide shift to the Common Core State Standards (2010) has placed an emphasis on strategic reading beginning in kindergarten. Traditionally, students were engaged in emergent literacy primarily through fictional texts. The shift of the current standards now requires students to perform close readings of higher-level fiction as well as nonfiction informational texts. Close reading requires much more cognitive and information processing than ever before.

Not only is a student expected to have recall of events, but also delve into inferential meaning, and evidence citation. The multimodality of e-books, either on a mobile device or a computer, offers a unique opportunity to educators. Just as students in past generations have had to learn critical skills of finding valid sources of information by investigating multiple sources, today's generation faces the same validity issues, just on a much larger scale. Learning how to effectively use multimodal tools in the younger grades can give students much needed structure with which to facilitate their learning as they progress through their school years (VanLoon, Ros, & Martens, 2012).

While the potential benefits of technology in an educational setting provide limitless possibilities, there is still one gap that must be addressed. Teachers are by and large digital immigrants – not having grown up in a digital world. The primary use of technology by teachers in the educational setting is that of preparation and communication. While the availability of innovative technology is on the increase, many teachers have to adapt, adjust, and learn new programs, often with very little training. With all of the additional responsibilities included in a teacher's job description, self-reliance on learning how to implement student-centered technology in the classroom is not a priority. Larson (2008) emphasizes the importance of teachers' inclusion of electronic reading in reading instruction, but also equally emphasizes that teachers must be properly trained in methods that use technology effectively within an elementary classroom setting. If teachers are not utilizing the student centric as well as teacher centric features of the technology, then they have only changed the method of transmission, and are not achieving the potential impact that can be gained through the use of the technology. If given the proper training and support for proper implementation, teachers are more likely to use available programs with fidelity and become more effective in the process.

### **Recommendations for Further Research**

The choice of second grade students for this study was such that second graders are at a crossroads in their reading skill development. Generally, most students at this age have learned to properly decode words to the point of functional fluency. Students at this grade level are now learning to read strategically, as well as to read for pleasure (Berninger, et al., 2010; Burns, et al., 2011). Due to the nature of this study, the number of participants was limited. In order to increase generalizability, it is recommended that this type of study be conducted on a larger scale. It would be appropriate to continue to research effective uses of eBooks in the classroom setting because the results of the statistical analysis showed a higher upward trend in the increase of reading comprehension of students who used eBooks versus the students who read traditional books. Should the study be conducted over a longer period of time, it would be beneficial to see if the students using multimodal texts continue to increase in achievement at a high enough rate to prove statistical significance over students reading printed text. As for the students who use the multimodal features versus students who simply use the iPad or mobile device as a method of delivery, it is also recommended to extend the study for a longer period of time. The statistical analysis of the group who used multimodal features each time they read also showed an increased upward trend over their peers who did not use the features consistently. Extending the time of the study would give a more comprehensive view of the effectiveness of the program, as opposed to the snapshot that this study provided.

As educators strive to meet the diverse and ever changing needs of their learners, there will be a need for quality, research-based technology programs and devices that will provide sound and practical solutions. With the increase in requirements for individualized instruction as a result of programs, such as Response to Intervention to remediate students and bridge the

achievement gap, it is imperative to find economical alternatives that provide the most impact (Berkeley & Lindstrom, 2011). Because eBook readers are now becoming an affordable option for the classroom, researchers must contribute to the field by investigating structural and user-friendly methods that will enable teachers to implement these devices and programs with purpose and fidelity.



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## APPENDIX A

**St. Johns County School District**  
**Planning, Accountability & Assessment**  
2955 Lewis Speedway, Room 880  
St. Augustine, Florida 32084  
(904) 547-3816  
[www.stjohns.k12.fl.us](http://www.stjohns.k12.fl.us)



**TO:** Joy Reichenberg  
**FROM:** David Morell, Director for Planning, Accountability and Assessment  
**SUBJECT:** Request to perform research within the St. Johns County School District  
**DATE:** October, 11, 2013

Thank you for your request to do research within the St. Johns County School District. I am delighted to let you know that your request has been approved. Please provide a copy of this letter to the Principal at the school where you will be conducting the research. We also ask that you please coordinate all research activities with a school administrator.

