Lexia Core5's Impact on Phonemic Awareness, Phonics, Fluency, Vocabulary, and Comprehension

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Abstract

The purpose of this study was to determine the effect Lexia Core5 had on first, second, and third grade students' development of foundational reading skills; phonemic awareness, phonics, fluency, vocabulary, and comprehension reading scores. Another purpose was to learn if the amount of time students logged online while using Lexia Core5 impacted first, second, and third grade students' academic gain scores in foundational reading skills. The final purpose of this study was to provide decision makers in the educational community with information about the contributions of Lexia Core5 on reading development.

Data from first, second, and third grade students were collected from Renaissance STAR Early Literacy and STAR Reading Enterprise assessments in order to calculate student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension skills after using the Lexia Core5 program for the 2013-2014 school year. An academic gain was calculated by subtracting the student's reading skills pre-test score from the post-test score. The minutes students logged online while using Lexia Core5 were compiled in a report produced from the Lexia Learning Company. There were four categories of time spent online for each grade level. The categories were used in conjunction with student phonemic awareness, phonics, fluency, vocabulary, and comprehension academic gain scores to determine the effect of time on first, second, and third grade students' reading skills development

Data revealed that Lexia Core5 yielded statistically significant growth in phonemic awareness, phonics, fluency, vocabulary, and comprehension for first grade students. The data also showed students in second and third grade had significant growth

in phonics, fluency, vocabulary, and comprehension. A deeper analysis of the results revealed time was a factor in first, second, and third grade students' academic gain scores. The results indicated first grade students' academic gain scores in phonemic awareness, phonics, vocabulary, and comprehension skills were impacted by the amount of time students logged online while using Lexia Core5. Time was not a factor in first grade students' fluency academic gain scores. In addition, second grade students' phonics and comprehension academic gain scores were impacted by time, but time was not a factor in their fluency and vocabulary academic gain scores. Further analysis revealed third grade students' academic gain scores in phonics, vocabulary, fluency, and comprehension skills were not impacted by the amount of time students used the program.

Dedication

I dedicate my work to my family who believed in me every step of the way. My husband's continuous support, encouragement, and constant companionship along this journey was priceless. I am grateful for my daughters Shancy and Kari, and my son, Javen, whose constant support and humor along this journey helped in so many ways. I am forever blessed by a mother who instilled in me a solid foundation to believe with God all things are possible.

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Chapter One

Introduction

According to the National Institute of Child Health and Human Development (NICHD), reading is the single most important skill necessary for a happy, productive, and successful life (Hoss, 2016). Connors-Tadors (2014) defined reading as the ability to interpret and understand written words on a page. The ability to read enables people to find out more about the world and to use that information to improve their lives. Readers have the potential to be lifelong learners, enabling them to think critically about what they have read, to make decisions based on that information, and to make connections to their own lives. Reading affects school success, earning potential, and the ability to function well in every-day living.

The skill of reading is critical to academic learning and success in school (Lyon, 2002). Students who are competent readers are more likely to perform well in other subjects such as mathematics and science (Carnine & Carnine, 2004; Hyde, 2007). Mathematics, social studies, and science are vital for academic and intellectual development, but learning specific information relevant to these disciplines is difficult for a non-reader (Lyon, Shaywitz, & Shaywitz, 2003). Two studies by the Anne E. Casey Foundation provided evidence of a strong relationship between early reading ability and later academic achievement (Fiester 2010, 2013). Successful academic achievement allows students to graduate from high school.

The ability to read is fundamental and an essential foundation for advancement in education, personal economics, and functionality. Reading skills help individuals accomplish everyday tasks needed to make informed choices and participate fully in daily

living. Tasks such as reading a sign, reading medicine labels or nutritional labels on food products, and filling out job applications may be difficult for those individuals with limited reading skills (Cree, Kay, & Stewart, 2012).

Background

Grade-level reading proficiency by the end of third grade is a high priority of government officials and educational leaders (Hayes, Bhat, Connors-Tadros, & Martinez, 2011). Kansas Governor Sam Brownback committed to grade level reading proficiency by launching the Kansas Reading Initiative (KRI) aimed at boosting reading proficiency for elementary school children (Ranney, 2013a). The 2013 Kansas Legislative session passed HB 2140 (Kansas Reads to Succeed Act) that funded the KRI with six million dollars a year for two years. The bill was designed to support grade level reading proficiency by giving schools access to an instructional software package called Lexia Core5 (Ranney, 2013b). Lexia Core5 (Lexia Learning Systems, 2013) was selected by the KRI to be incorporated into Kansas elementary schools without cost for students in kindergarten through fifth grades for the 2013-2014 and 2014-2015 school years.

There were 11,000 Kansas elementary students in kindergarten through fifth grade who used Lexia Core5 during the 2013-2014 school year. Officials from the Lexia Learning Company reported the percentage of students working at or above grade level increased from forty-five percent to ninety-four percent during the school year and seventy percent of students met end-of-year grade level benchmarks (Lexia Learning Systems, 2013). According to the 2014 report from the KRI (Lexia Learning Systems, 2014), nineteen percent of the students in first through fifth grades in Kansas began the school year two or more years below grade level in reading and were considered at-risk

of reading failure. By the end of the 2014 school year seventy-two percent of the students finished the school year above grade level in reading and had mastered more than two years' growth in foundational reading skills. At-risk students showed the most growth advancing one or more grade levels by the end of the school year. Eighty-seven percent of at-risk students advanced two or more grade levels and ninety-nine percent of at-risk students advanced at least one grade level in the 2013-2014 school year (Lexia Learning Systems, 2014).

Statement of Problem

Lexia Core5 was developed as an improved version of an earlier educational technology-based program called Lexia Reading (Schechter, Macaruso, Kazakoff & Brooke, 2015). The primary focus of Lexia Reading was to build phonological awareness and word attack skills (Macaruso and Walker, 2008; Macaruso & Rodman, 2011). According to the Lexia Learning Company, Lexia Core5 provides explicit, systematic instruction and practice in five foundational reading skills. The research on the benefits of Lexia Core5, specifically its impact on the five foundational reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension (Crawford-Brooke, Macaruso, & Schechter, 2014) is minimal. In order to address the problem of limited research on the impact of Lexia Core5 on reading skills development more research is needed.

Purpose of Study

The purpose of this study was to examine Lexia Core5 assessment data from the 2013-2014 school year to discern whether first grade student usage of the Lexia Core5 program supported growth in phonemic awareness, phonics, fluency, vocabulary, and

comprehension reading skills. Another purpose was to determine if usage of the program contributed to second and third grade student growth in phonics, fluency, vocabulary, and comprehension reading skills. Additionally, the study examined first, second, and third grade students' time logged online in Lexia Core5's effect on foundational reading skills academic gain scores. The final purpose of this study was to provide the Kansas Legislature and school leaders' information about the contributions of Lexia Core5 on reading development. Decision makers may find the outcomes of this study useful in ascertaining if Lexia Core5 is a viable instructional tool for the KRI and an effective use of resources.

Significance of Study

This study provided information about the effects of Lexia Core5 program on first grade students' foundational reading skill development of phonemic awareness, phonics, fluency, vocabulary, and comprehension and the effects of the program on second and third grade students' reading skill development of phonics, fluency, vocabulary and comprehension. Multiple Lexia Reading studies were reported with positive outcomes (Macaruso, Hook & McCabe, 2006; Macaruso & Rodman, 2011; Macaruso & Walker, 2008). However, limited research was found on Lexia Core5's efficacy on student development of foundational skills as opposed to over-all reading skills (Crawford-Brooke et al., 2014).

The results from a published Lexia Core5 study, indicated elementary students' use of the program promoted growth in two of the five foundational reading skills, reading comprehension and vocabulary (Lexia Learning Systems, 2014). Crawford-Brooke et al. (2014) established first and second grade students had significant gains in

reading comprehension. Juarez-Tillery (2015) found third grade students had improvements in comprehension skills after using the program for 20 weeks. The present study adds to the information about Lexia Core5's impact on the five foundational reading skills.

Another significance of the current study was the supportive evidence it added to instructional software in the field of reading. It addressed the claims that students made adequate grade level progress on the foundational reading skills if students used the program the proper amount of minutes suggested by the Lexia Core5 Company. This information is significant in discerning the effectiveness of this software package as a supplemental reading program in a school setting.

Delimitations

Delimitations are boundaries on the purpose and scope of the study set by the researcher (Lunenburg & Irby, 2008). Included in this study are the following delimitations:

- This research study was limited to students in first, second, and third grades, enrolled in a Kansas elementary school during the 2013 – 2014 school year.
- The study was limited to first grade students with pre- and post-test scores on the STAR Early Literacy Enterprise assessment.
- The study was limited to second and third grade students with pre- and post-test scores on the STAR Reading Enterprise assessment.

Assumptions

Assumptions are postulates, premises, and propositions that are accepted as operational for purposes of the research (Lunenburg & Irby, 2008). Assumptions regarding this study were as follows:

- All teachers followed the stated guidelines of the Lexia Core5 program.
- All teachers received initial and on-going professional development to support the proper implementation of the program.
- All students worked attentively while logged online in the Lexia Core5 program.
- Renaissance STAR Reading assessments were administered following the proper protocol based upon the manufacturer's instructions and the school's guidelines.
- All students put forth the effort needed to complete the assessments to the best of their ability.

Research Questions

The research questions focus and serve as the "directional beam for the study" (Lunenburg & Irby, 2008 p. 126). The following research questions were developed as a guide for this study.

RQ1. To what extent did first grade students demonstrate academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5?

RQ2. To what extent did second and third grade students demonstrate academic gain in phonics, fluency, vocabulary, and comprehension as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5?

RQ3. Was first grade student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Early Literacy Enterprise pre- and post-test assessment scores impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program?

RQ4. Was second and third grade student academic gain in phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Reading Enterprise pre- and post-test assessment scores impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program?

Definition of Terms

The following definitions were used for the purpose of this study.

Comprehension. Comprehension is the construction of the meaning of a written text through a reciprocal interchange of ideas between the reader and the message in a particular text (NRP, 2000).

Criterion-referenced Reading Scores. These scores are a measurement of student performance against predetermined criteria (Renaissance Learning, 2014b).

Fluency. Fluency is the ability to read a text quickly, accurately, and with proper expression (NRP, 2000).

Foundational skills. In the Lexia Core5 program, the foundational skills include print concepts, phonics and word recognition, and fluency, which is similar to the Reading Foundational Skills defined by Common Core State Standards (Lexia Learning Systems, 2013).

Grade Equivalency. A Grade Equivalent (GE) score indicates the grade placement of students for whom a particular score is typical. If a student receives a GE of 10.7, this means the student scored as well on STAR Reading Enterprise Assessment as did the typical student in the seventh month of grade 10 taking the same test (Renaissance Learning, 2016).

Graphemes. This refers to the units of written language that represent phonemes in the spelling of words. Examples include single letters, such as P, T, N, or multiple letters, CH, SH, TH, CK, or IGH, each symbolizing one phoneme (NRP, 2000).

Norm-referenced Reading Scores. Norm-referenced reading scores compare and rank students to similar students who took the same test (Renaissance Learning, 2014b).

Phonemes. This refers to the smallest units constituting spoken language. English consists of 41 phonemes. Phonemes combine to form syllables and words. Examples of phonemes are a or oh, which is one phoneme; go includes two phonemes; check includes three; and stop has four phonemes (NRP, 2000).

Phonemic awareness. This refers to the ability to focus on and manipulate phonemes in spoken words (NRP, 2000).

Phonics. This refers to the understanding that there is a predictable relationship between phonemes and graphemes (NRP, 2000).

Rasch Ability. Rasch ability is a summary measure of a student's ability in literacy skills that is assessed by the STAR Early Literacy Enterprise (Renaissance Learning, 2014a).

Reading Foundational Skills. Reading Foundational Skills are defined by the CCSS, which are directed toward fostering students' understanding and working knowledge of concepts of print, the alphabetic principle, and other basic conventions of the English writing system (Common Core State Standards Initiative, 2010).

Renaissance STAR Early Literacy Enterprise Assessment. STAR Early Literacy Enterprise is a computer assessment instrument designed to measure the early literacy skills of beginning readers (Renaissance Learning, 2014a).

Renaissance STAR Reading Enterprise Assessment. This assessment is a computer assessment that provides immediate feedback to teachers and administrators about students' reading development along with reports about a wide range of discrete reading skills (Renaissance Learning, 2014b).

Scaled Scores. Scaled Scores are a non-linear, monotonic transformation of the Rasch ability estimate resulting from the STAR Early Literacy Enterprise assessment. The scaled scores range from 300 to 900 (Renaissance Learning, 2014a.)

Vocabulary. Vocabulary is understanding the meaning of individual words (NPR, 2000).

Overview of Methodology

Archived data of first, second, and third grade students' from a Kansas elementary school during the 2013-2014 school year were used to answer the research questions. The purposive sample size was 573 first, second, and third grade students enrolled at the

elementary school (Kansas State Department of Education, 2014). All students were expected to use the Lexia Core5 program during the 2013-2014 school year.

The first two research questions were answered using first, second, and third grade student data generated from the Renaissance Learning assessments. Students in first grade were evaluated using the STAR Early Literacy Enterprise assessment to calculate academic gain scores for phonemic awareness, phonics, fluency, vocabulary, and comprehension reading skills. Students in the second and third grades were evaluated using the Renaissance STAR Reading Enterprise assessment to evaluate academic gain scores for phonics, fluency, comprehension, and vocabulary skills. All students were given a pre-test in August 2013 and a post-test in May 2014. Academic gain scores were calculated by subtracting the pre-test from the post-test for each of the foundational reading skills of the individual students.

The data for the assessments were retrieved from the Renaissance reports titled Student Diagnostic Report Enterprise Test. The diagnostic report for second and third grade students showed phonological awareness and phonics as one component under Reading Foundations. Phonemic awareness scores were not reported for students who exceeded the skill expectation on the phonemic awareness portion of the STAR Reading assessments.

The last two research questions were analyzed using student data generated from Lexia Learning Company. The Lexia Learning Company produced a report that included information about the amount of time, measured in minutes, students were logged online with the Lexia Core5 program during the 2013-2014 school year. The information was

used to compare minutes to student academic gain scores in phonemic awareness, phonics, fluency, vocabulary, and comprehension.

All data used for research questions one through four were analyzed, compiled, and organized in an Excel spreadsheet by the researcher. The data were transferred into the Just Another Statistical Program (JASP), (JASP, 2016) for analysis. The independent variable was Lexia Core5 scores and the amount of time students logged online in the Lexia Core5 program. The dependent variables were academic gain scores in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores.

Organization of Study

This study is organized into five chapters. Chapter one includes an overview of the study, consisting of statement of the problem, significance of the study, a rationale for the study, delimitations and assumptions, research questions, and an overview of methodology. Chapter two encompasses a historical description of the National Reading Panel (NRP), (2000) along with a description of the five reading skills identified by the NRP, and factors that affect students learning to read. Federal initiatives designed to improve reading instruction, and an explanation of scientifically based reading interventions are included. Chapter two concludes with information about computer assisted instruction, the development of Lexia Learning Systems (2013), and literature summary. A detailed account of the methodology, including information about the population, data collection and analysis procedures are presented in chapter three. Further details defined in chapter three are research questions as well as an explanation of reliability and validity of the assessment tools, STAR Early Literacy and STAR Reading Enterprise. The data analysis for each question are reported in chapter four. Finally,

chapter five includes a summary and discussion of the findings, implications for action based on study results, and recommendations for further research based on the results from this study.

Chapter Two

Review of the Literature

This chapter provides a review of the literature on reading development. It includes a description of Lexia Core5's components of phonemic awareness, phonics, vocabulary, comprehension, and fluency skills. Chapter two includes information on the findings from the National Reading Panel's (NRP) research on the best approach to reading instruction and the influence United States federal education policies have on current education. The final section of this chapter incorporates the discussion of scientifically based reading interventions; computer assisted reading tools, and the development of the Lexia Core5 software program.

