The Dissertation Committee for Min Kyung Kim Certifies that this is the approved version of the following dissertation:

A Comparison of the Effects of Reading Interventions on the Word Identification and Oral Reading Fluency of 5th Grade Students with Learning Disabilities

Committee:

Diane P. Bryant, Supervisor

Brian R. Bryant

Terry S. Falcomata

Colleen Reutebuch

Melissa M. Chavez

A Comparison of the Effects of Reading Interventions on the Word Identification and Oral Reading Fluency of 5th Grade Students with Learning Disabilities

by

Min Kyung Kim, B.Ed.; M.Ed.

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

August 2014

Dedication

This dissertation is dedicated to my parents for their endless love and support.

Acknowledgements

I sincerely appreciate all the opportunities to learn from the best mentors, who have supported me while I completed my Ph.D. program. I have always considered it a privilege and an honor to work for students with exceptionalities. First of all, I owe special thanks to my advisor, Dr. Diane Pedrotty Bryant, for her great love and support throughout this professional and academic journey. Throughout my Ph.D. program, she has been the biggest mentor and modeled caring, kindness, and integrity as a scholar and teacher. I am grateful for all of the invaluable opportunities in research, academic writing, and teacher preparation. I thank Dr. Brian R. Bryant for his guidance, mentorship, and generosity throughout my Ph.D. program. In addition, several iPad studies conducted with him showed me a right and clear path to my career, and his advice on assessment and assistive technology provided me insights on this dissertation study.

I am grateful to Dr. Colleen Reutebuch. She has always been my mentor, colleague, and friend. Her enthusiasm for research, caring for students with disabilities, and great teamwork taught me great lessons to move forward as a young researcher. It was a great experience to work with you and Dr. Sharon Vaughn for high school students with autism spectrum disorders. I would also like to thank Dr. Terry S. Falcomata for his significant help and advice on a single-case research design and visual analysis. Thank you very much for making time in your very busy schedules to provide me with strong guidance and suggestions. I would also like to acknowledge Dr. Melissa Chavez. I am very much thankful for her support and continual encouragement in initiating and conducting my dissertation study at the University of Texas Elementary School. I will

never forget her kindness and valuable insights into working with great teachers and students.

Although not on my dissertation committee, I would like to thank Dr. James Patton for his support and helpful advice as my teacher and dear friend throughout my Ph.D. journey and job search. His invaluable advice from his extensive teaching experience allowed me to make the right decisions at every critical moment, and I learned a lot from his college teaching skills and appreciation of multiculturalism.

I would like to extend my sincere thanks to my former advisor, Dr. Ock Ryeo Kang at Seoul National University of Education in Korea, for her support, encouragement, and guidance since 2008. I have been fortunate to learn from such a caring, passionate, and knowledgeable scholar.

Special thanks should go to Ms. Arlis Flores and her babies at the University of Texas Elementary School for allowing me to enjoy and successfully conduct the entire research process. I would also like to express my appreciation to Dr. Stephanie Stillman for kindly providing various assessments and warm-hearted advice, and a thank you goes to Garrett Roberts for taking his valuable time to double-check and code all the data from the study. I am thankful to my friends and colleagues (Dr. Seung-Hyun Son, Eun Ji, Eunyoung Kang, Fangjuan Hou, Farah El Zein, John McKenna, Julie Heier, Kat Hughes Pfannenstiel, Michael Solis, Mikyung Shin, Min Wook Ok, Stephanie Townsend, and Yu-Ling Sabrina Lo). Lastly, the biggest thanks should go to my grandma, parents, and my little brother. I am really grateful to my family for their endless support and encouragement.

A Comparison of the Effects of Reading Interventions on the Word Identification and Oral Reading Fluency of 5th Grade Students with Learning Disabilities

Min Kyung Kim, Ph.D.

The University of Texas at Austin, 2014

Supervisor: Diane P. Bryant

Abstract: The purpose of this study was to examine and compare the effectiveness of teacher-directed instruction (i.e., teacher-directed instruction without using an iPad, TDI) and iPad-assisted instruction (IAI) on the word identification and oral reading fluency of elementary school students with reading learning disabilities (RLD), who have reading goals on their individual education plans (IEPs). Four 5th grade students with RLD participated in the study. An alternating treatments design combined with a multiple baseline design across the participants was applied.

Visual analysis indicated that a moderate experimental effect from TDI and IAI on word identification and oral reading fluency was present for all four students when the baseline and intervention phases were compared. Specifically, regarding word identification, the percentage of non-overlapping data (PND) and non-overlap of all pairs (NAP) indicated that TDI and IAI are effective reading instructional procedures according to single-case research design standards. The finding was also supported by a Tau-U analysis that suggests both TDI and IAI demonstrated a large effect on improving word identification. Regarding oral reading fluency, however, the results were mixed; Tau-U indicates there was a large and significant effect from TDI and IAI for three of the

four students in terms of increasing their oral reading fluency. Although data analysis indicates that TDI and IAI demonstrate moderate evidence in improving word identification and oral reading fluency, there was no clear differentiation found between the two treatments. A social validity questionnaire that examined student perspectives about intervention showed the students' positive views on their intervention experience and revealed their perspectives that intervention was helpful in building their reading skills. The second social validity questionnaire that asked the students about their reading perspectives indicated that the intervention increased their positive attitudes toward their reading (e.g., reading is a source of excitement and interest, reading is fun).

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Reading learning disability (RLD) is one of the most common disorders in children (Hindson, Byrne, & Fielding-Barnsley, 2005; Shaywitz & Shaywitz, 2003). RLD is manifested by unexpected problems in acquiring basic reading skills (Raskind, 2001; Vellutino, Fletcher, Snowling, & Scanlon, 2004), and is estimated to occur in approximately 5-17% of school-aged children (Shaywitz & Shaywitz, 2003). Within the population of students with learning disabilities (LD), at least 80% of those who have been identified with LD are associated with RLD (Shaywitz & Shaywitz, 2003).

According to Siegel (2006), RLD occurs when an individual student has significant difficulty with accurately and speedily decoding words, which also affect comprehension and spelling. Thus, students with RLD display significant deficits in word identification (Shaywitz & Shaywitz, 2005) and oral reading fluency (Shaywitz & Shaywitz, 2008).

Word Identification and Oral Reading Fluency as Critical Components for Reading

For struggling readers, automatic word identification should be attained as it plays an important role in reading fluently. Readers who identify words quickly and effortlessly can read words automatically, thereby freeing up their limited cognitive resources for comprehension (Hudson, Lane, & Pullen, 2005; Hudson, Pullen, Lane, & Torgesen, 2009). If a child reads words incorrectly and slowly, this may lead to a misinterpretation of the text.

Oral reading fluency has been identified as one of five essential components of reading by National Reading Panel (NRP, 2000) and refers to the ability to read with "speed, accuracy, and proper expression" (p. 3-1). With the report of the National

Reading Panel, reading fluency has become targeted as a key component of successful reading interventions. Moreover, oral reading fluency is one of the most fundamental characteristics of good readers because such a reader should learn how to read accurately and quickly to facilitate reading comprehension (Allor & Chard, 2011).

Researchers have demonstrated that, when limited attentional resources are spent on decoding, relatively less cognitive resources are available for higher-level comprehension activities; the lack of oral reading fluency negatively affects comprehension (Rasinski, Rikli, & Johnston, 2009). Thus, oral reading fluency is an important reading component because it acts as a bridge from decoding to comprehension (Rasinski, 2004). Accordingly, oral reading fluency has received considerable attention from researchers and practitioners (Rasinski, Blachowicz, & Lems, 2006).

DIFFICULTY WITH WORD IDENTIFICATION AND STUDENTS WITH RLD

Students with RLD face enormous challenges in learning to read. They have weaknesses in critical reading areas; in the beginning stages of learning to read, the most salient characteristic manifested is a difficulty in achieving efficient word reading skill (Ayala & O'Connor, 2013; Gustafson, Falth, Svensson, Tjus, & Heimann, 2011; Jenkins, 2002). As noted by Shaywitz and Shaywitz (2005), students with RLD experience difficulties "first in decoding the word and then in identifying it" (p. 1302).

Wise et al. (2007) examined different measures of reading achievement for 279 students with RLD in second and third-grade and found that the majority of the students (i.e., 91%) demonstrated significantly low word identification scores, which ranked below the 16th percentile. This result supports Jenkins (2002), who noted that students with RLD already show serious deficits in word reading relative to their peers without RLD by fourth-grade, when the majority of them are identified with RLD.

Word level reading is essential for reading comprehension because word reading consumes attention, leaving even less cognitive capacity for comprehension (Hudson et al., 2009; Jenkins, 2002). Thus, students who achieve automatic and efficient word identification free their cognitive energy for reading for meaning. That is why students who cannot read words accurately and fluently often do not fully comprehend what they read.

DIFFICULTY WITH ORAL READING FLUENCY AND STUDENTS WITH RLD

Oral reading fluency has been identified as a key component in reading and learning to read because a large number of struggling readers manifest difficulties in reading connected text quickly, accurately, and, with expression. Students with RLD and reading difficulties tend to significantly struggle with reading fluency (Chard, Vaughn, & Tyler, 2002; Vaughn & Linan-Thompson, 2004). As Shaywitz and Shaywitz (2008) noted, individuals with RLD are described as having a reading level, and particularly a reading fluency level, below that expected for a person of their level of education and intelligence.

According to Spear-Swerling (2006), students with RLD manifest two patterns of difficulties in reading: (a) they read words slowly and laboriously and have difficulty reading words accurately, and (b) they may have achieved word decoding but still read in a slow fashion relative to their peers without RLD. Although RLD has been primarily assessed with single word decoding, it has been increasingly acknowledged that the difficulty in reading fluency is a significant aspect of students with RLD (Meisinger, Bloom, & Hynd, 2010). Given that oral reading fluency is the defining feature of students with RLD, measures of reading fluency (e.g., curriculum-based reading fluency probes)

are often used in Response to Intervention approaches to assess students with RLD (Wayman, Wallace, Wiley, Tichá, & Espin, 2007).