Thank you,

David Morell  
Director for Planning, Accountability & Assessment

## **APPENDIX B**

### **Parental Consent Form for Research Participation**

#### **The use of iPads to Facilitate Growth in Reading Comprehension Skills of Second Grade**

#### **Students**

Your child is invited to be in a research study of using iPads vs. printed books for growth in reading comprehension. Your child was selected as a possible participant because your child is a second grade student at a participating school. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Joy Reichenberg, Liberty University School of Education

#### **Background Information:**

The purpose of this study is to examine the difference in the reading comprehension scores of second grade students when using an eBook on the iPad compared to students who use printed text. Another question to be examined is the difference in the reading comprehension skills of second grade students who use the multimodal features of the eBook read on the iPad every time they read the eBook when compared to students who do not use the multimodal features each time.

#### **Procedures:**

If you agree for your child to be in this study, I would ask your child to do the following things:

Complete a multiple choice pre test that will take approximately 20-30 minutes to complete, read your choice of books on an iPad using the Storia app for a period of six weeks (this is to be done during student independent reading time in class), and complete a multiple choice post test at the end of the six weeks. The post test will take approximately 20-30 minutes to complete.

#### Risks and Benefits of being in the Study:

The risks in this study are minimal. They are no more than your child would encounter in everyday life. Steps will be taken to protect the confidentiality of each student participant involved. This study includes a 15 minute time of daily reading for a length of 6 weeks. Your child already participates in this activity on a regular basis, so this activity should not pose any additional risk.

The benefits to participation include the opportunity to increase reading comprehension skills through strategies learned in this study. The benefits could include students who are better prepared to succeed in the next grade level. Third grade is the year that high-stakes testing in reading determines whether or not a student is retained for a year. One of the barriers to achievement in this area is reading comprehension. The use of technology in reading practice and instruction can possibly increase student performance in an efficient and effective way.

#### Compensation:

Your child will receive no payment for participation in this study.

#### Confidentiality:

The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely and only the researcher will have access to the records. Confidentiality will be maintained through use of a numerical identification system (no names will be attached to any data in this study). The researcher will store paper data in a locked cabinet at her home and will store all digital data on password protected files on a personal computer.

#### Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to allow your child to participate will not affect current or future relations with Liberty University or the school district. If you decide to allow your child to participate, he or she is free to not answer any question or withdraw at any time without affecting those relationships.

#### Contacts and Questions:

The researcher conducting this study is Joy Reichenberg. If you have questions concerning this study you are encouraged to contact her at \_\_\_\_\_. If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the Institutional Review Board, 1971 University Blvd, Suite 1837, Lynchburg, VA 24502 or email at [irb@liberty.edu](mailto:irb@liberty.edu).

You will be given a copy of this information to keep for your records.

#### Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to allow my child to participate in the study.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature of Investigator: \_\_\_\_\_ Date: \_\_\_\_\_

## CONSENT FORM

### The use of iPads to Facilitate Growth in Reading Comprehension Skills of Second Grade Students

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This study is being conducted by Joy Reichenberg, Liberty University School of Education  
Background Information:

The purpose of this study is to examine the difference in the reading comprehension scores of second grade students when using an eBook on the iPad compared to students who use printed text. Another question to be examined is the difference in the reading comprehension skills of second grade students who use the multimodal features of the eBook read on the iPad every time they read the eBook when compared to students who do not use the multimodal features each time.

#### Procedures:

If you agree for your child to be in this study, I would ask your child to do the following things: Complete a multiple choice pre test that will take approximately 20-30 minutes to complete, read your choice of books provided by the researcher, independently and using reading strategies for a period of six weeks (this is to be done during student independent reading time in class), and complete a multiple choice post test at the end of the six weeks. The post test will take approximately 20-30 minutes to complete.



#### Risks and Benefits of being in the Study:

The risks in this study are minimal. They are no more than your child would encounter in everyday life. Steps will be taken to protect the confidentiality of each student participant involved. This study includes a 15 minute time of daily reading for a length of 6 weeks. Your child already participates in this activity on a regular basis, so this activity should not pose any additional risk.

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You will be given a copy of this information to keep for your records.

#### Statement of Consent:

I have read and understood the above information. I have asked questions and have received answers. I consent to allow my child to participate in the study.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature of Investigator: \_\_\_\_\_ Date: \_\_\_\_\_