Primary students who have reading skill deficits need effective research-based interventions to help support growth in reading. Learning to read proficiently has a tremendous effect on students and their later success in life. Learning to read proficiently by the end of third grade is crucial, as it is a pivotal point in a student's education (Hernandez, 2011). Third grade is the time students shift from learning to read to reading to learn. The results of a longitudinal study of 4,000 students reported students who were not proficient readers by the end of third grade, were four times more likely to leave school without a diploma than proficient readers (Hernandez, 2011). For the worst readers, those who could not master even the basic skills by third grade, the rate was nearly six times greater (Hernandez, 2011). According to Spaull (2015), aside from the apparent cognitive importance of learning to read, children who became novice readers within the first three years of primary school had higher levels of social-emotional well-being because they expressed themselves better and communicated with others

adequately. They were also more self-confident (Spaull, 2015). The importance of early intervention for those students who were at-risk for reading failure were highlighted in the findings.

As students move through elementary and middle school, the distance widens between struggling readers and successful readers. This phenomenon is referred to as the Matthew Effect by Stanovich (1986). According to the concept of the Matthew Effect, as successful readers become more proficient readers, they are exposed to more challenging text, while struggling readers fall behind their peers and become less interested in reading. This contributes to less reading and insufficient exposure to text. An increase in the occurrence of challenging behaviors in the classroom are exhibited by struggling readers as they continue into later school years (Oakes, Mathur, & Lane, 2010; Wang & Algozzine, 2011). Reading struggles not addressed are often manifested in troublesome behaviors that can hide the reading difficulties of these readers.

Students learn to read through their knowledge of the alphabet and using that knowledge to decode words. Very early in the reading process poor readers, who experience greater difficulty in breaking the spelling-to-sound code, begin to be exposed to less text than more skilled readers and therefore do not get much reading practice (Allington, 1984). The inability to break the spelling-to-sound code delays the poor reader's development of automaticity and word recognition speed, which is foundational for comprehension and reading for meaning (Cunningham & Stanovich, 1998). The NRP based its 2000 report on the important reading components of the alphabet, decoding words, automaticity, and comprehension. The report became one of the most important documents in understanding how children's reading skills can be improved through

systematic instruction (NRP, 2013). The NRP analysis made it clear that the best approach to teaching reading is one that incorporates explicit instruction in phonemic awareness, systematic phonics instruction, methods to improve fluency, vocabulary, and ways to enhance comprehension.

Reading has become the focal point for American education policy. Policy makers recognized the importance of reading as a fundamental skill critical to academic learning and success (Hernandez, 2011). In an effort to improve learning and reading instruction, legislators, over the past three decades, have developed policies related to reading instruction using scientifically based reading research. These United States federal education policies: the Reading Excellence Act (1999), the No Child Left Behind Act (NCLB) (Lyon, Shaywitz, Shaywitz, & Chhabra, 2005), and Reading First initiative (Edmondson, 2005) have impacted the educational instructional practices of teachers. The outcome of these federal policies have been felt at the classroom level and informed teachers' instructional practice (Juarez-Tillery, 2015).

National Reading Panel

In 1997, Congress asked the director of the NICHD to coordinate and cooperate with the Secretary of Education in establishing a panel to assess effectiveness of different approaches to reading instruction. The members of the panel were asked to find reading instruction that was research-based with empirical evidence. The National Reading Panel was given the task of assessing the various approaches to teaching children how to read. In 2000, the National Reading Panel conducted a meta-analysis to review the best evidence available to guide instruction in reading. Education policy makers were interested in determining a standard method that would work best to improve the reading

skills of students. Through a meta-analysis, the researchers found a set of questions that would help determine an effective approach to reading instruction. A series of regional public hearings, helped the panel, composed of 14 members, determine their final areas of focus (NICHD, 2000). These questions were examined:

- What are the effects of phonemic awareness instruction on reading achievement and improvement?
- What are the effects of phonics instruction on reading achievement and improvement?
- What are the effects of repeated readings on reading achievement and improvement?
- What are the effects of guided oral readings on reading achievement and improvement?
- What are the effects of wide reading programs on reading achievement and improvement?
- What are the effects of vocabulary instruction on reading achievement and improvement?
- What are the effects of comprehension instruction on reading achievement and improvement?
- What are the effects of teachers' background and education on reading achievement and improvement of students? (Shanahan, 1999, p. 3)

In 2000, the NRP, gathered data from experimental and quasi-experimental research studies and evaluated the importance of alphabetics (phonemic awareness and phonics), fluency, vocabulary and text comprehension, teacher education, and technology

on the effectiveness of reading instruction (Courtade, Jimenez, & Delano, 2014; Torgesen, Meadows, & Howard, 2006). Studies included in the meta-analysis were evidence-based (Courtade, et al., 2014; Torgesen et al., 2006).

Through this rigorous collection and analysis of data from evidence-based studies, the NRP (2000) was able to offer concise evidence that children can effectively learn how to read if teachers have undergone the appropriate training on how to use scientifically based instruction in their classrooms (Courtade, et al., 2014; Torgesen et al., 2006). This meta-analysis by the NRP offered great value to reading instruction in the early grades. Overall, it established a comprehensive, scientifically based approach to reading instruction was critical for children to achieve reading proficiency (Courtade, et al., 2014; Torgesen et al., 2006).

The researchers of the NRP were separated into subcommittees based on the specific reading skills. Subcommittee reports were summarized in the panel's final product, *Report of the National Reading Panel: Teaching Children to Read* (U.S. Department of Health and Human Services, 2000a). The report prepared by the NRP was dispersed to all school districts in America, to the National Institute for Literacy, the U.S. Department of Education, and the NICHD. These institutions acknowledged the best reading instruction should include the foundational components of systematic and direct instruction in phonemic awareness, phonics, fluency, vocabulary development, and comprehension strategies. Reading skills identified in the NRP report served as the foundation for effective reading instruction across the nation.

Five Reading Skills Identified by NRP

Phonemic Awareness. The NRP (2000) defined phonemic awareness as the ability to focus on and manipulate phonemes in spoken words. The NRP report states,

> Phonemes are the smallest units constituting spoken language. English consists of about 41 phonemes. Phonemes combine to form syllables and words. A few words have only one phoneme, such as "a" or "oh." Most words consist of a blend of phonemes, such as "go," with two phonemes, "check," with three phonemes, or "stop," with four phonemes. Phonemes are different from graphemes, which are units of written language and represent phonemes in the spellings of words. Graphemes may consist of one letter, for example, P, T, K, A, N, or multiple letters, CH, SH, TH, -CK, EA, -IGH, each symbolizing one phoneme. (p. 2-1)

Phonemic awareness is the foundational skill that students need to master early in their academic career. It is imperative students master phonemic awareness because it improves a student's ability to read words and helps students learn to spell (NRP, 2000). Third grade students should have mastered phonemic awareness within the first two years of school. Once students have mastered phonemic awareness, there is no need to continue instruction in this area. Many teachers use music, poetry, and other activities that have rhyme in the content to teach phonemic awareness. Based on the NRP (2000) report, daily phonemic awareness instruction in the lower elementary grades was recommended by the Center for the Improvement of Early Reading Achievement, (1998) (Ashby, Dix, Bontrager, Dey, & Archer, 2013; Nicholson, 2005; Suggate, 2016).

According to The NRP (2000), phonemic awareness instruction is not the same as phonics instruction. Phonemic awareness is the ability to hear and identify individual sounds in spoken word (U.S. Department of Education, 2003) and it is the understanding that spoken words are made up of phonemes or individual sounds. Components of phonemic awareness include phoneme isolation, segmenting, and blending individual sounds (Trehearne, Healy, Cantalini-Williams, & Moore, 2003). Phoneme isolation involves identifying the first sound in a word, segmenting is the ability to segment speech into phonemes, and blending is the ability to put together individual sounds to form words (Hattie, 2009).

Children who attained phonemic awareness could hear, identify, and manipulate sounds in spoken language. With this ability, they became capable of matching letters to sounds to decode words in text or print. Reading researchers also confirmed the phonemic awareness skill allowed students to learn how to read because they had the foundation to identify words. Researchers claimed phonemic awareness was the basic skill students needed before they could learn phonics and begin to learn writing (Hook & Haynes, 2008; Rasinski & Padak, 2004 Torgesen, 2002).

Moreover, the findings from foundational studies in reading instruction literature indicated phonemic awareness was a predictor for early reading success and was the lacking component among children struggling to read (Adams, 1990). Low phonemic awareness in first grade was the best predictor of poor reading achievement, as children become older (NRP, 2000). Correlational studies included in the meta-analysis prepared by the NRP established that phonemic awareness and letter knowledge were the two best school-entry indicators of how well children learn to read during the first 2 years of their

schooling (NRP, 2000). These studies provided the scientific basis for the importance of phonemic awareness instruction (NRP, 2000; Courtade, et al., 2014; Torgesen et al., 2006).

Phonics. According to the NRP (2003), phonics is the relationship between letters (graphemes) of written language and individual sounds (phonemes) of spoken language. The study by the NRP addressed this question, "Does phonics instruction improve children's ability to read and comprehend text as well as their decoding and word-reading skills?" (U.S. Department of Health and Human Services, 2000, pp. 2-90). Through a meta-analysis method, the NRP used 38 studies to determine an effect size (Camilli, Vargas, & Yurecko, 2003; U.S. Department of Health and Human Services, 2000b). The NRP (2000) subcommittee found phonics instruction could positively affect the reading comprehension skills of young readers with an effect size of 0.51, compared to students who did not undergo phonics instruction (U.S. Department of Health and Human Services, 2000b).

The NRP (2000) stated in the section on phonics that systematic phonics instruction produced significant benefits for elementary students and for children having difficulty learning to read. According to the NRP (2000) phonics subgroup report, kindergarteners who received systematic phonics instruction accomplished greater skill acquisition in their ability to spell words. First graders taught phonics systematically were able to improve their decoding and spelling skills and made significant progress in their ability to comprehend text. Although older children who received phonics instruction improved their decoding and spelling skills and reading text orally, their

comprehension of text did not significantly improve (Beers, 2003; U.S. Department of Health and Human Services, 2000b).

Phonics is referred to as a method of teaching reading (Eh Ehri, Nunes, Stahl, & Willows, 2001) and is the type of instruction about how the sounds of speech are represented by letters and spellings (Snow, Burns, & Griffin, 1998). Phonics is the awareness of the phonemic composition of words. The goal of phonics instruction is to help early readers understand the connection between letters and their sounds. Phonics instruction emphasizes the acquisition of letter-sound relationships in order for students to apply this knowledge to spelling patterns and learning to read. Phonics can be taught systematically or incidentally. Systematic phonics instruction includes teaching phonics in a sequential order along with an element of explicitness depending on the type of phonics method taught (Ehri et al., 2001). Incidental phonics instruction does not follow a sequence of phonics instruction but highlights different letter-sound relationships in words when they appear in text. Overall, the instruction of phonics is powerful in the process of learning to read both for reading skills and for reading comprehension (Hattie, 2009).

Students who mastered the decoding process tend to enjoy reading because more time was spent on fluency and comprehension (Suggate, 2016; Warnick & Caldarella, 2015). Children who developed competency in the decoding processes were able to start reading more effectively and faster than their peers (Suggate, 2016; Warnick & Caldarella, 2015). Students with the ability to decode had an easier time concentrating on the meaning of a text, which contributed to a more enjoyable reading time, compared to children who had not mastered phonics, (Stanovich, 1986). According to Ehri (2012) and

Weber (2014), phonics instruction should start as early as kindergarten, occur daily over a period of two years, and be combined with phonemic awareness instruction.

Fluency. According to the NRP (2000) fluency is the ability to read a text quickly, accurately, and with proper expression. A fluent reader can maintain the skill of reading without practice, can generalize across texts, and can maintain the performance of reading over a long period of time (Sapp, 2012). Three key components to reading fluently are accuracy in word decoding, automaticity in recognizing words, and appropriate use of prosody or meaningful oral expression while reading (Rasinski, 2016). These three elements are a doorway to comprehension (Hudson, Mercer, & Lane, 2000). To make sense of what is read, readers need to decode words and at the same time put words together into meaningful sentences while using the appropriate expression to make sense of what was read.

The first component of reading fluency is the ability to read words accurately which involves the skill of decoding the words correctly. In order to decode words correctly the reader understands the alphabetic principle of phonemic awareness and phonics (Ehri & McCormick, 1998). Using other cues to identify words in text and possessing a large knowledge of high frequency words is required for reading accuracy (Tunmer & Chapman, 1995).

The second component of fluency is the rate words are read. This involves identifying individual words with speed and accuracy while reading with fluidity. As students practice reading, they increase their knowledge of words. They recognize a number of words by sight, without sounding them out. They move through connected text comprehending the meaning of what was read without using contextual cues (Ehri,

2012; Share & Stanovich, 1995). Words that are recognized automatically are described as sight words (Kuhn & Stahl, 2000; LaBerge & Samuels, 1974). Automaticity of reading means the student can rapidly recognize words even with little cognitive effort, which makes it crucial to word reading accuracy. If an intense amount of cognitive effort is put forth to get the word right by phonemically decoding words or in guessing words from context, it will be hard for readers to comprehend a text's meaning (Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004). Reading rate in terms of reading speed are measured according to the number of words that the child can read correctly per minute as well as the length of time it takes a reader to read a passage.

Prosody is the third component of reading fluency and indicates a student understands the text. The linguistic term prosody describes the rhythmic and tonal aspects of speech as the "music" of oral language (Torgeson & Hudson, 2006). Prosodic features contribute to the expressive reading of a text which includes three elements; variations in pitch (intonation), stress patterns (syllable prominence), and duration (length of time) (Allington, 2002; Dowhower, 1991; Schreiber, 1980). A reader is reading with expression when intonation, syllable prominence, and duration is used when asking questions, portraying surprise or making exclamations in oral reading (Hudson, Lane, & Pullen, 2005). Prosody sounds natural and expressive (Rasinski, 2003). It is comprised of the appropriate pausing and responses to punctuation as the child verbalizes the words (Rasinski, Blachowitz, & Lems, 2012).

For students to become fluent readers they must have mastered the above skills. Students who are fluent will not have to spend time recognizing each letter or word. Fluent readers spend time comprehending meaning from the text. Students become

fluent readers by listening to good role models and practicing (Lai, Benjamin, Schwanenflugel, & Kuhn, 2014; Rasinski et al., 2012; Silverman, Speece, Harring, & Ritchey, 2013). Fluency can be enhanced when students participate in repeated reading and guided repeated oral reading (Rasinski et al., 2012). Comprehension is enhanced when a student reads fluently and smoothly (Lai et al., 2014; Rasinski et al., 2012; Silverman et al., 2013). National Assessment of Educational Progress (NAEP), conducted a study with findings of w 44% of students with low comprehension scores had poor fluency skills (Pinnell, Pikuiski, Wixson, Campbell, Gough, & Beatty1995).

Vocabulary. Vocabulary was identified and investigated by the NRP as a necessary component to reading instruction. Vocabulary is defined as the knowledge of specific word meanings (Armbruster, Lehr, Osborn, & Adler, 2009). Vocabulary knowledge includes an awareness of the different uses of words (Boardman et al., 2008). Reading is dependent on a student's oral as well as print vocabulary. Oral vocabulary is the ability to recognize spoken words. It is easier to attain than print vocabulary. Print vocabulary involves a student's ability to recognize written words (Armbruster et al., 2009). The research by the NRP included both types under the broad umbrella of vocabulary.

Vocabulary knowledge is foundational for success in reading. Students cannot understand what they read without understanding what most of the words mean. Decades of research have confirmed the important role vocabulary plays in reading comprehension and in students' overall academic success (Hiebert & Kamil, 2005). In early elementary grades, vocabulary instruction includes high frequency words called sight words (Beck, 2006). Repeated exposure to new words in different contexts over

extended periods are components of high quality vocabulary instruction (Kamil, 2008). Vocabulary is developed through extensive reading (Boardman, et al., 2008).

There are different types of vocabulary that students need. However, the most important type for improvement of the reading process is reading vocabulary, which are words, used and recognized in print (McKeown & Curtis, 2014). Students lacking a vast reading vocabulary are unable to build fluency and comprehension (Cain & Oakhill, 2014; McKeown & Curtis, 2014). Students can receive explicit vocabulary instruction through a variety of methods such as, modeling, reading to others, and using context clues. It is important to use more than the dictionary as the sole source of learning new and unfamiliar words (Texas Reading Initiative, 2002). Students can also learn vocabulary through oral language and listening to adults read to and with them. Vocabulary instruction should be a daily practice within the reading blocks as well as integrated into other subject areas (Cain & Oakhill, 2014; McKeown & Curtis, 2014).