TABLET TECHNOLOGY FOR READING

In today's diverse classroom, using tablets for classroom learning activities is an effective application of technology (Spencer, 2011) and provide several advantages as an instructional tool. For example, students can benefit from the portability (Ozok, Benson, Chakraborty, & Norcio, 2008) and accessibility (Pyper, 2011) of tablet devices. Furthermore, as tablet computers are small in size, they can be easily embedded within students' learning environments.

In addition, tablet devices can be effective instructional tools to improve the reading skills of struggling readers (Conn, 2012; Larson, 2010; Miranda, Johnson, & Rossi-Williams, 2012). For example, students actively participate in tablet-assisted reading instruction because of several functions that they can manipulate (e.g., built-in dictionary, text-to-speech feature, different font sizes) (Larson, 2010). Moreover, the tablet devices can motivate some students by encouraging their ability and interests in operating the new technology (Miranda et al., 2012) and by providing sufficient and various reading materials (Larson, 2010). Scaffolds provided by tablet computers potentially help struggling readers to read independently and improve their reading skills by providing immediate feedback and features such as simulations, games, and vocabulary supports (Moody, 2010).

Although there has been limited research on tablets such as the iPad and their effectiveness for students with RLD, research suggests emerging evidence of the beneficial potential of tablet computers for struggling readers (Bryant, Kim et al., in

press; Conn, 2012; Huang, Clark, & Wedel, 2013; Israel, Maynard, & Williamson, 2013; McClanahan, Williams, Kennedy, & Tate, 2012; Saine, 2012).

THEORETICAL FRAMEWORK

The theoretical framework for teaching students with RLD effective reading strategies is grounded in information processing theory (Atkinson & Shriffin, 1968), because students with RLD show impairment in early information processing (Dhar, Been, Minderaa, & Althaus, 2008). Based on the theory of automaticity (LaBerge & Samuels, 1974), it is suggested that the best way to teach students with RLD word identification and oral reading fluency in order to achieve reading comprehension is by assisting them in performing lower-level reading process (i.e., word identification and oral reading fluency) automatically, thereby freeing up available cognitive resources for higher-level reading process (i.e., reading comprehension). The following sections provide an overview of the information processing and automaticity theories to frame the intervention proposed by this study.

Information processing theory

Information processing theory, developed in the early 1950s, explains how the human mind works by using the analogies between a computer and a human brain (Samuels, 1987). For example, when students with reading difficulties struggle in learning the skills and strategies, it would be similar to a computer software problem. One of the most widely accepted theories is the "multi-store model," based on the research of Atkinson and Shriffin (1968). The model suggests that the processing and storage of information involve a sequence of three stages: sensory memory, short-term memory (i.e., working memory), and long-term memory. The information in the short-term store is lost within 30 seconds, but a limited amount of information can be

maintained through a control process, which is called "rehearsal" (Atkinson & Shriffin, 1968).

Students with RLD appear to be impaired in early information processing (Dhar et al., 2008). Research shows that deficits in cognitive processes are often presented in students with low academic achievement (Johnson, Humphrey, Mellard, Woods, & Swanson, 2010). On the other hand, effective learners are good at perceiving, analyzing, and integrating information to enrich their knowledge in working on cognitive tasks, which primarily relate to information processing (Anderson-Inman & Knox-Quinn, 1996).

Several studies examined the relationship between the deficits and students with RLD (Bonifacci & Snowling, 2008; Compton, Fuchs, Fuchs, Lambert, & Hamlett, 2012; Jerman, Reynolds, & Swanson, 2012; Johnson et al., 2010; Johnson & Swanson, 2011; McGrath et al., 2011; Swanson, Orosco, & Lussier, 2012). Johnson et al. examined the cognitive processes of students with RLD and found that students with RLD showed significant deficits in phonological processing (ES = −1.276), processing speed (ES = −.947), verbal working memory (ES = −.920), and receptive and expressive language (ES = −.782) relative to typically achieving students.

The information processing theory is where the modern concept of instructional strategies emerged (Pressley & Harris, 2008). Instructional strategies are defined as cognitive behaviors that students employ to fulfill the academic goals and expectations of school (Anderson-Inman & Knox-Quinn, 1996). The use of strategies and strategy instruction has been prominent with extensive consideration of the role of strategies for the academic cognition of students, particularly in academic areas such as reading (Pressley & Harris, 2008).

Theory of automaticity

LaBerge and Samuels (1974) suggested the theory of automatic information processing in reading to explain difficulties that readers encounter in learning to read and to demonstrate the acquisition of automaticity when readers are involved in associative learning in the decoding and comprehension of words. Automaticity is defined as the "ability to read the words in text not only accurately but also automatically or effortlessly" (Morrow, Wixson, & Shanahan, 2013, p. 69) or as the "ability to perform complex skills with minimal effort and attention" (Samuels & Flor, 1997, p. 108). That is, readers who have not yet obtained automaticity in word identification need to spend a significant amount of their cognitive resources on low-level decoding tasks (Hudson et al., 2005; Rasinski et al., 2009; Samuels, Ediger, & Fautsch-Patridge, 2005). When cognitive energy or attention is being applied to decode words, relatively less cognitive energy is available for higher-level comprehension. Word identification requires being automatic because comprehension needs higher-level processes, which cannot be automated (Hudson et al., 2005).

The importance of the concept of "automaticity" has been continuously recognized in the field of education since LaBerge and Samuels (1974) first proposed the theory. For example, the "repeated readings" approach, which requires students to read a short passage until they are able to read the passage accurately and quickly with expression and comprehension (Samuels et al., 2005) is based on the automaticity theory. Similarly, Samuels (1988) noted that automaticity in decoding and word identification is achieved only through extended practice. Thus, struggling readers such as students with RLD need to achieve automaticity in word identification and oral reading fluency through sufficient practice and effective reading instruction.

INSTRUCTIONAL COMPONENTS FOR TEACHING STUDENTS WITH RLD

Given the importance of teaching word identification and oral reading fluency to students with RLD and the significance of implementing effective instructional practices for them, it is important to examine instructional components for decoding unfamiliar words and for reading texts fluently and accurately. There are a number of studies that suggest teaching effective word identification strategies (e.g., Bos & Vaughn, 2009; Bryant, Smith, & Bryant, 2008; Chard & Osborn 1999; Combs, 2011; Ehri, 2005; Gaskins & Ehri, 1996; Lenz & Hughes, 1990) and fluency-building practices (e.g., Chard et al., 2002; Chard, Ketterlin-Geller, Baker, Doabler, & Apichatabutra, 2009; NRP, 2000; Therrien & Kubuina, 2006) to struggling readers. The following sections provide an overview of instructional components for teaching word identification and oral reading fluency to help students with RLD.

Word identification

As noted earlier, word identification is a critical component in reading because readers who lack automaticity in word identification need to allocate a great deal of cognitive load to lower-level tasks (Hudson et al., 2005; Rasinski et al., 2009; Samuels et al., 2005). In addition to automatic word recognition, the use of syntax and semantics are suggested for improving word identification (Bos & Vaughn, 2009). For the identification of sight words, students need to experience a limited set of sight words that include both phonetically regular and irregular words (Chard & Osborn, 1999).

When words cannot be read automatically, students need to decode them by using effective word identification strategies (Bos & Vaughn, 2009; Combs, 2011; Ehri, 2004). There are three types of word identification strategies: (a) phonic analysis that identifies and blends letter-sound correspondences into words, (b) structural analysis that uses knowledge of word structures to decode words and identify their meanings (Bos &

Vaughn, 2009), and (c) multisyllabic word identification that involves the use of common syllable types to identify multisyllabic words (Bryant et al., 2008; Chard & Osborn, 1999). For multisyllabic word identification, students are required to understand the concept of the syllable and identify syllable patterns (Bryant et al., 2008; Bryant, Ugel, Thompson, & Hamff, 1999).

Specifically, students who have difficulties in identifying unfamiliar words can be taught strategies to enhance word identification (Bryant et al., 2008; Chard & Osborn 1999; Lenz & Hughes, 1990). Word identification strategies, such as DISSECT (Lenz & Hughes, 1990) and SPLIT (Bryant et al., 2008), assist struggling readers in decoding unknown words using different steps of the strategies. For example, the SPLIT strategy, designed to decode multisyllabic words, encourages students to use their knowledge of syllable types and patterns.

Oral reading fluency

To increase oral reading fluency, researchers have concluded that repeated reading is one of the most effective approaches, with evidence-based practices for helping students in reading fluently (Chard et al., 2002; Chard et al., 2009; NRP, 2000; Therrien & Kubuina, 2006). Chard et al. synthesized research on fluency interventions targeted for elementary students with LD to identify effective oral reading fluency instruction. In the synthesis, repeated reading was reported as an effective intervention in improving the oral reading fluency of elementary students with LD. Repeated reading refers to reading connected text more than once each session to improve oral reading fluency (Chard et al., 2009); it requires students to have multiple opportunities to read texts or engage in repeated oral reading.

In the synthesis (Chard et al., 2002), repeated reading was categorized into three types: (a) repeated reading with a model, (b) repeated reading without a model, and (c) repeated reading interventions with multiple features. Chard et al. found that repeated reading with a model (i.e., reading passages with a teacher or parent modeling) appeared to be more effective than repeated reading without a model. In addition, regular feedback is suggested as an essential instructional component that needs to be embedded in repeated reading (Allor & Chard, 2001; Therrien, 2004).

Chard et al. (2002) also synthesized oral fluency practices at the word level. In word practice interventions, students are asked to practice miscued words during their initial passage reading. In recent studies (Burns, Dean, & Foley, 2004; Watson, Fore, & Boon, 2009), students were taught key words before they read their grade-level passages or were provided with lessons that included error correction procedures.

STATEMENT OF THE PROBLEM

Although several interventions have focused on computer-assisted reading instruction for elementary students with LD (e.g., Blythe, 2006; Cohen, Torgesen, & Torgesen, 1988; Esteves & Whitten, 2011; Hebert & Murdock, 1994; Jimenez et al., 2003; Jones & And, 1987; Kast, Baschera, Gross, Jancke, & Meyer, 2011; Rashotte & Torgesen, 1985; Thorkildsen, Waters, Cohen, & Torgensen, 1988; van Daal & van der Leij, 1992), few have examined iPad-assisted reading instruction for elementary students with LD, and no study has presented the effects of iPad-assisted instruction in teaching word identification and oral reading fluency for elementary students with LD. Furthermore, students with RLD are required to learn effective strategies and practices that assist them in decoding unfamiliar words (Bos & Vaughn, 2009; Bryant et al., 2008; Chard & Osborn 1999; Combs, 2011; Ehri, 2005; Gaskins & Ehri, 1996; Lenz & Hughes,

1990) and improving oral reading fluency (Chard et al., 2002; Chard et al., 2009; NRP, 2000; Therrien & Kubuina, 2006). In the current study, iPad-assisted reading instruction and teacher-directed instruction, where elementary students with RLD were taught word identification strategies and given fluency-building practice, were implemented to examine and compare the effectiveness of two types of instructions on the fundamental components to successful reading, namely, word identification and oral reading fluency. The theory of automaticity (LaBerge & Samuels, 1974) and Chall's stages of reading development (1983) imply that elementary students with RLD should be provided with instructions for word identification and oral reading fluency. Given the significant deficits in word identification (Ayala & O'Connor, 2013; Gustafson et al., 2011; Jenkins, 2002; Shaywitz & Shaywitz, 2005) and oral reading fluency (Chard et al., 2002; Shaywitz & Shaywitz, 2008; Spear-Swerling, 2006; Vaughn & Linan-Thompson, 2004) of students with RLD, teaching them in order to bridge this gap is important. Thus, examining and comparing the effectiveness of two types of reading instruction (i.e., iPad-assisted instruction and teacher-directed instruction) on word identification and oral reading fluency skills warrants research.

PURPOSE OF THE RESEARCH

The purpose of this study was to examine and compare the effectiveness of teacher-directed instruction (i.e., teacher-directed instruction without using an iPad) and iPad-assisted instruction on the word identification and oral reading fluency of elementary students with RLD, who have reading goals on their IEPs (i.e., Individualized Education Program). The following questions guided this study.

RESEARCH QUESTIONS

1. Which instructional procedure, teacher-directed instruction (TDI) or iPad-assisted instruction (IAI), is more effective in increasing the word identification performance of 5th grade students with RLD?
2. Which instructional procedure, TDI or IAI, is more effective in improving the oral reading fluency performance of 5th grade students with RLD?
3. How do 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention?
4. How do 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to their reading comprehension?
5. What are the perspectives of 5th grade students with RLD about TDI or IAI after the intervention?
6. What are the perspectives of 5th grade students with RLD about their reading?

Chapter 2: Review of Related Literature

Background and Rationale

The National Reading Panel (2000) identified the five components of reading instruction that are most critical to support students in becoming proficient readers. These five important components include: (a) phonological awareness, (b) phonics, (c) fluency, (d) vocabulary, and (e) comprehension. According to the most recent report of the National Center for Education Statistics (NCES, 2011), 34% of fourth-grade students read below basic level. The numbers for students with disabilities are even more disturbing, with up to 68% of those students being poor readers (NCES, 2011). If students fail to build essential reading skills at young ages, time-intensive remediation should follow (Zumeta, Compton, & Fuchs, 2012), which emphasizes the importance of early reading interventions for elementary students. Given the importance of reading, which is an integral component of academic success, struggling readers need to be taught how to read fluently.

A large percentage (i.e., 80%) of students with LD have difficulties reading (Drummond, 2005). Despite the deficits in the reading fluency of students with LD, fluency is often neglected in reading instruction (Kame'enui & Simmons, 2001; NRP, 2000). Given that students with RLD often struggle in reading at the word level, the reading instruction also needs to focus on word identification. As an effective approach for learning, the use of technology can enhance the learning of students with LD by supporting them in experiencing greater success and in using their strengths to overcome their disabilities (Stanberry & Raskind, 2009).

It has been more than 25 years since the Technology Related Assistance for Individuals with Disabilities Act (1988), commonly referred to the "Tech Act," was passed by Congress. The "Tech Act" increased attention on assistive technology and

provided the first legislated definition of assistive technology services and devices, which help students with disabilities improve their functional ability (Alper & Raharinirina, 2006; Edyburn, 2013). In particular, assistive and instructional technology has supported students with disabilities, including those with LD, to develop functional capabilities by operating as instructional adaptations in their classroom settings (Bryant & Bryant, 1998). Assistive technology not only promotes students' access to various resources, but it also increases the students' successes (Courtad & Bouck, 2013). Over the past decade, technology has long been viewed as playing an important role in providing learning opportunities for students with LD by helping them to reach their potential (Stanberry & Raskind, 2009). Although tablets and applications are not always AT devices, they become AT devices when used by students with disabilities to "increase, maintain, or improve the functional capabilities of a child with disabilities" (Technology Related Assistance of Individuals with Disabilities Act, 20 U.S.C. 1401[1]).

Recently, inexpensive and easy-to-access education applications, also called "apps," have emerged with tablet technologies to support students in learning across various academic areas, including reading. Despite several cited advantages of the use of tablet technology, such as the iPad, in the classroom (e.g., portability, a great deal of education apps, touch technology), there has been little research that has examined the effects of apps or compared students' academic performances with apps versus that of more traditional methods of teacher-directed instruction.

Thus, there is a need for intervention studies that focus on word identification and oral reading fluency with apps with teacher-directed instruction to address the effects of the apps in improving the reading skills of elementary students with LD. The purpose of this chapter is to: (a) explain the importance of building word identification and oral reading fluency in the process of learning to read; (b) review instructional strategies

designed to develop word identification and oral reading fluency for struggling readers, and (c) provide a rationale for why the iPad was selected as an instructional technology to improve the word identification and oral reading fluency of elementary students with LD as opposed to the more traditional, solely teacher-directed method of instruction, and to justify the use of iPad-assisted instruction in the dissertation study.

WORD IDENTIFICATION AND ORAL READING FLUENCY

Word identification

Word identification is defined as the ability to effortlessly and quickly recognize sight words (Ehri, 2005) or use decoding strategies to decipher efficiently unfamiliar words (Bos & Vaughn, 2009; Paulson & the IRIS Center, 2004). Successful readers identify words automatically and, if a word is unknown, use effective decoding strategies to decipher the word (Bos & Vaughn, 2009). Word identification is achieved through sufficient opportunities to practice reading and identifying words until the process becomes automatic (Bos & Vaughn, 2009).

When the word is not automatically and effortlessly recognized, however, students need to apply effective decoding strategies to assist them in identifying the troublesome words (Bos & Vaughn, 2009; Bryant et al., 2008; Chard & Osborn, 1999; Combs, 2011; Ehri, 2005; Gaskins & Ehri, 1996; Lenz & Hughes, 1990). In identifying unknown words, students can be assisted by the meaning of word segments (e.g., prefix, suffix) and word structure (e.g., syllables, roots) (Paulson & the IRIS Center, 2004). To accomplish accurate and automatic word identification, which is a key in developing reading fluency (Bashir & Hook, 2009), readers can apply various reading strategies (Combs, 2011).

Methods of word identification in reading

Ehri (2004, 2005) suggested four ways to accomplish word identification: decoding, analogizing, predicting, and recognizing whole words on sight.

1. Decoding: The first approach of word identification is decoding unfamiliar words, which involves breaking the words apart, sounding them out by sound, and then blending the sounds together. During this process, upper elementary students may use their knowledge of word structure (e.g., prefix, suffix, syllables, or roots) and of letter-sound correspondences to recognize the words. Effective decoding strategies are essential in teaching struggling readers, who encounter a great deal of unknown words in their reading. Additionally, learning letter-sound blending and familiar word patterns (i.e., word families) are important word identification strategies for students with reading disabilities (Wanzek & Haager, 2003).
2. Analogizing: This involves utilizing words that students already knew (i.e., known words) or word parts as an aid in recognizing unknown words (Bryant et al., 2008). For example, students can use known words (e.g., cat) to identify unknown words (e.g., pat, bat, hat) with similar spelling patterns. Using word parts from known words can help students make logical decisions about unknown words (Wanzek & Haager, 2003).
3. Predicting: This involves using the surrounding context, letter clues, and knowledge of syntax to decipher unfamiliar words (Bryant et al., 2008; Chard & Osborn, 1999). According to Bryant et al., the use of predicting through surrounding words, sentences, or images can narrow students' guesses and help students identify unknown words more effectively.

4. Recognizing: The fourth method of word identification is recognizing sight words through a reader's memory or sight. Readers simply look at the words, which are then easily recognized by their memory. Often times, the sight words are immediately recognized as readers look at the words.

In addition to word identification as a key element for reading comprehension, a large number of struggling readers have difficulties in oral reading fluency. Research on oral reading fluency has received attention from many researchers and practitioners (Rasinski et al., 2006) because of its important role as a bridge from decoding to comprehension (Rasinski, 2004) in reading.

Oral reading fluency

The NRP (2000) identified five areas that are critical for effective reading instruction (i.e., phonemic awareness, phonics, fluency, vocabulary, and comprehension). Oral reading fluency has been identified as one of five essential components of reading and is defined as the ability to read with "speed, accuracy, and proper expression" (NRP, 2000, p. 3-1). Therefore, oral reading fluency refers to the combination of the rate and accuracy of reading and also involves expression or prosody (e.g., altering pitch, tone) (Bryant et al., 2008). Proficient readers need to learn how to read quickly; fluent reading facilitates reading comprehension (Allor & Chard, 2011).