Comprehension. The NRP (2000) found that comprehension is foundational to the development of reading skills. Reading comprehension is the understanding of the meaning of text (Wallot, O'Brien, Haussmann, Kloos, & Lyby, 2014). Comprehension is described as active and intentional thinking, in which meaning is constructed through interactions between text and reader (Durkin, 1978). It is the final goal of reading instruction. All academic learning is affected by the ability to comprehend written text.

Text comprehension refers to gaining meaning from text (Kim, 2015; Macedo-Rouet, Braasch, Britt, & Rouet 2013; Wallot et al., 2014). Students will not master the reading process completely, if they do not master comprehension of text. Good readers will use reading as a means to gain understanding, information, and pure enjoyment of a

good story. Comprehension is the whole purpose for reading. It should be taught explicitly for students to learn comprehension strategies (Kim, 2015; Macedo-Rouet et al., 2013; Wallot et al., 2014). Explicit comprehension instruction includes modeling, graphic organizers, summarizing, and story retelling using a combination of literature and expository text (Kim, 2015; Macedo-Rouet et al., 2013; Wallot et al., 2014).

Factors that Affect Reading Skills of Students

Teachers. Teachers are fundamental to any student success. Several studies have confirmed effective teachers play the most important role in their students' acquisition of effective reading skills, more so than the curriculum materials, pedagogical approaches, or the programs used to deliver instruction (Allington, 2002). Teachers are vital to the success of students acquiring effective reading skills. To facilitate learning, it is not enough that the teachers know how to teach the subjects. Teachers need to know how to keep and maintain students' ability and skills through motivation (De Naeghel et al., 2014; Lerkkanen et al., 2012; Le Fevre, 2014). If the teachers do not possess such skills, students' successful education could be at stake (De Naeghel et al., 2014; Lerkkanen et al., 2012; Le Fevre, 2014).

Teachers are often called upon to use and evaluate instructional designs and material to provide effective learning opportunities for students (Critchfield & Twyman, 2014). A challenge in the process of successful learning is the proper or improper use of instructional designs and materials (Critchfield & Twyman, 2014). Improper use of instructional designs may lead to problems pertaining to the students' cultural and cross-cultural diversity such as language barriers, unavailability of resources, and lower levels of interest toward the subject matter (Critchfield & Twyman, 2014). Meanwhile, the use

of different visual aids and other forms of instructional materials also greatly affects the student's learning. If an educational institution could not provide appropriate teaching materials and equipment, and a place conducive to learning, facilitation of education may not be as fast or successful as schools that could provide these resources (Critchfield & Twyman, 2014).

Good teachers seek ways to teach and motivate students to read. Good teachers understand that they do not know it all and will continue to learn through professional development (De Naeghel et al., 2014; Lerkkanen et al., 2012; Le Fevre, 2014). Professional development is a catalyst that begins the process to the improvement of student achievement (Phillips, Nichols, Rupley, Paige, & Rasinski, 2016; Hollenbeck & Kalchman, 2013). Effective professional development includes teachers' understanding how to teach, understanding the subject matter, understanding how students learn, and how best to present the body of knowledge (Phillips et al., 2016; Hollenbeck & Kalchman, 2013).

Moreover, studies found that professional development focused on academic content and curriculum and aligned with standards-based reform could lead to improvements in the ability of teachers to teach reading skills (Hollenbeck & Kalchman, 2013; Phillips et al., 2016). To accomplish this task, a variety of trainings need to be offered focused on the content and curriculum aligned to the standards with an emphasis on effective teaching practices (Collins, 2013; Connor et al., 2013). To be successful, these elements must be present in the professional development programs: coherent policies, integrated professional development, effective leadership, student and teacher partnerships, and sufficient resources (Collins, 2013; Connor et al., 2013). Teachers need

time to collaborate and learn together to improve their instructional practices (Collins, 2013; Connor et al., 2013).

More Instructional Time. Students who struggle with reading need more instructional reading time to become proficient in the reading process. Even though less than half the day is spent reading and students are engaged in a variety of reading activities, much of that time is not spent on reading instruction (Wanzek, et al., 2013). Elementary students need at least 90 minutes of reading instruction daily and students who struggle in reading need an additional 25-30 minutes of reading instruction added to the school day (Wanzek, et al., 2013).

Students need time for activities that allow them to hear an effective reading model, to read together, and to read independently (Rasinski, 2008; Vaughn & Wanzek, 2014). Many schools struggle to find additional time during the regular school day; however, there are other options that should be considered to afford those students more time (Rasinki, 2008; Vaughn & Wanzek, 2014). Additional time can be provided with after school programs, summer school programs, and extended school years (Rasinski, 2008; Vaughn & Wanzek, 2014). The success of using time outside the school day is presenting instruction in different and engaging ways to maintain student interest. Reviews of research on summer school show that high quality programs can make a difference in student learning (Rasinski, 2008; Vaughn & Wanzek, 2014). The results from the findings indicated programs that target corrective or accelerated learning can affect student learning positively. There is also evidence that summer school can improve struggling students' reading skills and prevent loss of learning in other subjects

(Rasinski, 2008; Vaughn & Wanzek, 2014). While additional time is important, what is more important is what teachers accomplish with that time.

Student Characteristics. Apart from the teachers, curriculum, and classroom, the characteristics of the students can affect how they acquire reading skills effectively (Chansa-Kabali & Westerholm, 2014; Kim & Quinn, 2013; Lesaux, 2012). Recent findings from studies suggested that many children who come from homes that are economically disadvantaged might have a motivation problem that keeps them from doing well in school. It is this motivation problem, and not the seeming inability of the students to perform, that reflects in their report cards and standardized test scores (Chansa-Kabali & Westerholm, 2014; Kim & Quinn, 2013; Lesaux, 2012).

Various researchers have indicated a correlation between disadvantaged children and poor reading scores (Harris & Butaud, 2016; Herbers et al., 2012; Votruba-Drzai, Miller, & Coley, 2015). Many of these children come from homes that do not have access to many books, and have limited money. These disadvantages keep children from reaching their potential because they simply do not have access to information and learning activities that more affluent children enjoy (Harris & Butaud, 2016; Herbers et al., 2012; Votruba-Drzai, et al., 2015).

How well children are able to regulate their own behavior is also very important to how well and easily they learn to read. Children with poor self-regulation will consistently do worse than children with good self-regulation, all other factors being constant (Schünemann, Spörer, & Brunstein, 2013). There is evidence that parents have a great effect on their child's reading ability, especially in earlier, more formative years (Hornery, Seaton, Tracey, Craven, & Yeung, 2014; Silinskas et al., 2012; Sim,

Berthelsen, Walker, Nicholson, & Fielding-Barnsley, 2014). Parents who read to their children or let their children read to them are helping to show them a love of books, encouraging them to take an interest in discovering information for themselves (Hornery, et al., 2014; Sim, et al., 2014; Silinskas et al., 2012).

Teaching Methods. Various teaching methods can improve reading skills of students. Using graphics is becoming more popular as one way of teaching children to read and keep students interested in the world of words (Duke et al., 2013). Some children learn better when they can see how the words on the page apply to real-life scenarios. Graphics provide a clear picture of what is being presented in the text, and help foster an understanding of the words that are being read (Hochpöchler et al., 2012 Rajan, 2013). Another goal of this approach is to help the reader memorize the information that they read more easily so that it can be recalled on tests and other events (Hochpöchler et al., 2012; Rajan, 2013). Children who have problems with memorization can learn more and retain more by using graphics (Hochpöchler et al., 2012; Rajan, 2013).

A study relating to the visual impressions of written words as an art form, like dance or music, was an effective teaching method for struggling readers (Cleveland, 2015; Martinez & Harmon, 2015; Rowland, 2014). Students allowed to draw their visual representations of what they read consistently fared better at reading, and showed more interest in reading stories, than others who were not allowed this visualization exercise (Cleveland, 2015; Martinez & Harmon, 2015; Rowland, 2014). The authors of the study suggested performing plays, writing poetry, and drawing pictures of what children read or

had read to them, may be beneficial when used as a teaching method for children who were having trouble learning to read well.

Apart from the use of graphic tools and visual aids, a general consensus has been reached by researchers that children need more one-on-one time with teachers or other adults when they are learning to read (Jennings et al., 2015; Tracey et al., 2014). Since reading is the foundational skill used in all subjects, it is vitally and fundamentally important that children acquire the skill early in life and continue to practice it as they grow up (Jennings, McDowell, Carrol, Bohn-Gettler, 2015; Tracey, Hornery, Seaton, Carven, & Yeung, 2014). Without enough one-on-one time, and without enough interest in reading, a love for reading will never be created in these children, and they will struggle with many other subjects throughout their lives because they cannot read the textbooks well enough to understand other subjects (Jennings et al., 2015; Tracey et al., 2014).

Although teachers provide individualized reading instruction for improved student learning, computerized programs offer supplementary support to develop reading skills (Schechter et al., 2015). School systems in this country have implemented computerized programs to help children learn to read (Khan & Gorard, 2012; Taylor, Spichtig, & Radach, 2016; Wood et al., 2012). The use of software as a teaching method has been found to be effective in increasing reading skills of students (Khan & Gorard, 2012; Taylor, Spichtig, & Radach, 2016; Wood et al., 2012). Many schools use software programs to assess the needs of individual students and to allow students to work at their own pace so that those who read poorly are not left behind (Khan & Gorard, 2012; Taylor et al., 2016; Wood et al., 2012). Computer software provides students with poor reading

skills a chance to catch up, and improve reading skills of students who are better readers (Khan & Gorard, 2012; Taylor et al.; Wood et al., 2012).

Federal Initiatives to Improve Reading Instruction

Reading Excellence Act. The Reading Excellence Act (REA) of 1999 was a federal initiative designed specifically to improve reading instruction. The Republican majority in Congress introduced this act in an effort to improve the reading skills of our nations' students in kindergarten through third grade by using scientifically based research in reading instruction. The REA (1999) was the first to use the phrase scientifically based reading research (SBRR). The REA described SBRR as the application of rigorous, systematic, and objective procedures to obtain valid knowledge relevant to reading development, reading instruction, and reading difficulties upon approval by a panel of independent experts or a peer-reviewed journal (REA, 1999). States provided competitive grants to improve students' reading skills by implementing the findings of SBRR to guide their reading curriculum and instruction. States were required to verify REA funds were used for educational reading programs developed from SBRR.

SBRR refers to practices that have demonstrated to be effective in improving reading achievement. The effectiveness is manifested in two ways, through research-study data collected through a rigorous design, and by consensus among expert practitioners who have evaluated and followed up these outcomes as part of their practice. All results must be valid and reliable and come from a variety of sources (REA, 1999). This Act provided the scientific foundation for the inclusion of this term in future

educational policies. It paved the way for the adoption of the No Child Left Behind Initiative of 2001 and its Reading First component (Edmondson, 2005).

No Child Left Behind and Reading First Initiative. The NCLB Act of 2001 was passed by congress with bipartisan support. This enactment was a strategy to gain educational improvement in the United States. It was a reauthorization of the *Elementary and Secondary Education Act (ESEA)* of 1965 (No Child Left Behind Act of 2001). The NCLB placed intense pressure on schools and teachers to find methods to ensure every child was proficient in the areas of reading and mathematics. The federal NCLB Act required states to identify state standards, which are the foundational skills students should master at particular grade levels and to give annual assessments in reading, math, and science based on these state standards. This process identified students who did and did not meet proficiency standards and the schools that were failing to make Adequate Yearly Progress (AYP) (Dee & Jacobs, 2010). The attainment of AYP was a cornerstone of the NCLB legislation (Linn, 2003). Schools where students did not achieve AYP were subject to imposed sanctions. Schools who achieved AYP status were issued rewards.

School improvement was the major goal of the NCLB policy regarding accountability and student achievement. Sanctions and rewards served as the foundation for this approach. The main consideration was that negative consequences were linked to standardized test performance and therefore would encourage teachers and students in low performing schools to work harder in achieving a certain level of proficiency and fluency in reading (Nichols, Glass, & Berliner, 2012). Studies demonstrated that relying on standardized tests was not effective because these tests had little relationship to reading achievement (Braun, Wang, Jenkins, & Weinbaum, 2006; Figlio & Ladd, 2008;

Nichols et al., 2012). Questions were raised regarding the relationship between standardized tests and increasing student learning. The findings from these studies suggested the problem of students with low reading scores persisted despite mandated standardized tests.

NCLB was built on four principles: accountability for results, more choices for parents, greater local control and flexibility, and an emphasis on doing what works based on empirical research. This law holds districts accountable for the academic progress of their students in math and reading. Closing the achievement gap between students of specific race, gender, and socio-economic level subgroups and students in the majority population was one of the intentions of NCLB (No Child Left Behind Act of 2001; U.S. Department of Education, 2003). The Act was also designed to make sure students were taught by effective teachers with the use of research-based instructional materials.

Designed to boost students' academic gains, NCLB demanded heightened attention be placed on teacher professional development. Professional development ensured their understanding of effective instructional strategies founded upon scientifically based reading research (NCLB 2001). The law's main focus was to improve the reading skills of students in the primary grades (McLauglin, 2012). According to the law, this would need to be accomplished by schools and teachers using scientifically based reading instruction and material. The theoretical concepts supporting the reading portion of the NCLB act was based on the *Report of the National Reading Panel: Teaching Children to Read* (U.S. Department of Health and Human Services, 2000a) presented to congress in early 2000 (NICHD, 2000; U.S. Department of Education, 2003). The five foundational reading skills, phonemic awareness, phonics,

vocabulary, fluency, and comprehension highlighted by the report were identified as the focus of early reading instruction (Boardman et al., 2008).

Nationally, NCLB focused on the importance of reading proficiently by the end of third grade. In a determination to meet the requirements of the law, schools across the nation dedicated their efforts to realign and reorganize reading curriculum and instruction to employ instructional practices based upon scientifically based research (Biancarosa & Snow, 2006). A reading initiative authorized by NCLB, Reading First, was put into place to ensure all students, regardless of ethnicity or socioeconomic status, received scientifically based reading instruction enabling all students to be able to read by the end of third grade (U.S. Department of Education, 2009).

NCLB and the Reading First legislation were written as a guide to make certain all children could read at grade level by the end of third grade. The NCLB component of using scientifically based instructional reading programs was a significant factor in how funds were spent in school districts. Funds provided by the Reading First legislation were dedicated to schools with a high percentage of students in poverty. The funds were to be used to provide reading instruction based on the NRP's five foundational reading skills, phonemic awareness, phonics, vocabulary, fluency, and comprehension, in the form of federal grants (Courtade et al., 2014; Torgesen et al., 2006; U.S. Department of Education, 2009). Across the nation, the NRP's research had a strong impact on instructional reading practices and decisions, because the distribution of federal funds to schools depended on compliance with the NRP's findings (Pressley & Fingeret, 2007; Wilson, Martens, Arya, & Altwerger, 2004). Under the Reading First guidelines,

programs that did not comply with the panel's guidelines focusing on the five areas of reading were considered inappropriate.

Scientifically Based Reading Interventions

The positive effects of early and targeted reading interventions for students with learning disabilities or at-risk of having inefficiencies have been documented in several studies (Cavanaugh, Kim, Wanzek, & Vaughn, 2004; Vaughn & Wanzek, 2014; Boardman et al., 2008). It is important to have reading interventions tailored to the needs of students and involve appropriate resources to address those needs (Burns & Gibbons, 2008). Targeted intervention components that provided an appropriate level of challenge for the individual student, focused on explicitly teaching a specific skill, were highly effective (Burns & Gibbons, 2008). Instructional material that gave students many opportunities to respond and provided immediate corrective feedback were important features of effective interventions (Burns & Gibbons 2008).

Reading interventions should attend to the motivational needs of students. Students who have experienced repeated failure in reading are likely to have less motivation to read or put effort into learning new strategies for reading (Minskoff, 2005; Morgan, Fuchs, Compton, Cordray, & Fuchs, 2008). It is imperative to include components aimed at increasing motivation when designing an intervention for struggling readers. Effective scientifically based interventions engaging to students are important for helping students gain foundational reading skills.

A growing number of computer software programs have been designed to provide SBRR intervention. The programs were developed to deliver reading instruction and practice that was once only available from teachers. Advances in technology such as

high-quality sound, digitized speech, colorful graphics, and interactive design created to hold students' attention and motivation add to the instructional value of computer software programs (Silver-Pacuilla, Ruedel, Mistrett, 2004). The benefits of using computer software programs allowed students to work at their own pace and instructional level, while, providing opportunities for individual feedback and motivation, and needed drill and practice (Hattie, 2009). Even though the research exploring the effectiveness of computer software programs on reading instruction increased there continued to be considerable need for research in this area. As school leaders make decisions about instruction provided by computer software programs it is important to reflect and evaluate whether the interventions attempted have met the goal of raising student achievement in reading (Clarke, 2002).