The role of oral reading fluency in the process of learning to read

Since the 1960s, researchers have investigated the reading process through the concept of oral reading fluency. LaBerge and Samuels (1974) conducted research on the theory of automaticity in oral reading. Automaticity is defined as the "ability to read the words in text not only accurately but also automatically or effortlessly" (Morrow et al., 2013, p. 69). That is, when reading processes become more automatic and fluent, readers

spend less cognitive resources on their working memory or low-level reading process, thereby allocating more resources to higher-levels of comprehension (Hudson et al., 2009). Therefore, oral reading fluency is a key link between word identification and comprehension (Bashir & Hook, 2009). Given the importance of oral reading fluency as a key element for reading comprehension, effective reading instruction needs to focus on fluency-building practices.

Summary

To summarize, this section focused on the definitions of word identification and oral reading fluency and their roles in learning how to read. Word identification skills allow readers to quickly recognize words and apply decoding strategies to identify unfamiliar or unknown words. Although word identification can be achieved through practice until the process becomes automatic, students need to use decoding strategies when the words are not automatically recognized. According to Ehri (2004, 2005), there are four ways to identify words: decoding, analogizing, predicting, and recognizing. In addition to word identification, proficient readers are required to read fluently and accurately to facilitate reading comprehension (Allor & Chard, 2011). Oral reading fluency allows readers to allocate less of their cognitive energy on lower-level reading processes and more resources on higher-level comprehension (Hudson et al., 2009).

INSTRUCTIONAL APPROACHES

Building word identification

As students read more and more difficult and complicated texts, effective word identification strategies are required to support struggling readers to recognize the pronunciation and meaning of known and unknown words and thereby comprehend what they are reading. Researchers suggest three types of word identification strategies: phonic

analysis, structural analysis, and multisyllabic word identification (Bryant et al., 2008; Chard & Osborn, 1999).

Phonic analysis

Phonics analysis involves identifying and blending letter-sound correspondences into words. Relative to the phonic analysis, structural analysis and multisyllabic word identification strategies are more advanced (Chard & Osborn, 1999).

Structural analysis

Structural analysis involves using knowledge of word structures to decode words and identify their meanings (Bos & Vaughn, 2009). Students apply their knowledge of suffixes, prefixes, or root words when they encounter unfamiliar words.

Multisyllabic word identification

Common syllable types can help students identify multisyllabic words. Multisyllabic word identification involves syllabication and the analysis of combinations of vowels and consonants within a word to decide where the word breaks into syllables (i.e., a unit of pronunciation including a single vowel sound) (Bryant et al., 1999; Bryant et al., 2008). Bryant et al. suggested that decoding multisyllabic words requires students to understand the concept of the syllable, identify phonograms (i.e., phonic chunks of single-syllable words), recognize vowels and consonants within the word, and identify types and patterns syllables.

In addition, Bos and Vaughn (2009) suggested automatic word recognition (i.e., recognizing high frequency and less predictable words through automaticity), syntax (i.e., word order), and semantics (i.e., context) in assisting with the pronunciation and identification of a word's meaning. According to Chard and Osborn (1999), when students are being taught how to identify words, reading instruction should include a

limited set of sight words that are phonetically regular in the beginning stages and become phonetically irregular later. For teaching phonetically irregular words, word identification instruction should be provided by repeating simple tasks and increasing the task difficulty gradually (Allor & Chard, 2011).

Chard and Osborn (1999) noted that a beginning program should include strategies for identifying words that contain more than one syllable. To help struggling readers who display an inability to identify unfamiliar words, there are word identification strategies that are designed to assist them in learning how to decode multisyllabic words. One of the strategies is DISSECT (Lenz & Hughes, 1990), which involves seven steps to use in decoding unknown words. Students can apply the strategy to general reading assignments and content-specific texts (Warrington, 2006). The steps are as follows: (1) D—Discover the context, (2) I—Isolate the prefix, (3) S—Separate the suffix, (4) S—Say the stem, (5) E—Examine the stem, (6) C—Check with someone, and (7) T—Try the dictionary. Students start with the first step, discovering the context, and move on to the next step if the initial step does not work for them. For example, the first step requires the student to read to the end of the sentence, skipping over an unknown word and guessing what word might best fit in by using the meaning of the sentence (Bremer, Clapper, & Deshler, 2002). The student proceeds to the next step (i.e., isolate the prefix), if he or she is not able to match the guess with the unknown word. If the student is not able to decode the word with steps 1 through 5, then the student checks with a teacher, parent, or an advanced peer. If someone is not available to help or if the assistance appears to be incorrect, the final step prompts the student to look up the word using a dictionary, pronounce the word using its pronunciation information, and read the definition. Bryant et al. (2000) noted that the DISSECT strategy works most effectively

for struggling readers when the word being analyzed is already included in the student's listening vocabulary and intensive assistance is provided.

SPLIT is another strategy for decoding multisyllabic words (Bryant et al., 2008). SPLIT involves the use of syllable types and patterns in decoding an unknown word. The SPLIT strategy includes five steps that match up with the abbreviation: (1) S—See the syllable types, (2) P—Place a line between the syllables, (3) L—Look at each syllable, (4) I—Identify the syllable sounds, and (5) T—Try to say the word. Bryant et al. suggested that teachers can use the strategy effectively by: (a) explaining to students what each letter in SPLIT stands for and asking them to read the steps aloud together, (b) pointing to and naming each letter in SPLIT and having students identify the five steps through choral reading, (c) asking students to name the letters and each step for each letter from their memory without looking at the SPLIT poster, and (d) reviewing the procedure until students can recall the five steps from memory. In addition to instructional strategies to improve word identification, there have been several approaches to help students build oral reading fluency.

Improving oral reading fluency

The NRP (2000) conducted a meta-analysis and found that oral reading fluency was more effectively developed by oral reading practices than silent reading practices, and that repeated reading had a positive impact on oral reading fluency. To identify effective oral reading fluency instruction, Chard et al. (2002) synthesized research on fluency interventions targeted for elementary students with LD and organized the fluency-building interventions into the following categories: (a) repeated reading with a model, (b) repeated reading without a model, (c) repeated reading interventions with multiple features (i.e., activities that target other reading skills as well, such as retell or

paragraph summary), and (d) word practice interventions that contain fluency practice at the word level.

Repeated reading

Repeated reading intervention involves reading connected text more than once each session to improve oral reading fluency (Chard et al., 2009). In their synthesis, Chard et al. (2002) found that repeated reading was considered the most effective method for developing oral reading fluency and noted that effective oral reading fluency interventions were associated with multiple opportunities to read text or engage in repeated oral reading.

As noted earlier, repeated reading is categorized into three types of approaches: (a) repeated reading without a model, (b) repeated reading with a model, and (c) repeated reading interventions with multiple features (Chard et al., 2002). The first approach, repeated reading without a model, encourages students to read passages without teacher or parent modeling. The second approach, repeated reading with a model, features a model that is a better reader and encourages students to read passages repeatedly with that model (e.g., teacher, parent, advanced peer). The third approach, repeated reading with multiple features, involves repeated reading as one of the instructional features. In their synthesis, Chard et al. indicated that repeated reading with a model appeared to be more effective than repeated reading without a model. Modeling and feedback are important for passage reading to develop oral reading fluency (Allor & Chard, 2001).

Therrien (2004) emphasized the essential instructional components that should be included in repeated reading interventions as follows. First, a student should read aloud passages to a tutor so that the tutor can monitor the student's oral reading and provide feedback. Second, corrective feedback on errors and reading speed should be provided to

students. Third, the repeated reading (i.e., rereading passages) should be continued until the student reaches a certain criterion.

Fluency practices at the word level

In the synthesis by Chard et al. (2002), the fourth category of fluency-building interventions was word practice interventions, which involve fluency practices at the word level. Contrary to repeated reading, which asks students to read the same passage repeatedly, word practice interventions involve students practicing the individual words that they missed or mispronounced during the initial passage reading. With word practice interventions, students participate in passage reading first, which is then followed by supplemental practice with error words.

In another study, Burns et al. (2004) taught students in experimental group key words for their grade-level and one grade below their level before they read a passage on their grade-level. When compared to a control condition (i.e., no intervention), improvements in the oral reading fluency of students in the experimental condition showed a small to moderate effect (d = .38). In yet another study that focused on error correction, Watson et al. (2009) compared oral reading fluency in a word supply lesson to a phonics-based lesson. The word supply lesson focused on miscue correction given as a whole word by asking the student to practice incorrectly read words (i.e., repeating the word and the passage). The phonics-based lesson also asked students to sound out incorrectly read words but provided phonetic-modeling from the teacher. Results showed that both word supply and phonics-based instruction increased the level of words correct per minute (WCPM) relative to the WCPM established as the baseline level. In addition, the word supply condition demonstrated a higher-level of WCPM than the phonics-based condition.

For building oral reading fluency, students need to be provided with sufficient opportunities to practice reading decodable text and to listen to modeling by a fluent reader. There are various approaches to help students with their oral reading fluency. Teachers and educators should implement effective fluency practices with careful consideration of evidence-based instructional features and systematic feedback.

Summary

To summarize, this section focused on instructional approaches to build word identification and oral reading fluency. To improve word identification, effective word identification strategies are critical in assisting struggling readers with recognizing the pronunciation and meaning of words. Researchers (e.g., Bos & Vaughn, 2009; Combs, 2011; Ehri, 2004) have emphasized the importance of applying word identification strategies to help readers identify words that contain more than one syllable. Word identification strategies such DISSECT (Lenz & Hughes, 1990) and SPLIT (Bryant et al., 2008) are suggested.