Computer Assisted Instruction

Computer usage is of high interest for students, which can assist in student engagement, aid in positive attitudes toward learning, and provide a medium for deliberative practice and feedback along with customizing the learning experience (Hattie, 2009). Student engagement is associated with positive learning outcomes (Carini, Kuh, and Klein, 2006). Findings from studies have revealed when instructional technology has been deployed in the classroom there is a positive correlation between the use of educational technology and student engagement, (Chen, Lambert, & Guidry, 2010; Nelson, Laird, & Kuh, 2005). Students who are interested and engaged in their own learning will be more apt to achieve greater learning. Computers are the medium through which this learning can take place.

An advantage of computer usage is that students are likely to be offered deliberative practice in learning knowledge and concepts. A key ingredient of deliberative practice is drill and practice. Drill is the euphemism for practice, which is repeated learning of the material until it is mastered (Hattie, 2009). Students need drill and practice. Computer games contain engaging drill and practice allowing students to be thrilled and motivated to achieve higher levels of skill attainment. The challenge increases as students achieve mastery of each level by drill and practice or over learning. Feedback from computer-assisted instruction has a powerful influence on the learner. It provides cues or reinforcement that can be acted upon by the students to further enhance learning. Computer feedback occurs in a more programmed manner, which provides information about the learning task (Blok, Oostdam, Otter, & Overmaat, 2002) . This feedback aids in meeting students' learning needs and individualizes instruction needed for the skill to be mastered. Computer assisted instruction is interactive, provides personalize learning adapted to each student's skill level, and is a hook to engage and motivate students.

Lexia Core5

The origin of the Lexia programs was designed on the multisensory approach of Orton-Gillingham. Samuel T. Orton, known as the "father of dyslexia" and a neurologist, developed the multisensory approach for students who have reading difficulties (Colony, 2001). He suggested students who have language disorders receive remedial training with a combination of phonics and kinesthetic exercises. The exercises included tracing letters, finger pointing, and handwriting (Colony, 2001). Anna Gillingham trained in

education and psychology, worked with Orton in the early 1930s. She developed the alphabetic method, a remedial reading program (Academy of Orton-Gillingham, 2014).

The alphabetic method included continuous letter exposure of how it looks, sounds, and how the hand feels when creating the letter (Richardson, 2001). This multisensory approach stimulated all visual, auditory, and tactile-kinesthetic sensory organs (Gillingham & Stillman, 1997). As students learned individual sounds, they also learned how to use sounds to build their vocabulary (Gillingham & Stillman, 1997). The student then learned how to associate sound with print (visual), what is heard (auditory), and what is felt when the sounds are heard (tactile sensations in the mouth) and the letters are printed (kinesthetic) (Gillingham & Stillman, 1997). The Lexia programs were based on the foundational practices of Orton and Gillingham.

Lexia Learning Systems were established in 1984 by Bob Lemire. He was a respected investment advisor and land consultant. He was not a reading specialist nor was he looking for a new career. He had a personal mission when he developed the computer software programs that would help educators teach reading skills (Lexia Learning Systems, 2014). Lemire's son was diagnosed with developmental dyslexia. He consulted Dr. Edwin Cole, a noted neurologist and head of the Reading Clinic at the Massachusetts General Hospital. Dr. Cole was also the founder of several schools for dyslexics and a longtime colleague of Dr. Samuel T. Orton and Anna Gillingham. Lemire's son, Bo, received tutoring from the Orton-Gillingham clinic and for two years attended a small private school in Vermont for students with dyslexia.

Lemire and his wife were touched by their son's success in overcoming his reading difficulties and wanted to help others. Lemire and Dr. Cole discussed solutions

with a neighbor, Dr. Littleton Meeks, an expert in technology (Lemire, 2014). The three decided to create a computer software program designed to promote skill development for students who experience reading difficulties. With modest funding, the new company, received grants from the NIHCD (Lemire, 2014). It took many years and resources to obtain the proper scope and sequence (Lemire, 2014).

The Lexia program was designed to give verbal and visual prompts as students worked independently at the computer. The student responded by clicking images with a mouse and the program exercises automatically branched depending on the child's performance. Additional practice was provided when repetition was needed as well as diverging to challenging levels when the student was ready (Lexia Learning Systems, 2014). Lexia was designed to be integrated into the language arts curriculum and included an intense focus on phonological awareness and phonemic awareness skills (Lexia Learning Systems, 2014).

Through the Lexia program, students were provided personalized learning, explicit instruction, and corrective feedback (Lexia Learning Systems, 2014). Students worked on their own for 18 levels of self-paced activities. By interacting with the complex texts on their own, the students acquired critical listening and reading comprehension skills. A student who struggled with a specific activity received a scaffolded approach so he became an expert in a specific skill. The struggling student also received skill-specific, explicit instructions online. Teacher-led instruction using Lexia's scripted lesson materials were also present to aid the struggling student. The company claimed that through their personalized approach, at-risk students could

progress continuously and consistently under the guidance of their teachers (Lexia Learning Systems, 2014).

The capacity to learn and grow as a reader depends on students learning the reading skills of phonemic awareness, phonics, fluency, vocabulary, and text comprehension (NRP, 2000). Lexia Core 5 incorporated activities focused on developing the five reading skills. Phonological awareness activities in Lexia Core5 encompassed identifying, segmenting, blending, and manipulating syllables and sounds in words (Lexia Learning Systems, 2014). In Lexia Core5, phonics activities included the ability to apply knowledge of letter-sound correspondence to reading and spelling words, pattern recognition of syllable types, and rules for syllable division and simple spelling generalizations that were based on letter-sound correspondence. In addition, through a series of warm-ups and activities focused on speed of processing, automaticity was developed. Fluency activities involved analysis of sentence structure and the timed silent reading of passages. Lexia Core5 incorporated structured activities designed to teach word-learning strategies, to provide exposure to rich and varied vocabulary words, and to allow students to develop an awareness of word relationships and associations. Lexia Core5 activities focused on comprehension skills. These foundational skills through interaction with increasingly complex narrative and informational texts are critical to becoming a proficient reader. Individualizing instruction to specifically address the five reading skills and meet the needs of all students is a challenge. Lexia Core5 is an educational technology program that promotes individualized instruction for elementary students on the five reading skills and promotes greater reading development.

Research studies were conducted. Crawford-Brooke et al. (2014) investigated the benefits of the use of Lexia Core5 in early elementary grades. Participants were first and second graders from a metropolitan school district with a high Hispanic (83%) population (Crawford-Brooke et al., 2014). Classes were randomly assigned to treatment or control groups. There were 45 treatment and 38 control students. Treatment students used Core5 on classroom computers. Control students received regular language arts instruction. A pre- and post-test assessments were administered. The two groups did not differ significantly at pre-test. The treatment group showed greater gains in reading comprehension. Crawford-Brook et al. (2014) presented the findings signifying first and second grade students obtained significant gains in reading comprehension after using Lexia Core5.

Juarez-Tillery specifically evaluated the effectiveness of the Lexia Core5 program to determine if using the program resulted in improved reading achievement of third grade students. After gathering data from 91 third-grade students who used the Lexia Core5 program three times a week for half an hour each session, the researcher found Lexia Core5 was effective. The intervention led to improvements in three areas of reading. Students' Lexile Levels, fiction, and nonfiction comprehension all improved. However, there were no significant changes in the fluency of the students. Juarez-Tillery (2015) concluded there was a great necessity to continue both explicit and systematic instruction. Students needed to be exposed to other intervention opportunities to achieve further improvements and maintain their achievements (Juarez-Tillery, 2015).

Summary

Although there is a rich body of literature on the factors that can affect reading achievement of primary students, the problems they face, and the role of computer-assisted education in improving the reading skills of the students, there remains a limited number of studies about how Lexia Core5 benefited students. The literature showed that helping students learn to read proficiently by the end of third grade is dependent on students learning the five foundational reading skills, phonemic awareness, phonics, fluency, vocabulary, and comprehension in first, second, and third grades. The current study addressed the effectiveness of Lexia Core5 designed to improve student learning the foundational reading skills.

The literature review included information about school leaders, teachers, and state legislatures' recognition of the importance of reading proficiently (Lyon, 2002). Teachers have the responsibility to teach all students to read. In elementary classrooms, teachers offer students numerous opportunities and alternatives for developing their reading skills. The importance of individualizing instruction to meet the reading needs of students is a teaching task, which requires teachers to know the unique reading skill level of each student and then provide deliberate instruction to promote their reading ability and skills. A student's conceptual understanding of reading is improved by developing phonemic awareness, phonics, fluency, vocabulary, and comprehension reading skills through their teacher's guidance. Students use these skills to develop their ability to read. Lexia Core5 is a computerized instructional tool, which has the potential to help teachers individualize instruction and help students improve their knowledge of the five foundational reading skills without direct teacher instruction (Juarez-Tillery, 2015).

Chapter three includes the current study's methodology, population, sample, and sampling procedures used to answer the four research questions presented in chapter one. In addition, chapter three provides information about instrumentation, validity, reliability, and data collection. A description of the data analysis, hypotheses, assumptions, and limitations are also included in chapter three.

Chapter Three

Methods

This chapter contains a discussion of the study's methodology including the research design, description of the population, and sampling methods. Also in this chapter are details of reading assessment instruments Renaissance STAR Early Literacy Enterprise and the Renaissance STAR Reading Enterprise. Scores from the assessment instruments were used to evaluate efficacy of Lexia Core5 on students' academic gain of the reading skills phonemic awareness, phonics, fluency, vocabulary, and comprehension. An explanation of the measurement process was presented. Validity and reliability of the instruments used for measuring student's pre- and post-test scores, data collection techniques, and data analysis procedures are provided. Finally, the limitations of the study and a summary conclude the chapter.

This study examined archived data from the 2013-2014 school year to discern whether first grade student usage of Lexia Core5 contributed to student academic gain in the five foundational reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension. Second and third grade students' archived data from Lexia Core5 was studied to determine if program usage assisted in student academic gain in the foundational reading skills of phonics, fluency, vocabulary, and comprehension. Additionally, the current study examined whether time students logged online to use the program Lexia Core5 contributed to academic gain in scores.

Research Design

The research design was quantitative and non-experimental. In quantitative methodologies, quantitative measurement and statistical analysis were conducted on the

data to explain the topic being investigated (Mustafa, 2011). A non-experimental research design was utilized since there was no control group in the study (Babbie, 2012).

To answer the first and second research questions the independent variable was Lexia Core5. The dependent variables were the academic gain scores in phonemic awareness, phonics, fluency, vocabulary, and comprehension. Reading skills scores were taken from the reports of STAR Early Literacy Enterprise and STAR Reading Enterprise assessments. These scores were used to calculate students' academic gain in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills. The academic gain scores for each of the different skills were studied to learn the effect Lexia Core5 had on student growth of foundational reading skills.

To answer the third and fourth research questions, the independent variable was the time students logged online while using Lexia Core5 and the dependent variables were the academic gain scores. The Lexia Learning Company produced a report on the amount of time, measured in minutes, first, second, and third grade students were online using Lexia Core5 during the 2013-2014 school year. The time logged online was divided into four categories to describe the amount of time students used the program. The time categories for first, second, and third grade students are listed in Table 1. First grade students' time logged online in the first category was 840–1318 minutes, second category was 1319–2034 minutes, third category was 2035–2725 minutes, and the fourth category was 2726–6199 minutes. Second grade students' time logged online in the first category was 1033–1868 minutes, second category was 1869–2589 minutes, third category was 2590–3414 minutes, and the fourth category was 3415–8741 minutes. Third grade students' time logged online in the first category was 1696–2532 minutes,

second category was 2533–2845 minutes, third category was 2846–3269 minutes, and the fourth category was 3270–6457 minutes. A One-way Analysis of Variance (ANOVA) was conducted using the independent variable of time logged online while using the Lexia Core5 program and the dependent variable of academic gain scores.

Table 1

Categories of Minutes Logged Online

	First Category	Second Category	Third Category	Fourth Category
First Grade	840-1318	1319-2034	2035-2725	2726-6199
Second Grade	1033-1868	1869-2589	2590-3414	3415-8741
Third Grade	1696-2532	2533-2845	2846-3269	3270-6457

Note: Lexia Learning Company Report (October 13, 2014)

Population

The Kansas Legislature offered the fully funded program, Lexia Core5, to all Kansas elementary students during the 2013-2014 school year. Schools could choose to implement the program without incurring additional costs. The population for the present study was a suburban elementary school that participated in the program. First, second, and third grade students enrolled at the elementary school during the 2013-2014 school year were the population for the current study. There were 573 students registered in first, second, and third grades at the school during the targeted year (Kansas State Department of Education, 2014). The purposive sample was 477 students who met the criteria to be included in the study. Specifically, there were 149 first grade students, 157 second grade students, and 171 third grade students who met the criteria.

Sampling Procedure

The data for the current study were collected from a school database. Purposive sampling was used to identify students from the overall population. The use of purposive sampling involved recruiting targeted individuals with similar characteristics related to the objectives of the study (Yang & Banamah, 2014). First grade students who met the criteria were enrolled in Lexia Core5 with August 2013 STAR Early Literacy Enterprise pre-test and May 2014 post-test scores. Second and third grade students who met the criteria were enrolled in Lexia Core 5 with August 2013 STAR Reading pre-test and May 2014 post-test scores. First, second, and third grade students pre- and post-test scores were entered in an Excel spreadsheet. A generic identification number was assigned to each student's score to maintain confidentiality.

Instrumentation

The source of the archived data was from first, second, and third grade students' STAR Early Literacy Enterprise and STAR Reading Enterprise pre- and post-test assessment scores. First grade students' reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension were measured using the STAR Early Literacy Enterprise assessment tool in August and May of the 2013-2014 school year. Second and third grade students' reading skills of phonics, fluency, vocabulary, and comprehension were assessed using STAR Reading Enterprise assessments in August and May of the 2013-2014 school year. The difference was calculated between the pre- and post-assessment scores of each reading skill to determine the academic gain scores in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills.

STAR Early Literacy Enterprise. STAR Early Literacy Enterprise is a computerized standardized assessment designed for use with emergent readers (Renaissance Learning, 2014a). This assessment targets pre-kindergarten to third grade students who cannot read independently. Students wear headphones to listen to the assessment, allowing them to test independently. This assessment contains 25 items. STAR Early Literacy Enterprise tailors the test to students based on their responses by adaptive branching, which is comparable to the intelligent branching component in the Lexia Core5 program. Adaptive branching individualizes the assessment based on the student's response to the question. If a question is answered incorrectly, the following questions are less difficult. If the question is answered correctly, more difficult questions follow. This allows the test to be specific for each student based on his or her responses.

The content of the STAR Early Literacy Enterprise item bank is organized into sub-domains. STAR Early Literacy Enterprise is organized into three broad domains and 10 sub-domains. The three broad domains are Word Knowledge and Skills; Comprehension Strategies and Constructing Meaning; and Numbers and Operations. The 10 sub-domains are: Alphabetic Principle; Concept of Word; Visual Discrimination; Phonemic Awareness; Phonics; Structural Analysis; Vocabulary; Sentence-Level Comprehension; Paragraph-Level Comprehension; and Early Numeracy. This structure includes the National Reading Panel's recommendation for the five foundational skills of reading development (Renaissance Learning, 2014a). The assessment included graphic displays and dictated instructions by digitized audio recordings (Renaissance Learning, 2014a). The questions are multiple-choice with three response alternatives. Students use the keyboard or the mouse to select their answers. STAR Early Literacy Enterprise

assessments were used to evaluate first grade students' progress in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills

STAR Reading Enterprise. STAR Reading Enterprise is a student-based, computer-adaptive test that assesses students' reading skills and overall reading achievement (Renaissance, 2014). This test includes nationally norm-referenced reading scores and criterion-referenced reading scores. The program is designed for students in first through twelfth grades who can read at least 100 sight words. The STAR Reading Enterprise assessment was used in the current study to measure second and third graders' growth in phonics, vocabulary, fluency, and comprehension skills. According to Renaissance Learning (2013), the reading assessment focuses on measuring student performance with skills in five domains: word knowledge and skills, comprehension strategies and constructing meaning, understanding author's craft, analyzing literary text, and analyzing argument and evaluating text (Renaissance Learning, 2013).

The content of the STAR Reading Enterprise assessments includes 34 items in five broad domains: Word Knowledge and Skills; Comprehension Strategies and Constructing Meaning; Analyzing Literary Text; Understanding Author's Craft; and Analyzing Argument and Evaluating Text (Renaissance, 2014). The length of time needed to complete a STAR Reading Enterprise test ranges from 11–18 minutes, depending on the student's responses and grade level (Renaissance, 2014).

The foundation of STAR Reading Enterprise assessments are centered on the Core Progress Reading learning progression, a research-based and empirically supported learning progression of reading which identifies the continuum of reading strategies, behaviors, and skills needed for students to be accomplished and capable readers

(Renaissance Learning, 2013). The continuum begins with emergent reading and progresses to the level of reading ability required for college and careers. The skills assessed in STAR Reading Enterprise are a subset of this larger continuum of skills. All of the skills assessed are components of phonemic awareness, phonics, vocabulary, comprehension, and fluency reading skills.

Measurement

The two measurement tools used in the current study to assess reading skill development were STAR Early Literacy Enterprise and STAR Reading Enterprise. First grade students' reading skill development were measured with STAR Early Literacy Enterprise. Second and third grade students' reading skill development were evaluated with the STAR Reading Enterprise measurement tool.

STAR Early Literacy Enterprise. The present study utilized the STAR Early Literacy Enterprise to measure first grade students' growth in five foundational reading skills: phonemic awareness, phonics, fluency, comprehension, and vocabulary for the 2013-2014 school year. A pre-test and post-test format was used for the study. The data were collected from scores listed on the Student Diagnostic Report Skill Set from the STAR Early Literacy assessment.

Validity and reliability. According to the STAR Early Literacy Technical Manual (2014), good validity means that the scores should improve, as the students get older and should be greater in higher grades than in lower grades. Included in the Technical Manual is data from the calibration and validation studies providing evidence the instrument has acceptable validity (Renaissance Learning, 2014a). The validation study consisted of an accumulation of evidence about the relationship of STAR Early Literacy

scores with features included in a valid literacy skills assessment (Renaissance Learning, 2014a). The features included a test score increase directly related to the test-takers' ages, an increase with year level in school, and a correlation with scores on related assessments (Renaissance Learning, 2014a). The STAR Early Literacy Research Study was a collection of evidence on reliability of the latest test version, its psychometric equivalence to the previous version, and its validity as a measure of early literacy (Renaissance Learning, 2014a). All studies reported in the STAR Early Literacy Technical Manual were combined in a meta-analysis to come up with an overall validity score of .60. Although the score is not a strong validity value, the correlations obtained from widely different tests and among students from four different grades, the results provide support the validity of STAR Early Literacy as a measure of early reading skills (Renaissance Learning, 2016).

There were two ways to measure the reliability of STAR Early Literacy assessment according to Renaissance Learning Inc., the creator of the instrument. Reliability was assessed using the different tests of test-retest reliability and test of split-half reliability (Renaissance Learning, 2014a,). For the test-retest reliability similar tests were given to 14,000 students several days apart. The test-retest coefficient was .87, showing strong evidence of correlation in the test-retest of the STAR Early Literacy Enterprise instrument (Renaissance Learning, 2014a). The split-half reliability was calculated by splitting the assessment in half and correlating the responses on the first half with those on the second half. The first 24 items of the STAR Early Literacy Enterprise were divided by odd-numbered and even-numbered. The split-half reliability

coefficient was .91, which provided strong evidence for the split-half reliability of the instrument (Renaissance Learning, 2014a.)

STAR Reading Enterprise. The STAR Reading Enterprise test was the measurement tool used to calculate second and third grade students' reading skill development in the 2013-2014 school year. Scores from the STAR Reading Enterprise test were used to evaluate students' academic gain in phonics, fluency, comprehension, and vocabulary. All second and third grade students took the pre-test assessment in August 2013 and the post-test assessment in May 2014. This assessment tool provided immediate feedback on each student's reading skill development of phonics, fluency, comprehension, and vocabulary. The scores on the Student Diagnostic Report from the STAR Reading Enterprise assessments provided data for the current study.

Validity and reliability. The content of STAR Reading Enterprise is different from earlier versions, and was released for use in June 2011, and as a result there is limited research on the correlation between STAR Reading Enterprise and external reading test scores. During the development of STAR Reading Enterprise, the assessment was administered to thousands of students who took the previous versions of STAR Reading (Renaissance Learning, 2014b). Data correlated between STAR Reading Enterprise and traditional versions of STAR Reading: STAR Reading Classic and STAR Reading Service, provided validity data that supported a high correlation between the assessments indicating the previous versions measured similar underlying reading skills. The correlation of STAR Reading Enterprise and STAR Reading Classic was 0.87 for all grades combined. The scores ranged from 0.73 to 0.87 within the grade levels. The correlation of STAR Reading Enterprise and STAR Reading Service Version was 0.88

for all grades combined. The scores ranged from 0.64 to 0.94 within the grade levels (Renaissance Learning, 2014b).

STAR Reading Enterprise presents two ways to measure the reliability of this assessment. Reliability was computed with internal consistency and test-retest correlation coefficients during a national random sampling of more than 1.2 million reading tests between September 2012 and June 2013 (Renaissance Learning, 2014b). The generic reliability correlation was 0.97 for over-all grades combined. Within grades reliability ranged from 0.93 to 0.95. High test-retest consistency was demonstrated to be a 0.93 for overall grades combined. The within grades reliability ranged from 0.85 to 0.87 (Renaissance Learning, 2014b).

Lexia Core5 Reading. First, second, and third grade students were prescribed a number of weekly minutes based on their pre-assessment scores and progress as they worked through the Lexia Core5 activities. The number of minutes changed monthly based on students' progression through the program. As students advanced through the program, their skill level increased. If students did not progress through the program, activities were adjusted to meet their individual learning needs. The intelligent branching component of Lexia Core5 adjusted students' reading skill practice as needed, to prescribe weekly minutes students needed to work to gain reading skill mastery. The Lexia Learning Company generated a report based on the total amount of time students logged online while using Lexia Core5 during the 2013-2014 school year. The report from the company was used to determine if students' time logged online in Lexia Core5 added to greater student learning demonstrated by their academic gain scores in the five foundational reading skills.

Data Collection Procedures

Permission to conduct the study and to use archived data from the 2013-2014 school year from a Kansas elementary school was requested from the district office on December 3, 2015 (Appendix A). Permission to conduct the study was obtained from the district on December 4, 2015 (Appendix B). A written request was submitted on February 10, 2016 to Baker University for approval to conduct the study (Appendix C). Approval was granted from the IRB committee on February 24, 2016 (Appendix D).

To answer the first research question, data from the pre- and post-test scores on phonemic awareness, phonics, fluency, vocabulary, and comprehension were collected from all first, second, and third grade students using the Renaissance Learning assessment report. Data were gathered from the Student Diagnostic Skill Set report of students in first grade with August 2013 STAR Early Literacy Enterprise (Renaissance Learning, 2014) pre-test scores and May 2014 post-test scores. Academic gain scores were calculated by finding the difference between the pre- and post-test assessments for each of the five reading skills.

To answer the second research question, data from second and third grade students' August 2013 STAR Reading Enterprise pre-test scores and May 2014 STAR Reading Enterprise post-test scores were collected to evaluate academic gain in phonics, fluency, comprehension, and vocabulary skills. Academic gain scores were calculated by finding the difference between the pre- and post-test assessments for each of the four reading skills. Data were gathered from the STAR Reading Student Diagnostic Report Enterprise Test. In general, second and third grade students have exceeded the phonemic awareness skill expectation so those scores were not singularly stated on the Diagnostic

Report (Renaissance Learning, 2014b). The Student Diagnostic Report combined phonological awareness and phonics as one component under the Reading Foundations section.

Research questions three and four were answered using first, second, and third grade student data generated from a Lexia Learning Company report. The report included data on the amount of time, measured as the cumulative 2013-2014 minutes students logged online to use the Lexia Core5 program during the school year. All data for the four research questions were analyzed, compiled, and organized using the Just Another Statistic Program (JASP, 2016).

Data Analysis and Hypothesis Testing

Data analyses were conducted with a 95 percent confidence level using a level of significance or alpha level .05. Prior to running the inferential analyses, descriptive statistics of the study variables were presented. The descriptive statistics include the measures of mean and standard deviation to measure continuous measured variables. The data analyses procedures are outlined in the following sections for each of the research questions.

RQ1. To what extent did first grade students demonstrate academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5?

***H1*.** First grade students demonstrated academic gain in phonemic awareness as measured by the STAR Early Literacy Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H2. First grade students demonstrated academic gain in phonics as measured by the STAR Early Literacy Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H3. First grade students demonstrated academic gain in fluency as measured by the STAR Early Literacy Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H4. First grade students demonstrated academic gain in vocabulary as measured by the STAR Early Literacy Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H5. First grade students demonstrated academic gain in comprehension as measured by the STAR Early Literacy Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

To answer the first research question the independent variable was first grade students' academic gain scores, which was the difference between the pre-test and post-test scores. The dependent variables were the raw scores in phonemic awareness, phonics, fluency, vocabulary, and comprehension. Reports from STAR Early Literacy Enterprise assessment and the STAR Reading Enterprise assessments were used to obtain the reading skills scores. These scores were used to calculate first grade students' academic gain in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills. The academic gain scores for each of the different skills were examined to describe the effect of Lexia Core5 on student academic gain in foundational reading skills. Paired samples *t*-tests were conducted using the independent variable, and each of the dependent variables. A paired samples *t*-test is a statistical technique that is used to

compare two population means in the case of two samples that are correlated (Fay & Proschan, 2010). Paired sample *t*-tests are used in 'before-after' studies, or when the samples are correlated. A methodology summary for the first research question is located in Table 2.

Table 2

Summary for Methodology RQ1 (Alpha =<.05)

Independent Variables	Dependent Variables	Measurement	Analysis Method	Hypotheses First Grade
Lexia Core5	Phonemic awareness	Academic Gain	Paired Sample *t*-test	H1
	Phonics	Academic Gain	Paired Sample *t*-test	H2
	Fluency	Academic Gain	Paired Sample *t*-test	H3
	Vocabulary	Academic Gain	Paired Sample *t*-test	H4
	Comprehension	Academic Gain	Paired Sample *t*-test	H5

Note: First Grade Academic Gain is the difference between the pre-test and the post-test scores.

RQ2. To what extent did second and third grade students demonstrate academic gain in phonics, fluency, vocabulary, and comprehension as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one-year of enrollment in Lexia Core5?

H6. Second grade students demonstrated academic gain in phonics as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H7. Second grade students demonstrated academic gain in fluency as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H8. Second grade students demonstrated academic gain in vocabulary as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H9. Second grade students demonstrated academic gain in comprehension as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H10. Third grade students demonstrated academic gain in phonics as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H11. Third grade students demonstrated academic gain in fluency as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H12. Third grade students demonstrated academic gain in vocabulary as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

H13. Third grade students demonstrated academic gain in comprehension as measured by the STAR Reading Enterprise based on the difference in the scores between pre- and post-test assessments, after one year of enrollment in Lexia Core5.

To answer the second research question the independent variable was second and third grade students' academic gain score, which was the difference between the pre-test

and post-test scores. The dependent variables were the raw scores in phonics, fluency, vocabulary, and comprehension. Reports from STAR Reading Enterprise assessments were used to obtain the reading skills scores. These scores were used to calculate students' academic gain in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills. The academic gain scores for each of the different skills were examined to describe the effect of Lexia Core5 on student academic gain in foundational reading skills. Paired samples *t*-tests were conducted using the independent variable, and each of the dependent variables. A methodology summary for the second research question is located in Table 3.

Table 3

Summary for Methodology RQ2 (Alpha =<.05)

Independent Variables	Dependent Variables	Measurement	Analysis Method	Hypotheses Second Grade
Academic Gain Scores	Phonics	Academic Gain	Paired Sample *t*-test	H6
	Fluency	Academic Gain	Paired Sample *t*-test	H7
	Vocabulary	Academic Gain	Paired Sample *t*-test	H8
	Comprehension	Academic Gain	Paired Sample *t*-test	H9

Note: Second Grade Academic Gain is the Difference between the pre-test and the post-test scores.

RQ3. Was first grade student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Early Literacy Enterprise pre- and post-test assessment scores impacted by

duration of time when categorized by the minutes students logged online in the Lexia Core5 program?

H14. First grade student academic gain in phonemic awareness as measured by the difference between STAR Early Literacy pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H15. First grade student academic gain in phonics as measured by the difference between STAR Early Literacy pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H16. First grade student academic gain in fluency as measured by the difference between STAR Early Literacy pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H17. First grade student academic gain in vocabulary as measured by the difference score between STAR Early Literacy pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H18. First grade student academic gain in comprehension as measured by the difference score between STAR Early Literacy pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

To address the third research question, a One-way ANOVA was conducted since the dependent variable was the academic gain scores and the independent variables were the times students logged online to use Lexia Core5. The time logged online were grouped into four time categories (Babbie, 2012). ANOVA was used to compare differences between first grade students' academic gain scores for phonemic awareness, phonics, fluency, vocabulary, and comprehension and the different categories of time logged online in the Lexia Core5 program. The *p* value .05 was used as the level for statistical significance in the analysis. If the finding was significant, a follow-up Tukey post-hoc test was performed to determine the location of the significant difference. A methodology summary for the third research question is located in Table 4.

Table 4

Summary for Methodology RQ3 (Alpha =<.05)

Independent Variables	Time Categories	Dependent Variables	Measurement	Analysis Method	Hypotheses First Grade
Time Logged Online	First 840-1318	Phonemic awareness	Academic Gain	1-Way ANOVA	H14
	Second 1319-2034	Phonics	Academic Gain	1-Way ANOVA	H15
	Third 2035-2725	Fluency	Academic Gain	1-Way ANOVA	H16
	Fourth 2726-6199	Vocabulary	Academic Gain	1-Way ANOVA	H17
		Comprehension	Academic Gain	1-Way ANOVA	H18

Note: First Grade Students

RQ4. Was second and third grade student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Early Literacy Enterprise pre- and post-test assessment scores impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H19. Second grade student academic gain for phonics as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H20. Second grade student academic gain for fluency as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H21. Second grade student academic gain for vocabulary as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H22. Second grade student academic gain for comprehension as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

To address research question four, a One-way ANOVA was conducted using the independent variable of time logged online in the Lexia Core5 program, and each of the

dependent variables for second and third grade students' academic gain scores for phonics, fluency, vocabulary, and comprehension. The *p* value of 0.05 was used as the level for statistical significance in the analysis. If the finding was significant, a follow-up Tukey post-hoc test was performed to determine where the significant difference was located. The methodology summary for the fourth research question regarding second grade students is located in Table 5.

Table 5

Summary for Methodology RQ4 (Alpha =<.05)

Independent Variable	Minutes in Time Categories	Dependent Variables	Measurement	Analysis Method	Hypotheses Second Grade
Time Logged Online	First 1033-1868	Phonics	Academic Gain	1-Way ANOVA	H19
	Second 1869-2589	Fluency	Academic Gain	1-Way ANOVA	H20
	Third 2590-3414	Vocabulary	Academic Gain	1-Way ANOVA	H21
	Fourth 3415-8741	Comprehension	Academic Gain	1-Way ANOVA	H22

Note: Second Grade Students

H23. Third grade student academic gain for phonics as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H24. Third grade student academic gain for fluency as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment

scores were impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H25. Third grade student academic gain for vocabulary as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

H26. Third grade student academic gain for comprehension as measured by the differences in the score between STAR Reading Enterprise pre- and post-test assessment scores were impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

To address research question four, a One-way ANOVA was conducted using the independent variable of time logged online in the Lexia Core5 program, and each of the dependent variables third grade students' academic gain scores for phonics, fluency, vocabulary, and comprehension. The *p* value of 0.05 was used as the level for statistical significance in the analysis. If the finding was significant, a follow-up Tukey post-hoc test was performed to determine where the significant difference was located. A methodology summary for the fourth research question is located in Table 6.