Oral reading fluency is more effectively developed by oral reading practice than silent reading practice (NRP, 2000). Chard et al. (2002) found that repeated reading appeared to be the most effective method for improving oral reading fluency in their synthesis. In addition to repeated reading, students can be taught oral reading fluency through word practice interventions that focus on practicing error words that students missed or mispronounced during their initial reading. Recently, students have been provided meaningful reading experiences through the use of assistive technology, such as tablet devices.

TABLET TECHNOLOGY FOR READING

Use of tablet technology in learning

The use of technology in special education settings has significantly evolved since the 1990s (Edyburn, 2000). For students with special needs, assistive technology is defined as any item or product designed to increase, maintain, or improve the functional abilities of the students (Individuals with Disabilities Education Act, 2004) and has been historically considered an instructional tool in special education settings (Edyburn, 2013). With the rapid development of 21st century technologies and the growing use of technology in classrooms, new technologies need to be embedded into the curriculum to help students prepare for the reading demands of higher education and careers (International Reading Association [IRA], 2009). The IRA emphasizes the importance of integrating information and communication technologies into the curriculum. The innovative features of today's instructional technology can support access to a variety of resources, thereby helping to improve the reading skills of struggling learners by customizing their learning and supporting their access to a variety of resources.

More recently, tablet technologies (i.e., mobile touch-screen technologies) have introduced a new era of instructional tools that provide multiple access possibilities to a wide range of online resources. The advantages of tablet technologies, such as portability, access, and functionality, allow students to access more creative and broader learning materials that are not offered in traditional classroom settings.

Tablet technologies and social software can be used as tools for blended learning (Vesisenaho et al., 2010), which is "the thoughtful integration of classroom face-to-face learning experiences with online learning experiences" (Garrison & Kanuka, 2004, p. 96). Mobile technologies have a positive impact on student learning by broadcasting real-time classroom activities (e.g., video, audio, lecture notes, hand written work) (Wang,

Shen, Novak, & Pan, 2009). In addition, a mobile learning system allows teachers to (a) monitor all student activities and progress as shown on their mobile screens, (b) facilitate a supervision of student learning activities, (c) provide assistance when required, (d) communicate with students in a timely manner and more freely to offer better learning environments, and (e) support new ways of assisting the students with collaborative learning (Ferdig, 2007; Vesisenaho et al., 2010; Wang et al., 2009).

Specifically, the use of the iPad as an instructional tool in classrooms has significantly evolved since its introduction in 2010. Additionally, the iPad provides over 40,000 education apps (http://www.apple.com/education/ipad/apps-books-and-more/) that cover various subjects for diverse learners of different grade-levels. Research findings show emerging evidence of the potential of iPad applications for students (Shuler, 2012). Despite the positive impacts and potential for learning enhancement, there is a paucity of literature that documents the actual use and effects of the iPad in educational settings. In addition, relatively limited research has been conducted on the educational impact of the use of tablet devices for struggling readers.

Effective features of tablet computers for learning

There are several features that are suggested to be helpful for struggling learners. One of the primary features that tablet computers contain is multimedia components, including visual and audio supports. Voice-to-text allows struggling learners to carefully listen to sections of assigned passages using their e-books and helps them gain confidence in reading (Miranda et al., 2012). Using effective images about a reading passage, provided by tablet computers, can help students construct meanings while reading the digital text. The quality of images is as important a component of reading process as the words the students read (Cahill & McGill-Franzen, 2013). Moreover,

multimedia features enable "simulations" by allowing students to manipulate various components virtually, thus helping them to attain a strong foundational understanding of concepts that they are reading or learning about (Israel et al., 2013).

The functionality of tablet computers is also a critical feature that determines the success of the instruction (Cahill & McGill-Franzen, 2013). Functionality refers to the effects or usefulness of the instructional applications on the tablet devices, such as an electronic dictionary or the text-to-speech feature.

The tablet computer's effective features are aligned with the core principles of universal design for learning (UDL). According to Spencer (2011), there are three main principles that should be considered for technology-assisted learning: representation (i.e., how to help students access content), expression (i.e., how students show what they learned), and engagement (i.e., how students are motivated to work on a task). Regarding representation, students need to be provided with various methods to access learning, such as videos and images. For expression in UDL, a variety of options for the communication and presentation of what they have learned should be provided. Additionally, students need to be exposed to effective classroom strategies that can help them participate more, and actively be involved, in learning. The three aforementioned features are called the "cornerstones" of UDL and provide teachers with guidelines to support diverse learners (Center for Applied Special Technology [CAST], 2011).

The tablet computer's effective features allow students and teacher to use them to their maximum advantage and experience continuing improvements in classrooms. When the tablet computers are effectively utilized by students and teachers, the new technology finally becomes a beneficial and helpful tool for learning.

Benefits of tablet computer use for reading instruction

There are several benefits for students who are provided with the use of tablet devices in classrooms. One of the primary advantages of tablet devices is their portability (Ozok et al., 2008) and accessibility (Pyper, 2011) because given these characteristics, students can access the tablet devices anytime and anywhere and be provided with various learning materials that are broader and more flexible relative to the materials provided in traditional classroom settings. For students, tablet computers that have touch screens are easy to carry around and navigate with. Because tablet computers are relatively smaller-sized devices than laptop computers, they can be embedded into a student's learning routine more easily and naturally.

Tablet computers have positive impacts on student engagement and attitude. In particular, for students from low-income families, new instructional technologies, such as e-readers or e-books, effectively motivate their engagement in learning because the use of new technological devices at home is limited (Miranda et al., 2012). Previous studies have found that tablet-assisted instruction improved student engagement as well as their academic skills (Larson, 2010; Miranda et al., 2012; Pyper, 2011). For example, Larson found the Kindle tools helped second-grade students engage in reading by putting them in greater control of the text than when they read it in its printed form. The interactive functions of tablet computers facilitate student learning and build a unique reading experience. According to Cahill and McGill-Franzen (2013), students experiencing tablet-assisted reading instruction are provided with multiple modes of interactions, such as: reading to themselves, reading along, or reading while playing a game. Thus, the number and levels of interaction should be carefully considered prior to tablet-assisted reading instruction.

Students can be motivated to learn by having an opportunity to read e-text using a new technological gadget (Miranda et al., 2012) because they tend to focus more on the task when they read electronic texts than when reading printed ones (Pearman, 2008). Multimedia features such as bright images and sound effects stimulate student interests in learning (Pyper, 2011). Specifically, coupled with the quality animations provided by tablet computers, sound effects can be an effective component that contribute to the improvement of reading skills because sound effects play an important role in the background by reinforcing the mood of the reading content (Cahill & McGill-Franzen, 2013). According to Cahill and McGill-Franzen, the quality of narration can enrich student reading experiences and is considered as an indicator of the overall quality of the instructional technology.

Tablet reading devices are effective tools for improving reading skills (Conn, 2012; Larson, 2010; Miranda et al., 2012). In research conducted to improve the reading comprehension of second-grade students (Larson, 2010), the students themselves participated in reading instruction by manipulating applications (e.g., accessing the built-in dictionary, playing with the text-to-speech feature, adjusting the font size). Tablet devices allow students to look up definitions of unknown words, listen to difficult vocabularies, and reread passages. Also, students' ability to operate the devices and interest in the new devices motivate them to explore the tablet computer, thus devoting more time and focus to reading (Miranda et al., 2012).

Tablet computers can support a struggling reader's inability and deficits in decoding unfamiliar or difficult words (e.g., multisyllabic words) by providing access to built-in dictionaries and the ability to read with a larger font size; students are provided with sufficient and various reading materials (e.g., books, magazines, newspapers) that are already stored in the tablet and meet their reading interests (Larson, 2010). Larson

found that tablet-assisted instruction can target students with a variety of reading levels and skills because it offers customized settings for each unique reader. Tablet computers also provide scaffolds for struggling readers so that they can read passages independently, get immediate feedback, and gain comprehension skills using various features available on the tablet device (Moody, 2010).

Therefore, the use of a tablet (e.g., iPad, Kindle) is an effective application of technology in today's diverse classrooms (Spencer, 2011). One of the particularly attractive applications facilitates the use of electronic books. For example, students can access electronic text on tablet devices and customize their reading environments. Tablet devices allow students to navigate electronic dictionaries and have unknown words read loud, which helps them more readily understand unfamiliar text (Spencer, 2011). The use of a tablet in education supports UDL by providing students a wide range of options through which they can access text. Common features of tablet computers, such as a touch screen and a variety of applications, hold promising possibilities for effective learning (Hutchison, Beschorner, & Schmidt-Crawford, 2012).

Tablet devices have the potential to be easily and effectively integrated into reading instruction for elementary students. Hutchison et al. (2012) examined the effects of using an iPad to support the reading instruction of students in fourth-grade and to help them meet their learning goals. In the research, the use of iPads was guided and helped students use reading comprehension strategies (e.g., sequencing, visualization), which allowed them to have various communications with their peers about what they read using iPad applications (e.g., iBooks).

As noted earlier, tablet computers contain various benefits to assist struggling readers with their endeavors, such as portability, touch-technology, and multimedia features. When it comes to educational applications, the iPad is superior to other tablet

devices. For example, the iPad has over 40,000 education applications while the Kindle only has around 7,300 education applications. In addition, according to Edyburn (2013), the adoption of iPads and apps into education provide opportunities for understanding the effects of innovation in the field of special education.

iPad-assisted reading instruction for struggling readers

Most of today's inclusive classrooms contain students with LD (Spencer, 2011). In addition, more than 88% of students who are identified with LD participate in learning in a general education classroom for 40% of the day (Snyder & Dillow, 2011). For struggling readers, the use of iPads is important because technology-assisted instruction (e.g., e-storybooks) provides an effective form of differentiated reading instruction (Edyburn, 2007; Moody, 2010). Hutchison et al. (2012) suggest several advantages of iPad-assisted instruction: students can (a) access numerous downloadable books with audio support, word-by-word tracking, and picture animation; (b) further interact by recording and replaying their voices with texts; and (c) acquire the definition and pronunciation of any word by touching the screen.