Table 6

Summary for Methodology RQ4 (Alpha =<.05)

Independent Variable	Minutes in Time Categories	Dependent Variables	Measurement	Analysis Method	Hypotheses Third Grade
Time Logged Online	First 1696-2532	Phonics	Academic Gain	1-Way ANOVA	H23
	Second 2533-2845	Fluency	Academic Gain	1-Way ANOVA	H24
	Third 2846-3269	Vocabulary	Academic Gain	1-Way ANOVA	H25
	Fourth 3270-6457	Comprehension	Academic Gain	1-Way ANOVA	H26

Note: Third Grade Students

Limitations

The interpretation of data may be affected by the following limitations in this study, which could affect its application in educational settings. The primary limitation of the study was with the data used. As the study focused on the latest version of Lexia Core5, only archival data from STAR Early Literacy Enterprise and STAR Reading Enterprise in the school year 2013-2014 were used. As such, results of the study may be limited to the demographics of the first, second, and third grade students in this study during the 2013-2014 school year. In addition, this study focused on one elementary school; therefore, results may not be generalized to other elementary schools with different demographics.

Summary

Included in chapter three was a description of the components of the current quantitative, comparative study. The research questions and hypotheses, the population, sample, and sampling procedures were presented. The instruments Renaissance STAR Reading Enterprise and STAR Early Literacy Enterprise assessments were described. Chapter four includes the results from the quantitative data analysis used to address the four research questions. Details of the descriptive statistics along with the hypothesis testing analyses are also included.

Chapter Four

Results

The purpose of this study was to determine whether first grade student usage of the Lexia Core5 program supported growth in phonemic awareness, phonics, fluency, vocabulary, and comprehension reading skills. Another purpose was to determine if usage of the program contributed to second and third grade student academic growth in phonics, fluency, vocabulary, and comprehension reading skills. Additionally, the study examined first, second, and third grade students' time logged online in Lexia Core5's effect on foundational reading skills academic gain scores. The final purpose of this study was to provide the Kansas Legislature and school leaders' information about the contributions of Lexia Core5 on reading development.

Descriptive Statistics

The population for this study was comprised of 573 students from a Kansas elementary school. This included all students in first, second, and third grades enrolled in the school during the 2013-2014 school year. Of the 477 students who met the criteria to be included in this study, 149 were first grade students, 157 were second grade students, and 171 were third grade students. Data were taken from the first grade students' Renaissance STAR Early Literacy Enterprise Reading Assessments and from second and third grade students' Renaissance STAR Enterprise Reading Assessments.

Hypothesis Testing

To answer the first research question the independent variable was Lexia Core5. The dependent variables were the academic gain scores in phonemic awareness, phonics,

fluency, vocabulary, and comprehension. Reading skills scores were taken from the reports of STAR Early Literacy Enterprise assessments. These scores were used to calculate students' academic gain in phonemic awareness, phonics, vocabulary, comprehension, and fluency skills. The academic gain scores for each of the different skills were studied to learn the effect Lexia Core5 had on student growth of foundational reading skills. A paired sample *t*-test was used to challenge each hypothesis to determine if there was a significant difference in mean academic gain scores between the pre- and post-tests. The alpha level of .05 was established to determine statistical significance.

RQ1. To what extent did first grade students demonstrate academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5?

***H1*.** First grade students demonstrated academic gain in phonemic awareness as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in phonemic awareness between the pre- and post-tests scores was found (see Table 7). The Lexia Core5 reading program contributed to first grade students' academic gain (Mean-d = 17.93) in phonemic awareness reading skill. The mean post-test score (M = 81.78) was significantly higher than the mean pre-test score (M = 63.85). The hypothesis was supported.

Table 7

First Grade t-Test Results

Phonemic Awareness	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	14.75	148	<.001	17.93	1.215

Note: Academic gain Analysis for Phonemic Awareness

Table 8 includes first grade descriptive results for the analysis of H1, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 8

First Grade Descriptives

Phonemic Awareness	*n*	Mean	*SD*	*SE*
Pre-test	149	63.85	16.67	1.365
Post-test	149	81.78	12.56	1.029

Note: STAR Early Literacy Enterprise assessment scores

***H2*.** First grade students demonstrated academic gain in phonics as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in phonics between the pre- and post-tests scores was found (see Table 9). The Lexia Core5 reading program contributed to first grade students' academic gain (Mean-d = 17.32) in phonics reading skill. The mean post-test score (M = 83.50), was significantly higher than the mean pre-test score (M = 66.19). The Kansas school

established 80 percent or above was considered a mastery score. The hypothesis was supported.

Table 9

First Grade t-Test Results

Phonics	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	14.37	148	<.001	17.32	1.205

Note: Academic gain analysis for phonics

Table 10 includes first grade descriptive results for the analysis of H2, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 10

First Grade Descriptives

Phonics	*n*	Mean	*SD*	*SE*
Pre-test	149	66.19	16.47	1.349
Post-test	149	83.50	12.00	.098

Note: STAR Early Literacy Enterprise assessment scores

H3. First grade students demonstrated academic gain in fluency as measured by STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in fluency between the pre- and post-tests scores was found (see Table 11). Lexia Core5 reading program contributed to first grade students' academic gain (Mean-*d* = 39.95) in fluency reading skill. The mean post-test score ($M = 74.97$) was significantly higher than the mean pre-test score ($M = 35.03$). The hypothesis was supported.

Table 11

First Grade t-Test Results

Fluency	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	14.95	148	<.001	39.95	2.671

Note: Academic gain analysis for fluency

Table 12 includes first grade descriptive results for the analysis of H3, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 12

First Grade Descriptives

Fluency	*n*	Mean	*SD*	*SE*
Pre-test	149	35.03	27.44	2.248
Post-test	149	74.97	38.48	3.152

Note: STAR Early Literacy Enterprise assessment scores

H4. First grade students demonstrated academic gain in vocabulary as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in vocabulary between the pre- and post-tests scores was found (see Table 13). The Lexia Core5 reading program contributed to first grade students' academic gain (Mean-d = 16.32) in vocabulary reading skill. The mean post-test score (M = 83.38) was significantly higher than the mean pre-test score (M = 67.06). The Kansas school established 80 percent or above was considered a mastery score. The hypothesis was supported.

Table 13

First Grade t-Test Results

Vocabulary	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	14.49	148	<.001	16.32	1.126

Note: Academic gain analysis for vocabulary

Table 14 includes first grade descriptive results for the analysis of H4, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 14

First Grade Descriptives

Vocabulary	*n*	Mean	*SD*	*SE*
Pre-test	149	67.06	15.36	1.258
Post-test	149	83.38	11.42	.936

Note: STAR Early Literacy Enterprise assessment scores

H5. First grade students demonstrated academic gain in comprehension as measured by the STAR Early Literacy Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in comprehension between the pre- and post-tests scores was found (see Table 15). The Lexia Core5 reading program contributed to first grade students' academic gain (Mean-d = 19.16) in comprehension reading skill. The mean post-test score (M = 81.76) was significantly higher than the mean pre-test score (M = 62.60). The Kansas school established 80 percent or above was considered a mastery score. The hypothesis was supported.

Table 15

First Grade t-Test Results

Comprehension	*t*	*df*	*p*	Mean-*d*	*SED*
Pre- Post-test	-14.73	148	<.001	19.16	1.301

Note: Academic gain analysis for comprehension

Table 16 includes first grade descriptive results for the analysis of H5, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 16

First Grade Descriptives

Comprehension	*n*	Mean	*SD*	*SE*
Pre-test	149	62.60	17.88	1.465
Post-test	149	81.76	13.24	1.085

Note: STAR Early Literacy Enterprise assessment scores

To answer the second research question the independent variable was Lexia Core5. The dependent variables were the academic gain scores in phonics, fluency, vocabulary, and comprehension. Reading skills scores were taken from the reports of STAR Reading Enterprise assessments. These scores were used to calculate students' academic gain in phonics, vocabulary, comprehension, and fluency skills. The academic gain scores for each of the different skills were studied to learn the effect Lexia Core5 had on student growth of foundational reading skills. A paired sample *t*-test was used to challenge each hypothesis to determine if there was a significant difference in mean academic gain scores between the pre- and post-tests. The alpha level of .05 was established to determine statistical significance.

RQ2. To what extent did second and third grade students demonstrate academic gain in phonics, fluency, vocabulary, and comprehension as measured by the Star Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5?

***H6*.** Second grade students demonstrated academic gain in phonics as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in phonics between the pre- and post-tests scores was found (see Table 17). The Lexia Core5 reading program contributed to second grade students' academic gain (Mean-d = 16.28) in phonics reading skill. The mean post-test score (M = 86.46) was significantly higher than the mean pre-test score (M = 70.18). The Kansas school established 80 percent or above a mastery score. The hypothesis was supported.

Table 17

Second Grade t-Test Results

Phonics	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	12.05	156	<.001	16.28	1.350

Note: Academic gain analysis for phonics

Table 18 includes second grade descriptive results for the analysis of H6, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 18

Second Grade Descriptives

Phonics	*n*	Mean	*SD*	*SE*
Pre-test	157	70.18	24.50	1.955
Post-test	157	86.46	19.36	1.545

Note: STAR Reading Enterprise assessment scores

H7. Second grade students demonstrate academic gain in fluency as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in fluency between the pre- and post-tests scores was found (see Table 19). The Lexia Core5 reading program contributed to second grade students' academic gain (Mean-d = 34.15) in fluency reading skill. The mean post-test score (M = 108.61) was significantly higher than the mean pre-test score (M = 74.46). The Kansas school established 80 percent or above was considered a mastery score. The hypothesis was supported.

Table 19

Second Grade t-Test Results

Fluency	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	16.48	156	<.001	34.15	2.073

Note: Academic gain analysis for fluency

Table 20 includes second grade descriptive results for the analysis of H7, including sample size, mean, standard deviation *(SD*), and standard error of the difference (*SE*).

Table 20

Second Grade Descriptives

Fluency	*n*	Mean	*SD*	*SE*
Pre-test	157	74.46	38.51	3.073
Post-test	157	108.61	40.93	3.267

Note: STAR Reading Enterprise assessment scores

***H8*.** Second grade students demonstrated academic gain in vocabulary as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in vocabulary between the pre- and post-tests scores was found (see Table 21). The Lexia Core5 reading program contributed to second grade students' academic gain (Mean-d = 18.58) in vocabulary reading skill. The mean post-test score (M = 95.12) was significantly higher than the mean pre-test score (M = 76.54). The hypothesis was supported.

Table 21

Second Grade t-Test Results

Vocabulary	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	3.303	156	<.001	18.58	5.625

Note: Academic gain analysis for vocabulary

Table 22 includes second grade descriptive results for the analysis of H8, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 22

Second Grade Descriptives

Vocabulary	*n*	Mean	*SD*	*SE*
Pre-test	157	76.54	21.36	1.705
Post-test	157	95.12	71.30	5.690

Note: STAR Reading Enterprise assessment scores

***H9*.** Second grade students demonstrated academic gain in comprehension as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in comprehension between the pre- and post-tests scores were found (see Table 23). The Lexia Core5 reading program contributed to second grade students' academic gain (Mean-d = 16.14) in comprehension reading skill. The mean post-test score (M = 85.56) was significantly higher than the mean pre-test score (M = 69.72). The Kansas school established 80 percent or above a mastery score. The hypothesis was supported.

Table 23

Second Grade t-Test Results

Comprehension	*t*	*df*	*p*	Mean-*d*	*SED*
Pre- Post-test	-12.27	156	<.001	16.14	1.316

Note: Academic gain analysis for comprehension

Table 24 includes second grade descriptive results for the analysis of H9, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 24

Second Grade Descriptives

Comprehension	*n*	Mean	*SD*	*SE*
Pre-test	157	69.72	23.91	1.909
Post-test	157	85.86	19.24	1.536

Note: STAR Reading Enterprise assessment scores

H10. Third grade students demonstrated academic gain in phonics as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in phonics between the pre- and post-tests scores was found (see Table 25). The Lexia Core5 reading program contributed to third grade students' academic gain (Mean-d = 9.386) in phonics reading skill. The mean post-test score (M = 86.85) was significantly higher than the mean pre-test score (M = 77.46). The Kansas school established 80 percent or above a mastery score. The hypothesis was supported.

Table 25

Third Grade t-Test Results

Phonics	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post test	7.21	170	<.001	9.386	1.291

Note: STAR Reading Enterprise assessment scores

Table 26 includes third grade descriptive results for the analysis of H10, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 26

Third Grade Descriptives

Phonics	*n*	Mean	*SD*	*SE*
Pre-test	171	77.46	25.87	1.978
Post-test	171	86.85	19.12	1.462

Note: STAR Reading Enterprise assessment scores

***H11*.** Third grade students demonstrated academic gain in fluency as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in fluency between the pre- and post-tests scores was found (see Table 27). The Lexia Core5 reading program contributed to third grade students' academic gain (Mean-d = 21.65) in fluency reading skill. The mean post-test score (M = 114.87) was significantly higher than the mean pre-test score (M = 93.22). The hypothesis was supported.

Table 27

Third Grade t-Test Results

Fluency	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	12.36	170	<.001	21.65	1.752

Note: Academic gain analysis for fluency

Table 28 includes third grade descriptive results for the analysis of H11, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 28

Third Grade Descriptives

Fluency	*n*	Mean	*SD*	*SE*
Pre-test	171	93.22	38.52	2.946
Post-test	171	114.87	40.25	3.078

Note: STAR Reading Enterprise assessment scores

H12. Third grade students demonstrated academic gain in vocabulary as measured by the STAR Reading Enterprise pre- and post-test assessment scores after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in vocabulary between the pre- and post-tests scores was found (see Table 29). The Lexia Core5 reading program contributed to third grade students' academic gain (Mean-d = 8.56) in vocabulary reading skill. The mean post-test score (M = 86.09) was significantly higher than the mean pre-test score (M = 77.54). The Kansas school established 80 percent above a mastery score. The hypothesis was supported.

Table 29

Third Grade t-Test Results

Vocabulary	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	6.388	170	<.001	8.56	1.339

Note: Academic gain analysis for vocabulary

Table 30 includes third grade descriptive results for the analysis of H12, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 30

Third Grade Descriptives

Vocabulary	*n*	Mean	*SD*	*SE*
Pre-test	171	77.54	24.91	1.905
Post-test	171	86.09	19.14	1.463

Note: STAR Reading Enterprise assessment scores

H13. Third grade students demonstrated academic gain in comprehension as measured by the STAR Reading Enterprise pre- and post-test assessment scores, after one year of enrollment in Lexia Core5.

For the above hypothesis, a significant difference ($p < .001$) in mean academic gain scores in comprehension between the pre- and post-tests scores was found (see Table 31). The Lexia Core5 reading program contributed to third grade students' academic gain (Mean-d = 10.18) in comprehension reading skill. The mean post-test score (M = 83.53) was significantly higher than the mean pre-test score (M = 73.36). The Kansas school established 80 percent or above a mastery score. The hypothesis was supported.

Table 31

Third Grade t-Test Results

Comprehension	*t*	*df*	*p*	Mean-*d*	*SED*
Pre-Post-test	7.816	170	<.001	10.18	1.302

Note: Academic gain analysis for comprehension

Table 32 includes third grade descriptive results for the analysis of H13, including sample size, mean, standard deviation (*SD*), and standard error of the difference (*SE*).

Table 32

Third Grade Descriptives

Comprehension	*n*	Mean	*SD*	*SE*
Pre-test	171	73.36	26.99	2.064
Post-test	171	83.53	21.30	1.629

Note: STAR Reading Enterprise assessment scores

To address the third research question, a one-way Analysis of Variance (ANOVA) was conducted since the dependent variable was the academic gain scores and the independent variable was the time students logged online while using the Lexia Core5 program. There were four time categories for each grade level (Babbie, 2012). An ANOVA was used to compare differences in first grade students' academic gain scores for phonemic awareness, phonics, fluency, vocabulary, and comprehension among the different time categories of students' time logged online while using the Lexia Core5 program. The *p* value .05 was used as the level for statistical significance in the analysis. If the finding was significant, a follow-up Tukey post-hoc test was done to determine where the significant difference occurred. A methodology summary for the third research question is located in Table 33.

Table 33

Summary for Methodology RQ3 (Alpha =<.05)

Independent Variables	Minute Categories	Dependent Variables	Measurement	Analysis Method	Hypotheses First Grade
Time Logged Online	First 840-1318	Phonemic awareness	Academic Gain	1-Way ANOVA	H14
	Second 1319-2034	Phonics	Academic Gain	1-Way ANOVA	H15
	Third 2035-2725	Fluency	Academic Gain	1-Way ANOVA	H16
	Fourth 2726-6199	Vocabulary	Academic Gain	1-Way ANOVA	H17
		Comprehension	Academic Gain	1-Way ANOVA	H17

Note: First grade academic gain is the difference between the pre-test and the post-test scores.

RQ3. Was first grade student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Early Literacy Enterprise pre- and post-test assessment scores impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program?

***H14*.** First grade student academic gain in phonemic awareness as measured by the STAR Reading pre- and post-test assessment scores, was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program..

The results of the analysis indicated a statistically significant difference between the means, $F = 3.547$, $df = 3, 151$, $p = .016$ (See Table 34). The first grade students'

academic gain in phonemic awareness was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was done to determine where the difference occurred.

Table 34

First Grade Time Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	5088	3	1695.9		
Phonemic Awareness	72201	151	478.2	3.547	.016

Note: First grade students' time impact on academic gain in phonemic awareness

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the second category (1319-2034 minutes) compared to the fourth category (2726-6199 minutes) scores. The Tukey *p* value was computed to be .008, which was statistically significant as shown in Table 35. The difference of -15.643 was found between the second category mean score and the fourth category mean score. The impact of first grade student duration of time on phonemic awareness was only significant between the second and fourth categories.

Table 35

First Grade Phonemic Awareness Time Categories

Categories	Mean-*d*	*SE*	*t*	*p*-Tukey
1-2	8.820	4.994	1.766	.294
1-3	2.659	5.086	.523	.953
1-4	-6.822	5.024	-1.358	.528
2-3	-6.161	4.924	-1.251	.595
2-4	-15.643	4.86	-3.219	.008
3-4	-9.482	4.953	-1.914	.227

Note: JASP, 2016

H15. First grade student academic gain in phonics as measured by the Star Early Literacy Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated a statistically significant difference between the means, $F = 3.435$, $df = 3, 151$, $p = .019$ (See Table 36). The first grade students' academic gain in phonics was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was done to determine where the difference occurred.

Table 36

First Grade Descriptives

	Sum of Squares	*df*	MS	*F*	*p*
Categories	4992	3	1664.0		
Phonics	73151	151	484.4	3.435	.019

Note: First grade students' time impact on academic gain in phonics

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the second category (1319-2034 minutes) compared to the fourth category (2726-6199 minutes) scores. The Tukey *p* value was computed to be .01, which was statistically significant as shown in Table 37. The difference of -15.528 was found between the second and fourth category mean scores. Students' time logged online while using Lexia Core5 impact on phonics was most significant between the second and fourth categories.

Table 37

First Grade Phonics Time Categories

Categories	Mean-*d*	*SE*	*t*	*p*-Tukey
1-2	8.628	5.027	1.716	.319
1-3	2.408	5.119	.470	.965
1-4	-6.900	5.056	-1.365	.523
2-3	-6.220	4.956	-1.255	.593
2-4	-15.528	4.891	-3.174	.010
3-4	-9.308	4.986	-1.867	.247

Note: JASP, 2016

H16. First grade student academic gain in fluency, as measured by the Star Early Literacy Enterprise pre- and post-test assessment scores, was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = 2.274$, $df = 3, 151$, $p = .082$ (See Table 38). The first grade students' academic gain in fluency was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported but approached significance. No further analysis was conducted.

Table 38

First Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	9238	3	3079		
Fluency	204479	151	1354	2.274	.082

Note: First grade students' time impact on academic gain in fluency

H17. First grade student academic gain in vocabulary, as measured by the Star Early Literacy Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated a statistically significant difference between the means, $F = 3.444$, $df = 3, 151$, $p = .018$ (Table 39). The first grade students' academic gain in vocabulary was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was conducted to determine where the difference occurred.

Table 39

First Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	4718	3	1572.8		
Vocabulary	68961	151	456.7	3.444	.018

Note: First grade students' time impact on academic gain in vocabulary

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the second category (1319-2034 minutes) compared to the fourth category (2726-6199 minutes) scores. The Tukey *p* value was computed to be .01, which was statistically significant as shown in Table 40. The difference of -15.105 was found between the second category mean score and the fourth category mean score. The impact of first grade student duration of time on vocabulary was most significant between the second and fourth categories.

Table 40

First Grade Vocabulary Categories

Categories	Mean-*d*	*SE*	*t*	*p-T*ukey
1-2	8.722	4.881	1.787	.284
1-3	2.311	4.970	.465	.967
1-4	-6.383	4.910	-1.300	.564
2-3	-6.410	4.812	-1.332	.544
2-4	-15.105	4.749	-3.180	.010
3-4	-8.695	4.841	-1.796	.279

Note: JASP, 2016

H18. First grade student academic gain in comprehension as measured by the Star Early Literacy Enterprise pre- and post-test scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated a statistically significant difference between the means, $F = 3.528$, $df = 3, 151$, $p = .016$ (Table 41). The first grade students' academic

gain in comprehension was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was conducted to determine where the difference occurred.

Table 41

First Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	5394	3	1797.9		
Comprehension	76959	151	509.7	3.528	.016

Note: First grade students' time impact on academic gain in comprehension

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the second category (1319-2034 minutes) compared to the fourth category (2726-6199 minutes) scores. The Tukey *p* value was computed to be .009, which was statistically significant as shown in Table 42. The difference of -16.120 was found between the second category mean score and the fourth category mean score. The impact of first grade student duration of time on comprehension was most significant between the second and fourth categories.

Table 42

First Grade Comprehension Categories

Categories	Mean-*d*	*SE*	*t*	*p*-Tukey
1-2	8.723	5.156	1.692	.332
1-3	2.554	5.251	.486	.962
1-4	-7.397	5.186	-1.426	.485
2-3	-6.169	5.084	-1.213	.619
2-4	-16.120	5.017	-3.213	.009
3-4	-9.951	5.114	-1.946	.213

Note: JASP, 2016

To address research question four, a One-way ANOVA was conducted using the independent variable of time logged online in the Lexia Core5 program, and each of the dependent variables using data from the second and third grade students' academic gain scores for phonics, fluency, vocabulary, and comprehension. The *p* value of .05 was used as the level for statistical significance in the analysis. If the finding was significant, a follow-up Tukey post-hoc test was performed to determine where the significant difference occurred. A methodology summary for the fourth research question is located in Table 43.

Table 43

Summary for Methodology RQ4 (Alpha =<.05

Independent Variables	Time Categories	Dependent Variables	Measurement	Analysis Method	Hypotheses Second Grade	Hypotheses Third Grade
Time Logged Online	IV Categories	Phonics	Academic Gain	1-Way ANOVA	H19	H23
		Fluency	Academic Gain	1-Way ANOVA	H20	H24
		Vocabulary	Academic Gain	1-Way ANOVA	H21	H25
		Comprehension	Academic Gain	1-Way ANOVA	H22	H26

Note: Academic gain is the difference between the pre- and post-test scores.

RQ4. Was second and third grade student academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension scores as measured by the difference between STAR Reading Enterprise pre- and post-test assessment scores impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program?

H19. Second grade student academic gain for phonics as measured by the Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated a statistically significant difference between the means, F = 2.934, *df* = 3, 151, *p* = .035 (See Table 44). The second grade students' academic gain in phonics was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was conducted to determine where the difference occurred.

Table 44

Second Grade Descriptives

	Sum of Squares	*df*	Mean Square	*f*	*p*
Categories	2430	3	810.1		
Phonics	42239	153	276.1	2.934	.035

Note: Second grade students' time impact on academic gain in phonics

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the first category (1033-1868 minutes) compared to the fourth category (3415-8741 minutes) scores. The Tukey *p* value was computed to be .018, which was statistically significant as shown in Table 45. The difference of -11.155 was found between the first category mean score and the fourth category mean score. The results suggest the impact of second grade student duration of time on phonics was most significant between the first and fourth categories.

Table 45

Second Grade Phonics Categories

Categories	Mean-*d*	*SE*	*t*	*p* tukey
1-2	-6.423	3.768	-1.705	.325
1-3	-6.312	3.838	-1.645	.357
1-4	-11.155	3.768	-2.961	.018
2-3	.112	3.741	.030	1.000
2-4	-4.732	3.670	-1.289	.571
3-4	-4.843	3.741	-1.295	.568

Note: JASP, 2016

H20. Second grade student academic gain in fluency as measured by the Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = .262$, $df = 3, 153$, $p = .853$ (See Table 46). The second grade students' academic gain in fluency was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 46

Second Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	538.0	3	179.3		
Fluency	104662.3	153	684.1	.262	.853

Note: Second grade students' time impact on academic gain in fluency

H21. Second grade student academic gain in vocabulary, as measured by Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = 1.538$, $df = 3, 153$, $p = .207$ (See Table 47). The second grade students' academic gain in vocabulary was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 47

Second Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	22687	3	7562		
Vocabulary	752361	153	4917	1.538	.207

Note: Second grade students' time impact on academic gain in vocabulary

H22. Second grade student academic gain in comprehension, as measured by Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated a statistically significant difference between the means, F = 2.884, *df* = 3, 151, *p* = .038 (See Table 48). The second grade students' academic gain in comprehension was impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was supported. Further analysis was conducted to determine where the difference occurred.

Table 48

Second Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	2269	3	756.3		
Comprehension	752361	153	4917	2.884	.038

Note: Second grade students' time impact on academic gain in comprehension

The Tukey post hoc analysis was used to determine where the significant difference was located and the alpha level was set at 05. Six pairwise comparisons were made using the Tukey post hoc method. Only one of the pairs was significant; the first category (1033-1868 minutes) compared to the fourth category (3415-8741 minutes) scores. The Tukey *p* value was computed to be .02, which was statistically significant as shown in Table 49. The difference of -10.781 was found between the first category mean score and the fourth category mean scores. The results suggest the impact of second grade student duration of time on comprehension was most significant between the first and fourth categories.

Table 49

Second Grade Comprehension Time Categories

Categories	Mean-*d*	*SE*	*t*	*p*-tukey
1-2	-6.123	3.672	-1.667	.344
1-3	-6.125	3.740	-1.638	.361
1-4	-10.781	3.672	-2.936	.020
2-3	-.003	3.646	.000	1.000
2-4	-4.659	3.576	-1.303	.563
3-4	-4.656	3.646	-1.277	.579

Note: JASP, 2016

H23. Third grade student academic gain in phonics, as measured by the Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = .127$, $df = 3, 167$, $p = .944$ (See Table 50). The third grade students' academic gain in phonics was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 50

Third Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	110.3	3	36.76		
Phonics	48330.2	167	289.40	.127	.944

Note: Third grade students' time impact on academic gain in phonics

H24. Third grade student academic gain in fluency, as measured by the Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = .544$, $df = 3, 167$, $p = .653$ (See Table 51). The third grade students' academic gain in fluency was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 51

Third Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	864.4	3	288.1		
Fluency	88414.2	167	529.4	0.544	.653

Note: Third grade students' time impact on academic gain in fluency

H25. Third grade student academic gain in vocabulary, as measured by the Star Reading Enterprise pre- and post-test assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = .108$, $df = 3, 167$, $p = .953$ (See Table 52). The results suggest third grade students' academic gain in vocabulary was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 52

Third Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	101.1	3	33.70		
Vocabulary	52051.1	167	311.68	.108	.955

Note: Third grade students' time impact on academic gain in vocabulary

H26. Third grade student academic gain in comprehension, as measured by the Star Reading Enterprise assessment scores was impacted by duration of time when categorized by the minutes students logged online in the Lexia Core5 program.

The results of the analysis indicated there was not a statistically significant difference between the means, $F = .016$, $df = 3, 167$, $p = .997$ (See Table 53). The third grade students' academic gain in comprehension was not impacted by the duration of time when categorized by the minutes students logged online in the Lexia Core5 program. The hypothesis was not supported. No further analysis was conducted.

Table 53

Third Grade Descriptives

	Sum of Squares	*df*	Mean Square	*F*	*p*
Categories	14.01	3	4.669		
Comprehension	49256.73	167	294.950	.016	.997

Note: Third grade time impact on academic gain in comprehension

Summary

The results of the statistical analysis of the hypothesis findings were included in chapter four. A summary of the study is provided in chapter five, which includes a relationship of the findings to the literature, discussion of implications for action, and recommendations for future research.

Chapter Five

Interpretation and Recommendations

The NRP's (2000) report to Congress indicated the best approach to reading instruction incorporated explicit and systematic instruction concentrated on building elementary students' phonemic awareness, phonics, fluency, vocabulary, and comprehension skills. The NRP analysis made it clear the capacity to learn and grow as a reader was dependent on proficiency in these reading skills (NRP, 2000). Lexia Core5 is an educational software program that supports reading skill development for elementary students. During the 2013-2014 school year, the Kansas Legislature provided all Kansas elementary schools the opportunity to use Lexia Core5. The current study evaluated the effectiveness of Lexia Core5 on elementary students' foundational reading skills development and provided educational leaders' information about the effectiveness of this program on reading development. Outlined in chapter five, is a review of the current study, including an overview of the problem, the purpose statement, and the research questions, a review of the methods, and major findings. In addition, the researcher offers an analysis of findings related to the literature, recommendations for future research considerations, and concluding remarks related to Lexia Core5.

Study Summary

Through the use of Lexia Core5 software program, students in first, second, and third grades received supplementary reading instruction and practice during the 2013-2014 school year. Archived student data were examined to determine the effectiveness of Lexia Core5 on students' academic gain scores in foundational reading skills. Student data included first grade students' academic gain scores in phonemic awareness, phonics,

fluency, vocabulary, and comprehension in addition to second and third grade students' academic gain scores in phonics, fluency, vocabulary, and comprehension. Additionally, the amount of time students logged online to use Lexia Core5 was explored to determine the impact on foundational reading skills.

Overview of the problem. There was limited research on Lexia Core5's effect on the five foundational reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension (Crawford-Brooke et al. 2014). The 2013-2014 Kansas Legislature funded the Kansas Reading Initiative (KRI) in an effort to improve reading proficiency of students in elementary schools in Kansas (Ranney, 2013a). The instructional tool funded by the Legislature was Lexia Core5. Although Lexia Core5 was offered to elementary schools in Kansas during the 2013-2014 school year, it was not a statewide requirement. The intention of the Kansas Legislature was to help all students achieve grade level proficiency in reading by the end of third grade (Kansas Reads to Succeed Act, HB 2140, 2013). This study contributes to information on the efficacy of Lexia Core5 on elementary students' attainment of foundational reading skills.

Purpose statement and research questions. The purpose of this study was to determine if first grade student usage of Lexia Core5 supported academic gain of phonemic awareness, phonics, fluency, vocabulary, and comprehension reading scores. Another purpose was to explore the effect of second and third grade student usage of the program on phonics, fluency, vocabulary, and comprehension reading scores. Additionally, the study examined the effect of students logged online using Lexia Core5 on first, second, and third grade students' academic gain scores of foundational reading

skills. The final purpose of this study was to provide Kansas Legislature and school leaders' information about the contributions of Lexia Core5 on reading development.

Four research questions were developed to determine Lexia Core5's effect on first, second, and third grade students' reading skills development, and if the amount of time students' logged into the program impacted academic gain in phonemic awareness, phonics, fluency, vocabulary and comprehension reading skills. The first research question addressed the impact of Lexia Core5 usage on first grade students' phonemic awareness, phonics, fluency, vocabulary, and comprehension academic gain scores were affected by the use of Lexia Core5. The second research question focused on second and third grades students academic gain scores in phonics, fluency, comprehension, and vocabulary skills with the use of the program. The third research question was designed to determine the influence time logged online in Lexia Core5 had on first, grade students' development of all five reading skills. The fourth research question was developed to discover the effect time logged online in Lexia Core5 had on second and third grade students' reading skill development of phonics, fluency, vocabulary, and comprehension.

Review of the methodology. Permission to use archived 2013–2014 student data from a Kansas elementary school was obtained from the school district office. Data from first, second, and third grade student scores collected from Renaissance STAR Early Literacy Enterprise and STAR Reading Enterprise assessments were analyzed to answer research questions one and two. To answer research question one, first grade student data were evaluated using Renaissance Star Early Literacy Enterprise assessment scores to calculate academic gain in phonemic awareness, phonics, fluency, vocabulary, and comprehension skills. Students in second and third grades were assessed using the

Renaissance Star Reading Enterprise program to evaluate their academic gain in phonics, fluency, comprehension, and vocabulary skills to answer research question two. The data from the Renaissance programs was from a report titled "The Student Diagnostic Report Enterprise Test" for student scores. All students were given a pre-test in August of 2013 and a post-test in May 2014. An academic gain score was calculated by subtracting the individual student's pre-test from the post-test for each foundational skill.