Previous studies suggest that reading e-storybooks benefits struggling readers by improving their reading skills (e.g., phonological awareness, vocabulary, comprehension) as well as supporting their reading engagement by providing digital scaffolding supports (Moody, 2010). With the increasing popularity of tablet technologies, there has been a proliferation of instructional opportunities that support a broad range of learning experiences through various iPad applications and their effective features (e.g., simulations, games, vocabulary supports) (Moody, 2010).

There have been limited numbers of research studies on the iPad and its use for students with LD. According to Edyburn (2013), original research studies on the iPad for

learning in special education began to appear only after several studies, which described the use of the iPad for students with disabilities and how to find and evaluate the educational apps, came forth following the introduction of the iPad in 2010. It should be noted that very few studies have examined iPad-assisted reading instruction for struggling readers (Huang et al., 2013; Saine, 2012). Conn (2012) investigated the effects of using iPads in cooperative project-based learning experiences for fifth-grade students in a full inclusion classroom that included a population of about a quarter of the students with moderate to severe LD. The results showed that students improved their reading skills in terms of comprehending information text and displayed more confidence in using iPad applications for collaboration in their groups.

Israel et al. (2013) implemented iPad-assisted instruction for students with disabilities who displayed low-levels of academic achievement. They examined the effects on the students' content literacy skills across subjects (e.g., science, technology, engineering, mathematics) through integrated instructional technology. Through iPad-assisted instruction, students could enhance their learning in content areas and were motivated to keep learning by accessing a wide range of iPad resources (e.g., simulations, video games) (Israel et al., 2013).

In another study, McClanahan et al. (2012) examined the effects of iPad applications on the word identification and comprehension level of a fifth-grade student with ADHD who was reading at a second-grade level. iPad applications that targeted word identification (e.g., Vocabulary Builder, Miss Spell's Class, and ABC Alphabet Phonics) and comprehension (e.g., e-book that allowed the student to record himself as he read aloud) were implemented. The lessons were mainly combined with iPad applications and activities downloaded to the iPad from the Internet; they were implemented over six weeks at least twice a week for 20 minutes. As a result, the student made progress in his

reading ability, improving one full grade-level and showing a more positive attitude toward learning.

Summary

Recently, tablet technologies have emerged as effective tools that improve reading skills (Conn, 2012; Larson, 2010; Miranda et al., 2012), and they are considered effective applications of technology in today's diverse classrooms (Spencer, 2011). Despite the increasing popularity and advantages of tablet technologies in classrooms, a relatively limited number of studies examining the use of tablet devices for struggling readers has been conducted. In particular, research suggests emerging evidence of iPad applications as an effective instructional tool for students (Shuler, 2012). Even though there are positive impacts and potential shown by iPad-assisted learning, because of its relatively recent introduction and release into the market, there are a limited number of research studies on the effects of the iPad for students with LD.

SUMMARY OF THE CHAPTER

This chapter was designed to investigate the following areas: (a) the importance of building word identification and oral reading fluency in the process of learning to read, and (b) instructional strategies designed to develop word identification and oral reading fluency for struggling readers. In addition, previous studies were reviewed to provide a rationale for use of the iPad as an instructional technology that has potential for improving the word identification and oral reading fluency of elementary students with LD and to justify the use of iPad-assisted instruction in this study. According to the review of the literature, word identification and oral reading fluency are critical components in learning how to read. Thus, it is necessary to provide effective reading interventions to students with LD to develop the fundamental reading skills for them to

become good readers. Specifically, the uses of word identification strategies and repeated reading have been consistently suggested as effective teaching methods for students with LD in developing their word identification and oral reading fluency skills. The use of the iPad in classrooms and its potential as a promising instructional technology for reading has been reviewed. Previous studies reported several advantages of using the iPad in education (e.g., portability, accessibility, smaller-size, touch screens, multimedia features, immediate feedback, over 40,000 education applications), especially in reading (e.g., built-in dictionary, text-to-speech feature, adjustable font sizes, sufficient and various reading materials). Because of the recent introduction of the iPad and its release into the market, there have been a limited number of studies investigating the effectiveness of the iPad on improving the reading skills of students with LD.

Chapter 3: Method

OVERVIEW

According to the National Center for Education Statistics (2011), although 30% of students without disabilities were below basic readers, up to 68% of students with disabilities read below the basic level on the National Assessment of Educational Progress (NAEP) in reading. Additionally, over 40% of fourth-grade students were rated as "non-fluent" readers who displayed difficulty in reading simple phrases and relating what they read to the main context of the passage (Daane, Campbell, Grigg, Goodman, & Oranje, 2005).

Students with RLD experience enormous challenges in learning to read, especially in word identification (Ayala & O'Connor, 2013; Gustafson et al., 2011; Jenkins, 2002) and in oral reading fluency (Chard et al., 2002; Shaywitz & Shaywitz, 2008; Vaughn & Linan-Thompson, 2004). Children who do not acquire fluent reading skills in elementary school encounter higher reading demands in later education and are thereby at increasing disadvantages in the workplace and society (Torgesen, 2000). Despite the higher curricular demands on upper elementary students and the low performance of many upper elementary struggling readers with basic literacy, however, fluency instruction for these students has been relatively neglected (Denton, Wexler, Vaughn, & Bryan, 2008). In addition to the reading approaches already available to students in school, tablet computers have recently emerged as an effective tool for improving the reading skills of struggling readers.

Therefore, the purpose of this study was to examine the extent to which two procedures (i.e., teacher-directed instruction and iPad-assisted instruction) were associated with improving the word identification and oral reading fluency performance of 5th graders with RLD. The following research questions guided this study:

1. Which instructional procedure, teacher-directed instruction (TDI) or iPad-assisted instruction (IAI), is more effective in increasing the word identification performance of 5th grade students with RLD?
2. Which instructional procedure, TDI or IAI, is more effective in improving the oral reading fluency performance of 5th grade students with RLD?
3. How do 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention?
4. How do 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to their reading comprehension?
5. What are the perspectives of 5th grade students with RLD about TDI or IAI after the intervention?
6. What are the perspectives of 5th grade students with RLD toward reading?

This chapter describes the methodology for this study, including (a) the setting and participants, (b) research design, (c) measures, (d) procedure and data collection, (e) data analysis, and (f) social validity.

SETTING AND PARTICIPANTS

School

This study took place in an elementary charter school in central Texas. The school served students from prekindergarten through grade 5. In the school district, a total of 8.7% of students were African American, 60.2% were Hispanic, 24.9% were White, and 6.2% were another ethnicity. Within this population, 63.8% of the students had low socioeconomic status, 23.3% had Limited English Proficiency (LEP), and 10.1% of students were in special education. The elementary school was a Title I school according

to the number of students (70%) who received free/reduced-price lunch. The school's demographics included an 87% ethnic minority.

Intervention setting

All intervention sessions occurred during the school day in the resource room. Students attended the resource room to receive academic instruction according to their IEPs. They spent the majority of the school day in the general education classroom. The researcher worked closely with the classroom teacher and campus staff and completed all sessions of the pullout tutoring. Each intervention session lasted 30 minutes, four or five days a week from 9:25–9:55 in the morning for two students (i.e., Students 3 and 4) in Group 2 and during lunch (11:55–12:25) for the other two students (i.e., Students 1 and 2) in Group 1.

Participant selection

A multistep selection process was conducted to ensure the student sample in the study is the most appropriate sample for examining the research questions. To complete the participant selection, the following inclusion criteria were included:

1. The student was in 5th grade and was classified as having a learning disability.
2. The student had at least one objective addressing their reading skills on their IEP.
3. The student scored below average on standardized tests of reading administered by the school (i.e., has standard scores of less than 90 on either the Woodcock-Johnson III Tests of Achievement [WJ III ACH] (Woodcock, McGrew, & Mather, 2001) or the Wechsler Individual Achievement Test - 2nd Edition [WIAT II] (Wechsler, 2005).

4. The student scored at least 80 the Word Attack subtest. It placed raw scores in a normal distribution that had a mean of 100 and a standard deviation equal to 15.
5. The student had less than 166 WCPM on the EasyCBM reading passage for his/her grade level.
6. The student had 90% or more attendance during the previous academic year.

Finally, four students who met the criteria were selected to participate in this reading intervention study based on their special education teacher's recommendation. A parental consent form was sent home and all consent forms were obtained. The students also signed their consent forms.

Student 1 (Group 1)

Student 1 was a Hispanic male. At the start of the intervention, he was 11 years, 2 months old. During this study, he received reading intervention with his peers in the resource room during lunchtime from Monday through Thursday. He achieved 43% of the middle-of-year reading benchmark score and obtained a raw score of 15 and a standard score (68% Band) of 87 (85–90) on the WJ-III Word Attack test during baseline.

He had participated in a similar reading study in the previous school year. Because the EasyCBM passages were used for progress monitoring in the previous study, different passages (i.e., passages from Project AIM) were used for the assessment to identify student instructional reading levels. On the assessment (Project AIM passages) of the instructional reading level, he read 44 words per minute on the third-grade-level passage with an accuracy of 94% and read 37 words per minute on the fourth-grade-level passage with an accuracy of 88%. On the EasyCBM reading passage for his grade level (5^{th}), he read 69 words per minute, which met the 5^{th} participant selection criterion (i.e.,

the student acquired less than 166 WCPM on the EasyCBM passage reading at his/her grade level). His instructional reading level was identified as being at the third grade level. His teacher reported that he was very well behaved and completed class work but had lots of anxiety and his tests were very poor.

Student 2 (Group 1)

Student 2 was a Hispanic male. At the start of the intervention he was 11 years, 2 months old. He also received reading intervention with his peers in the resource room during lunchtime from Monday through Thursday. He achieved 35% of the middle-of-year reading benchmark score and obtained a raw score of 16 and a standard score (68% Band) of 88 (86–91) on the WJ-III Word Attack test during baseline.