Research questions three and four were answered using student data generated from Lexia Learning Company. A report was produced from the company that included information on the amount of minutes students logged online to use the program during the 2013-2014 school year. The number of minutes was used in conjunction with student phonemic awareness, phonics, fluency, vocabulary, and comprehension academic gain scores to determine the effect of time on reading skills development. All data for research questions one through four were analyzed, compiled, and organized in an Excel spreadsheet. Data were transferred into the Just Another Statistical Program (JASP) for calculations.

Major findings. The results of hypothesis testing for RQ1 indicated there was a statistically significant difference in mean academic gain scores in phonemic awareness, phonics, fluency, vocabulary, and comprehension reading skills for first grade students who used Lexia Core5 during the school year. In addition, results of hypothesis testing for RQ2, showed a statistically significant difference in mean academic gain scores in phonics, fluency, vocabulary, and comprehension reading skills for second and third grade students. The analysis showed students who used Lexia Core5 achieved academic gain in foundational reading skills.

Analysis of hypothesis testing showed fluency data from first, second, and third grade students' yielded results. First grade students made significant academic gain in fluency skills, achieving grade level proficiency. Second grade students made significant academic gain in fluency, but did not achieve grade level proficiency. Additionally, third graders made significant fluency academic gain but did not achieve grade level proficiency. In addition, their post-test scores dropped significantly.

Analysis of hypothesis testing for the third and fourth research questions presented varying results. First grade students' time logged online while using Lexia Core5 made a difference in their phonemic awareness, phonics, vocabulary, and comprehension academic gain scores. The gain was found between the second (1,319–2,034) and fourth categories (2,726–6,199) minutes of program usage. First grade students' fluency academic gain scores were not impacted by the amount of time logged online while using the program. Further results from the data analysis were inconsistent on the effect of time on second and third grade students' academic gain scores. Second grade students' phonics and comprehension academic gain scores were located between the first category (1,033–1,868) and the fourth category (3714-8,741) minutes of Lexia Core5 usage. In addition, Second grade students' fluency and vocabulary academic gain scores were not impacted by the time students were logged online while using the program. Third grade students' time logged online while using Lexia Core5 was not a factor in their academic gain scores for phonics, fluency, vocabulary, and comprehension.

Findings Related to the Literature

The findings from two Lexia Core5 studies showed positive results with program usage on foundational reading skills. Crawford-Brooke et al. (2014) investigated the use

of Lexia Core5 on early elementary students reading comprehension and vocabulary skills reporting significant reading comprehension gains among first and second grade English Language Learners, but did not find significant gains in vocabulary skills. Juarez-Tillery (2015), also reported improvements in third grade students' comprehension skills. The current study found similar results for reading comprehension. First, second, and third grade student academic gains scores in comprehension were significant.

Juarez-Tillery (2015), found no significant gains in third grade students' fluency skills following Lexia Core5 usage. The results of the current study established first, second, and third grade students did make significant academic gains in fluency. Although the gains were not significant enough for second and third grade students to achieve grade level proficiency in fluency.

The findings of the present study determined the effects of Lexia Core5 on elementary students' skill development in foundational reading skills was significant. First grade students made significant academic gains in phonemic awareness, phonics, fluency, vocabulary, and comprehension skills. The greatest academic gain was made in fluency. The results from the current study were similar to the findings from Macaruso's (2006, 2008, 2011) studies regarding academic gain in phonemic awareness and phonics for students who used an earlier version of Lexia Core5 called Lexia Reading. Macaruso, Hook, and McCabe, (2006) found Title 1 (also known as at-risk) first grade students in an urban public school system made the greatest academic gains in phonics word attack strategies. The results of two other Lexia Reading studies done by Macaruso and Walker,

(2008) and Macaruso and Rodman, (2011), indicated kindergarten students with the lowest pretest scores achieved the greatest gains in phonological awareness skills.

According to the results of the current study, time was a factor in first, second and third grade academic gain scores. The results indicated first grade students' academic gain scores in phonemic awareness, phonics, vocabulary, and comprehension skills were impacted by the amount of time students used Lexia Core5. Time was not a factor in first grade students' fluency academic gain scores. Although second grade students' phonics and comprehension academic gain scores were impacted by students' time logged online while using Lexia Core5, it was not a factor in fluency and vocabulary academic gain scores. Further analysis revealed third grade students' academic gain scores in phonics, vocabulary, fluency, and comprehension skills were not impacted by the amount of time students logged online while using the program.

Conclusions

While previous studies showed positive results for Lexia Reading, more research is recommended to solidify the impact of Lexia Core5 on the development of the five foundational reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension for first, second, and third grade students. Data analysis on the effect of time using Lexia Core5 on fluency skills presented mixed results, indicating more in depth research is needed to determine the impact of program usage on fluency skill development. The following section outlines implications for action.

Implications for action. First, second, and third grade students did improve their performance in the five reading skills of phonemic awareness, phonics, fluency, vocabulary, and comprehension by using the computer assisted instructional tool Lexia

Core5. Additionally first grade students' fluency skills improved while second and third grade students did not make adequate grade level academic gains in fluency. This is an area of weakness for the program. To be successful readers, students need to read with proper intonation, pace, use of punctuation, phrasing, stress on words, and with consistent reading rates (Fountas & Pinnell, 2006). According to the Lexia Learning Systems Company, Lexia Core5 promotes growth in fluency. Based on the results from this study, more research is recommended on the impact of Lexia Core5 on fluency development. Another recommendation to consider is the use of a different measurement tool for fluency. Fluency is often associated with oral reading skills (Rasinski, 2012). In the current study, the assessment used to measure fluency academic gains was a computer program. Additional research to determine if a computer program adequately measures oral reading fluency should be explored.

The use of software as a teaching method has been found to be effective in increasing reading skills of students (Khan & Gorard, 2012; Taylor et al., 2016; Wood et al., 2012). Many schools use software programs to assess the needs of individual students and to allow students to work at their own pace so that those who read poorly are not left behind (Khan & Gorard, 2012; Taylor et al., 2016; Wood et al., 2012). This provides students a chance to catch up, while not holding other students back (Khan & Gorard, 2012; Taylor et al.; Wood et al., 2012). Based on the findings of the current study, additional research is needed to discern the effectiveness of Lexia Core5 on students with different learning needs, such as students who are considered at-risk, on grade level, or above grade level. In addition, research is recommended to explore the

influence of the program on students based on socio-economic status, gender, and ethnicity.

A supplemental learning approach using Lexia Core5 along with the instructional practices of teachers to enhance student learning is highly recommended which can provide students with a well-rounded approach to learning reading skills (Schechter et al., 2015). Lexia Core5 helps teachers be more efficient and customizes learning for their students by adapting to students' reading abilities. It has the potential to aide teachers in providing additional support as an enhancement to core instruction in the five foundational reading skills. It allows students to work at their own pace and gives them the opportunity for independent practice on foundational reading skills.

Recommendations for future research. The findings of this study suggest additional research is needed in the areas listed below.

- Study the effectiveness of Lexia Core5 on special populations based on socioeconomic status, ethnicity, and ability or skill level. Explore which students made the greatest or least amount of growth in the five foundational reading skills.
- Replicate the current study but follow the program guidelines to ensure students' accomplish their weekly usage requirements. .
- Compare the effectiveness of Lexia Core5 program to a program that is guided by teacher instruction using treatment and control groups.
- Investigate the effect of Lexia Core5 on reading fluency and comprehension skill development growth for students in first, second, and third grades.

- Multiple measures of fluency growth should be included in future studies of Lexia Core5 to adequately determine the impact of Lexia Core5 on fluency development.

Concluding remarks. Insight gained from the current study informed educational stakeholders about the effect of Lexia Core5 on students' reading skills acquisition. Analysis of data revealed first, second, and third grade students who used Lexia Core5 during the 2013-2014 school year made academic gains in phonemic awareness, phonics, fluency, vocabulary, and comprehension skills. A deeper analysis of the data presented mixed results regarding the effect the amount of time students logged online while using the program had on second and third grade students' fluency skill development, indicating the need for additional research. The amount of time first grade students used Lexia Core5 made a difference in foundational reading skills growth. For second grade students, time was highly significant in phonics and comprehension skill development, but not in academic gain of fluency or vocabulary skills. The amount of time third grade students logged online while using Lexia Core5 did not make a significant difference in academic gain scores for phonics, fluency, vocabulary, and comprehension. Second and third grade fluency academic gain scores presents a concern and warrants further investigation.

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Appendices

Appendix A: Permission to the Conduct Study

[redacted]

December 3, 2015

[redacted]

Dr. [redacted]

I am a Doctoral candidate at Baker University and currently pursuing a Doctoral degree in Educational Leadership. I would like to request your permission to access and use archived data from the [redacted] Elementary School's student Renaissance STAR testing records from the 2013-2014 school year for my dissertation. The purpose of this study is to examine and evaluate the effect of Lexia Core5 on first, second, and third grade students' reading achievement as measured by the STAR.

The district will benefit from allowing me to analyze this data because it provides important program evaluation for a commercial curriculum still in use at our elementary school. I will share my findings with your office and make recommendations about the program based on the data analysis.

Attached is the submitted Baker University Institutional Review Board request. Thank you for your time and consideration in this request.

Respectfully,

Vickie S. Kelly

Vickie S. Kelly

Appendix B: Approval to Conduct Research

From: [redacted]
To: Vickie Kelly
Subject: Request to Conduct Research and IRB Form

Your request to use archived 2013-2014 data from the Renaissance STAR Early Literacy Enterprise and STAR Reading Enterprise assessments for students in first, second, and third grades has been approved.

From: Vickie Kelly
Sent: Thursday, December 03, 2015 10:38 AM
To: [redacted]
Subject: Request to Conduct Research and IRB form

Please find attached a letter requesting approval to conduct research and my submitted IRB form.

I really appreciate your time and attention to this matter.

Thank you,

Vickie

Appendix C: IRB Form

Date:

School of education IRB PROTOCOL NUMBER _____
Graduate department (irb USE ONLY)

IRB Request

PROPOSAL FOR RESEARCH

Submitted to the Baker University Institutional Review Board

I. Research Investigator(s) (Students must list faculty sponsor first)

Department(s) **School of Education Graduate Department**

	Name	Signature	
1.	Dr. Sharon Zoellner	_Sharon L Zoellner____,	Major Advisor
2.	Dr. Phillip Messner	Phillip E. Messner,	Research Analyst
3.	Dr. Harold Frye Member	_____,	University Committee

Principal Investigator: Vickie S. Kelly
Phone: 913-683-0312
Email: Vickie.kelly@usd469.net
Mailing address: 184 Canyon View Dr.
Lansing, KS 66043

Faculty sponsor: Dr. Sharon Zoellner
Phone: 913-344-1225
Email: Sharon.zoellner@bakeru.edu

Expected Category of Review: _X Exempt __ Expedited _ __Full

II: Protocol:
Impact of Lexia Core5 Reading Intervention on First, Second, and Third Grade Student Reading Achievement as Measured with Student Diagnostic STAR Enterprise Reports.

Summary

In a sentence or two, please describe the background and purpose of the research.

First, second, and third grade students at a Kansas school used the Lexia Core5 software program during the 2013-2014 school year. The purpose is to describe the effect of Lexia Core5's impact on first, second, and third grade students' reading achievement.

Briefly describe each condition or manipulation to be included within the study.

Archived data will be used in this study. There are no conditions or manipulations in this study.

What measures or observations will be taken in the study? If any questionnaire or other instruments are used, provide a brief description and attach a copy.

No measurement, observations, or other instruments will be used in this study.

Archived student phonemic awareness, phonics, vocabulary, comprehension, and fluency scores will be analyzed using the Student Diagnostic Report from the Renaissance STAR Early Literacy Enterprise program and the STAR Reading Enterprise program. Archived student data about the number of usage minutes students used the Lexia Core5 program provided by the Lexia Learning Company will be analyzed in this study. All data will be compiled onto an Excel spreadsheet.

Will the subjects encounter the risk of psychological, social, physical, or legal risk? If so, please describe the nature of the risk and any measures designed to mitigate that risk.

Students will not encounter the risk of psychological, social, physical**,** or legal risk. Only summary data will be used.

Will any stress to subjects be involved? If so, please describe.

There will be no stress involved to the students in this study, other than regular school activities.

Will the subjects be deceived or misled in any way? If so, include an outline or script of the debriefing.

The subjects in this study will not be deceived or misled in any way as only archived data will be used.

Will there be a request for information which subjects might consider to be personal or sensitive? If so, please include a description.

No, there will not be a request for personal or sensitive information.

Will the subjects be presented with materials which might be considered to be offensive, threatening, or degrading? If so, please describe.

No, since archived data will be used there will be nothing presented to subjects. That would be considered offensive, threatening, or degrading.

Approximately how much time will be demanded of each subject?

No time will be demanded of each subject as archived data will be used.

Who will be the subjects in this study? How will they be solicited or contacted? Provide an outline or script of the information which will be provided to subjects prior to their volunteering to participate. Include a copy of any written solicitation as well as an outline of any oral solicitation.

The subjects in this study are students in first, second, and third grades at a Kansas elementary school during the 2013-2014 school year. No solicitations of subjects will take place as archived data will be use.

What steps will be taken to insure that each subject's participation is voluntary? What if any inducements will be offered to the subjects for their participation?

No additional participation is necessary for this study.

How will you insure that the subjects give their consent prior to participating? Will a written consent form be used? If so, include the form. If not, explain why not.

Subjects will not be contacted for this study. Data is provided to all administrators by the Renaissance Learning Company and the Lexia Learning Company.

Will any aspect of the data be made a part of any permanent record that can be identified with the subject? If so, please explain the necessity.

No aspect of the data will be included in students' permanent records.

Will the fact that a subject did or did not participate in a specific experiment or study be made part of any permanent record available to a supervisor, teacher or employer? If so, explain.

There is no subject participation because archived data will be used. No data will be part of the students' permanent record

What steps will be taken to insure the confidentiality of the data? Where will it be stored? How long will it be stored? What will be done with it after the study is completed?

All data will remain confidential. A district technical person assigned numbers for student names. In three years, all data will be removed from the researcher's personal computer.

If there are any risks involved in the study, are there any offsetting benefits that might accrue to either the subjects or society?

There will be no risks to the subjects involved in this study.

Will any data from files or archival data be used? If so, please describe.

Yes, archived data from the 2013-2014 school year will be used. Scores will be obtained from the 2013-2014 STAR Early Literacy Enterprise Student Diagnostic Report for first graders and the 2013-2014 STAR Reading Student Diagnostic Enterprise Report for second and third graders. This information is provided to all district administrators with usernames and passwords to the Renaissance Learning programs. The Lexia Learning Company provides the archived data about the minutes students participated in the Lexia Core5 program for the 2013-2014 school year to all district administrators with usernames and passwords.

Appendix D: IRB Approval

Baker University Institutional Review Board

02/24/2016

Dear Vickie Kelly and Dr. Zoellner,

The Baker University IRB has reviewed your research project application and approved this project under Exempt Status Review. As described, the project complies with all the requirements and policies established by the University for protection of human subjects in research. Unless renewed, approval lapses one year after approval date.

Please be aware of the following:

1. Any significant change in the research protocol as described should be reviewed by this Committee prior to altering the project.
2. Notify the IRB about any new investigators not named in original application.
3. When signed consent documents are required, the primary investigator must retain the signed consent documents of the research activity.
4. If this is a funded project, keep a copy of this approval letter with your proposal/grant file.
5. If the results of the research are used to prepare papers for publication or oral presentation at professional conferences, manuscripts or abstracts are requested for IRB as part of the project record.

Please inform this Committee or myself when this project is terminated or completed. As noted above, you must also provide IRB with an annual status report and receive approval for maintaining your status. If you have any questions, please contact me at CTodden@BakerU.edu or 785.594.8440.

Sincerely,
Chris Todden EdD
Chair, Baker University IRB

Baker University IRB Committee
Verneda Edwards Ed,D
Sara Crump Ph,D
Erin Morris Ph,D
Scott Crenshaw