He was also one of the participants who attended a similar reading study in the previous school year. On the assessments for the instructional reading level, he read 43 words per minute on the third-grade-level passage with an accuracy of 90% and read 38 words per minute on the fourth-grade-level passage with an accuracy of 64%. His instructional reading level was identified as being at the third grade. On the EasyCBM reading passage for his grade level (5^{th}), he read 80 words per minute. His teacher reported that he thrived on positive reinforcement and was very competitive, but he was very emotional, saying that answering first was more important to him than getting the answer right.

Student 3 (Group 2)

Student 3 was a Hispanic female. At the start of the intervention she was 11 years, 1 month old. She received reading intervention with her peers in the resource room in the morning (8:55–9:25 A.M.) from Monday through Thursday and more intensive instruction with Student 4 for the next period (9:25–9:55 A.M.) of the day; the

interventions for Group 2 occurred from 9:25–9:55 A.M. She achieved 41% on the middle-of-year reading benchmark score and obtained a raw score of 11 and a standard score (68% Band) of 82 (79–85) on the WJ-III Word Attack test during baseline.

She was also one of the participants who attended a similar reading study in the previous school year. On the assessments for the instructional reading level, she read 54 words per minute on the third-grade-level passage with an accuracy of 92% and read 48 words per minute on the fourth-grade-level passage with an accuracy of 76%. Her instructional reading level was identified as being at the third grade. On the EasyCBM reading passage for her grade level (5^{th}), she read 78 words per minute. Her teacher reported that she thrived on positive reinforcement and had a creative imagination; she had serious processing problems, doubted herself and her ability, and lacked focus.

Student 4 (Group 2)

Student 4 was a Hispanic male. At the start of the intervention he was 10 years, 7 months old. He received reading intervention with his peers in the resource room in the morning from Monday through Thursday, followed by a more intensive reading instruction with Student 3 during the next class period; the intervention for the current study occurred during this next period. He achieved 28% of the middle-of-year reading benchmark score and obtained a raw score of 14 and a standard score (68% Band) of 88 (85–90) on the WJ-III Word Attack test during baseline.

He did not attend the reading study held during the previous school year but he had already used an iPad during the reading instruction taught by his special education teacher in the resource room. On the assessments for the instructional reading level, he read 55 words per minute on the third-grade-level passage with an accuracy of 92% and read 42 words per minute on the fourth-grade-level passage with an accuracy of 84%. His

instructional reading level was identified as being at the third grade. On the EasyCBM reading passage for his grade level (5th), he read 84 words per minute. His teacher reported that he did not show how capable he was; he sometimes worked very hard and tried and other times did little and only guessed and even admitted to not trying. Table 3.1 provides demographic and testing information for the four participating students.

Category \ Student	1	2	3	4
Age	11 years	11 years	11 years	10 years
Grade	5	5	5	5
Gender	Male	Male	Female	Male
Ethnicity	Hispanic	Hispanic	Hispanic	Hispanic
Home language	English	English	English	English
Free/reduced lunch	Free lunch	Reduced lunch	N/A	N/A
Standard score	(WJ III)	(WIAT II)	(WIAT II)	(WJ III)
Basic reading	77	79	69	85
Reading fluency	85	66	N/A[1]	81
Comprehension	76	66	77	73
Disability	RLD	RLD	RLD	RLD
Areas of difficulty	Reading	Reading	Reading	Reading

Note. RLD = reading learning disabilities; WJ III = Woodcock-Johnson III Tests of Achievement; WIAT II = Wechsler Individual Achievement Test - 2nd Edition; N/A = not applicable.

Table 3.1. Demographic and Testing Profiles of Participating Students

[1] Student 3's oral reading fluency subtest was not included in the reading composite score due to an examiner error. Therefore, a qualitative interpretation of her performance was reported; she read about 59 WCPM on the DIBELS reading test, which is below average for her age. Her accuracy was relatively low.

RESEARCH DESIGN

A single-case, alternating treatments design combined with a multiple baseline design across participants was used for the study. Once the baseline was stable, the interventions were introduced using a multiple baseline across participants design with alternating conditions. TDI and IAI were conducted in an alternating order during the intervention phases and were staggered across the participant groups. Each group consisted of two participants; each student was randomly assigned to a group. Students 1 and 2 were in Group 1, and Students 3 and 4 were in Group 2. One session was conducted each day, four or five days per week.

Alternating treatments design (Barlow & Hayes, 1979; Holcombe, Wolery, & Gast, 1994; Kennedy, 2005) was used to compare the treatments. One of the primary advantages of the design is that it allows rapid alternation between the two treatments (Barlow & Hayes, 1979; Myers & Hansen, 2011). In addition, the design is useful when a researcher is examining more than one treatment for a particular condition and wants to determine which treatment is more effective (Mertens, 2009). In this study, the alternating treatments design allowed for the examination of the relative effectiveness of two different instructional approaches in improving the word identification and oral reading fluency skills of four students with RLD.

A similar design (i.e., alternating treatments design combined with a multiple baseline design) was used in previous single-case reading studies for students with special needs. Waugh, Alberto, and Fredrick (2011) employed the design to examine the effects of error correction versus no error correction on the effectiveness and efficiency of simultaneous prompting on the acquisition of sight words by three students with moderate intellectual disabilities. Following a baseline phase, the two independent variables were counterbalanced. Similarly, Sterling, Robinson, and Skinner (1997)

employed the design to evaluate the effects of two taped-words interventions (i.e., rapid-paced and slow-paced) on sight-word reading accuracy of elementary students with mental retardation. During the treatments phase, each participant was exposed to rapid- and slow- paced interventions in counterbalanced order across sessions. The design was also used in a reading comprehension intervention. Mucchetti (2013) examined the impact of teacher-led adapted shared reading activities on student engagement and story comprehension of children with autism. In the study, three types of books were presented in an alternating order during both baseline and intervention phases, staggered across participants.

In the present study, the two instructional approaches (i.e., TDI and IAI) were conducted 11 times each within a randomly determined sequence for a total of 22 sessions. According to Kratochwill et al. (2010), an alternating treatments design requires five repetitions of the alternating sequence to meet the standards suggested by the "What Works Clearinghouse (WWC);" the design with 11 repetitions in this study was sufficient to meet these standards. To minimize the potential carryover effects that may occur in the alternating treatments design (Dallery, Cassidy, & Raiff, 2013; Kostewicz & Kubina, 2010), the order of the treatments was assigned in a counterbalanced order (Myers & Hansen, 2011). Regarding the criteria for designs that meet evidence standards, Kratochwill et al. also noted that a phase must have a minimum of three data points to demonstrate an effect. In the study, data collection during baseline phase continued until stable baselines were established.

Independent variable

The independent variable of this study was the two types of reading interventions: TDI and IAI. Both reading interventions consisted of two main components: (a) practices

for word identification and (b) practices for oral reading fluency. TDI involves a multi-syllable word identification strategy called SPLIT (Bryant et al., 2008) and partner reading. IAI involved three iPad applications: two applications for building word identification and one application for improving oral reading fluency.

Dependent variable

Table 3.2 summarizes the dependent variables for each research question for this study. For research questions 1 and 2, easyCBM one-minute probes (Alonzo, Tindal, Ulmer, & Glasgow, 2006) were used as a dependent measure.

During the 2012–2013 school year, the criterion-related evidence from the EasyCBM reading (for Grade 2–5) measures was provided by examining its relation to another published set of measures with known reliability and validity (i.e., Dynamic Indicators of Basic Early Literacy Skills [DIBELS]). Data collected from 882 students in grade 2 through grade 5 from ten elementary schools in Oregon showed strong correlation between the EasyCBM fluency-based measures and the DIBELS Oral Reading Fluency measure ($r > .80$).[2]

Specifically, for research question 1, word identification was measured through an easyCBM word reading fluency (WRF) probe that has decodable and sight words at the instructional reading level of the students. For research question 2, oral reading fluency was measured through an easyCBM passage reading fluency (PRF) probe that has narrative stories at the instructional reading level of students. Samples of easyCBM WRF and PRF are provided in Appendices B and C. Students were given one minute to read as many words as they could on the easyCBM WRF and PRF probe.

[2] Pearson Correlation coefficient (r)

Research Questions	Dependent Variable	Measures
1. Which instructional procedure, teacher-directed instruction (TDI) or iPad-assisted instruction (IAI), is more effective in increasing the word identification performance of 5th grade students with RLD?	Word identification	EasyCBM 1-minute Word Reading Fluency, Word Attack subtest of the WJ-III
2. Which instructional procedure, TDI or IAI, is more effective in improving the oral reading fluency performance of 5th grade students with RLD?	Oral reading fluency	EasyCBM 1-minute Passage Reading Fluency
3. How do 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention?	Word identification and oral reading fluency	EasyCBM 1-minute Word Reading Fluency and Passage Reading Fluency
4. How do 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to their reading comprehension?	Reading comprehension	Paragraph Construction subtest of TORC-4
5. What are the perspectives of 5th grade students with RLD about TDI or IAI after the intervention?	Perspectives about TDI and IAI	Student interview
6. What are the perspectives of 5th grade students with RLD toward reading?	Perspectives about reading	Researcher-developed perspective questionnaire, "Perspectives about Reading"

Table 3.2. Research Questions, Dependent Variables, and Measures

The total score was calculated using the number of words attempted minus the number of words pronounced incorrectly. An incorrectly read word was defined by one

or more of the following five types of errors: (a) individual words mispronounced according to standardized letter-sound correspondence, (b) words omitted or skipped, (c) words substituted for another word, (d) words repeated more than once, (e) the insertion of additional words, and (f) word or letter reversal (i.e., letters or words within a phrase) (Rasinski, 2004). If the student makes an error but then self corrects within three seconds, the assessor writes "SC" above the word and it is not counted as an error (Alonzo & Tindal, 2012).

Instructions for administering and scoring the easyCBM WRF and PRF from the easyCBM Teachers' Manual are provided in Appendices D and E. Nine alternate forms of the probe were administered from Forms 1 through 9. To make sure the reading levels of the passages in easyCBM PRF are appropriate for each grade-level, the Flesch–Kincaid readability of 36 passages from grade 1 through grade 4 was calculated (see Appendix F). EasyCBM probes were audio-recorded for double-checking by two raters. For research question 3, easyCBM WRF and PRF probes were used to examine if the students maintained their word identification and oral reading fluency in one week and two weeks after the end of the intervention. For research question 4, the Paragraph Construction subtest of the *Test of Reading Comprehension – Fourth Edition* (TORC-4; Brown, Hammill, & Wiederholt, 2009) was administered to determine if the students generalized their improvements in word identification and oral reading fluency to reading comprehension.

Dependent variables for research questions 5 and 6 are the students' perspectives about the intervention and their own reading abilities. For research question 5, social validity data was collected to determine student preferences for the two procedures administered. For research question 6, researcher-developed perspective questionnaire, "Perspective about Reading," was administered.

Experimental control

In single-case research designs, experimental control for threats to internal validity confirms a functional relationship between a manipulation of the independent variable and change in the dependent variable (Horner et al., 2005). In this study, an alternating treatments design combined with a multiple baseline design was used to examine the effectiveness of different instructional interventions to improve word identification and fluency skills for four elementary students with RLD. In the alternating treatments design, experimental control is established if the results show clear visible differentiation between treatments (Kennedy, 2005; Leslie & O'Reilly, 1999). Thus, for research question 1, the experimental effect of TDI or IAI on word identification is demonstrated if participants' improvements in word identification on daily probes (i.e., through easyCBM WRF) show clear visible differentiation between the two instructional procedures (i.e., TDI and IAI). Similarly, for research question 2, the experimental effect of TDI or IAI on oral reading fluency is demonstrated if there are clear visible differentiations between the participants' improvements in oral reading fluency on daily probes (i.e., easyCBM PRF) for the two instructional procedures (i.e., TDI and IAI).

MEASURES

Pretest

Prior to the baseline phase, each student was administered the Word Attack subtest of the WJ-III (Woodcock et al., 2001) to identify his/her knowledge of phonics-related skills. The subtest measured phonic and structural analysis skills regarding the pronunciation of unfamiliar printed words. The participants were required to read aloud a list of decodable nonwords of increasing difficulty. Specifically, the initial items required students to produce the sounds for single letters. The remaining items required the student

to read aloud letter combinations that are phonically consistent or regular, patterns in English but are nonwords or low-frequency words. A native English-speaking rater who holds a Master's degree in special education and has experience with administering the WJ-III graded the Word Attack subtest.

Dependent variable reading probes

EasyCBM one-minute WRF and PRF probes were used as the dependent measurement for reading data collection. The easyCBM WRF probe has increasingly difficult items that begin at the primer level and progress to the 8th level. Nine alternate forms of the probe were administered from Forms 1 through 9. Students were given one minute to read as many words as they can. The total score is the number of words attempted minus the number of words pronounced incorrectly.

Word identification

The easyCBM WRF probe that was used for the study has decodable and sight words at the instructional reading level of the students. In the 60-second timed test, students read as many words as possible aloud, moving left to right in the row and then down to the next row on the sheet of paper. When a student made errors (e.g., any word that was read incorrectly, replaced, or mispronounced) or skipped a word, the word was scored as incorrect; a student's self-corrections (i.e., making an error and then self-correcting within three seconds) and words read correctly were counted as correct. If the student was unable to read any words in the first three rows, the test was discontinued. If the student skipped a word or an entire row, the researcher helped the student find the right place. In the technical manual of the easyCBM, reliability coefficients of alternate forms for level 3 are reported from .87 to .93 (median = .91) for the WRF probes.

Oral reading fluency

The easyCBM PRF probe used for the study has narrative stories at the instructional reading level of the students. Students were given one minute to read as many words as they can. The total score is the number of words attempted minus the number of words pronounced incorrectly. In the technical manual of the easyCBM, alternate forms reliability coefficients for level 3 are reported from .94 through .95 (median = .94) for the PRF probes. The researcher followed along on her test protocol and marked as errors any words skipped or read incorrectly. If the student paused more than three seconds on a single word, the researcher provided the word and considered it as incorrect; a student's self-corrections were counted as correct. The score (i.e., total words read correctly) was calculated by subtracting the number of errors made from the total words read. The maximum total score was approximately 250 words. The native English-speaking rater graded all assessments.

Maintenance testing

Maintenance testing for WRF and PRF took place for one to two weeks after the end of the intervention. Students were assessed four times over the two-week period. The purpose of the maintenance testing was to determine whether the TDI and IAI influenced the students' performances on word identification and oral reading fluency over time. If students used Form 1 in the last intervention session, they were assessed with Form 2 for the first maintenance test and Form 3 for the second maintenance test. The students' scores on the easyCBM WRF and PRF were calculated and audio-recorded.

Generalization measure

Generalization testing occurred once two weeks after the end of the intervention, when the Paragraph Construction subtest of the TORC-4 (Brown et al., 2009) was

administered. TORC-4 is a newly revised version of TORC-3, which features fewer subtests, new normative data for testing a student's silent reading comprehension, and updated vocabulary. TORC-4 helps teachers and educators identify and document the progress of students who need help in improving their reading skills. There are five subtests (i.e., Relational Vocabulary, Sentence Completion, Paragraph Construction, Text Comprehension, and Contextual Fluency), one of which, the Paragraph Construction subtest, was used for this study.

To assess reading comprehension, the Paragraph Construction subtest asked students to rearrange sentences to form a coherent paragraph after they had silently read a list of sentences that are not in logical order. For example, a student read sentences that were not in the right order (e.g., A. Then I will eat dinner, B. I eat in the morning, and C. Next I will eat lunch) and reorganized the sentences in the order that made the most sense. The TORC-4 provides standard scores, percentiles, as well as a reading comprehension index. The TORC-4 is a norm-referenced test on a standardization sample of 1,942 students in 14 states. The subtest coefficients range from .90 to .98 with test-retest reliabilities ranging from .82 to .95. The validity of the TORC-4 is confirmed by criterion-prediction validity (i.e., the effectiveness of a test in predicting a student's performance in specific tasks) and construct-identification validity (i.e., the degree to which primary traits of a test can be identified and to which these traits reflect the assumptions on which the test is based).

Inter-rater agreement

Inter-rater agreement is defined as the percentage of agreements by dividing the number of agreements by the sum of agreements plus disagreements multiplied by 100. High scores, which are close to one (i.e., 100%), indicate that definitions for coding are

sufficiently clear (Ellis, 2010). One native English-speaking rater scored all of assessments, including pre-tests, daily probes, maintenance tests, and the generalization measure. The second rater (i.e., the researcher) independently scored at least 20% of randomly selected assessment forms in each of the baseline, intervention, and maintenance phases to determine the inter-rater agreement for each participant. Inter-rater reliability was achieved at 100% on the day of training. Throughout the study (i.e., baseline, intervention, and maintenance), inter-rater agreement was above 90% on the instructional probes across the three phases. In instances where inter-rater agreement was less than 100%, the two raters immediately discussed matters until they reached agreement.

PROCEDURE AND DATA COLLECTION

Training of students

Prior to the study, the researcher met with the students to provide an overview of the study and introduce the iPad applications to the students. After seeing the researcher model application procedures using the iPad, the students practiced logging in, finding and opening each iPad application, beginning and ending each application activity, and saving the results of their work. The researcher provided assistance to students when the students had any problems or difficulties (e.g., making transitions from one activity to another, finding the right application for each activity). At the end of the training session, the researcher answered questions from the students.

Reading intervention routines

Prior to the baseline phase, the Word Attack subtest was administered to identify student knowledge of phonics-related skills. Because the syllable pattern strategy was phonics-related, it was important that students possess knowledge of letter-sound

correspondence. Reading passages from Project AIM[3] were administered to identify the independent, instructional (i.e., highest-level passage with 90% or above accuracy), and frustration levels for each student, and thus identify proper passages to be used during the intervention.

During the baseline phase, the WRF and PRF tests were administered to record and chart WCPM for individual words and WCPM for the connected text. The testing continued until stable baselines for each dependent variable (i.e., word identification and oral reading fluency) was established. Each probe of WRF and PRF was scored immediately after the intervention and double-checked by the native English-speaking rater (i.e., the first grader) and the researcher (i.e., the second grader). The total number of WCPM for individual words and the connected text served as the raw scores that were recorded and plotted for each student.

After the baseline is established, interventions took place for 30 minutes per day for 22 days, divided into four phases (i.e., Phases 1 through 4). Phase 1 involved 14 minutes of phonics instruction (i.e., syllable patterns) administered either by TDI or IAI by the researcher. Phase 2 involved the administration of a one-minute word easyCBM WRF probe by the researcher. Phase 3 involved either Partner Reading (i.e., TDI) or a fluency-building IAI. Phase 4 involved the administration of a one-minute timed reading passage using the easyCBM PRF test.

During Phase 1, the researcher conducted the TDI lessons that involved a multi-syllable word identification strategy called SPLIT (Bryant et al., 2008). SPLIT consists of five steps that call for students to: (1) S—See the syllable types, (2) P—Place a line between the syllables, (3) L—Look at each syllable, (4) I—Identify the syllable sounds,

[3]http://terpconnect.umd.edu/~dlspeece/cbmreading/studentmat/grade3/

and (5) T—Try to say the word. The TDI lessons during Phase 1 focused on four syllable patterns: closed syllables (e.g., at, -og), vowel pairs syllables (e.g., eat, -ain), vowel-r syllables (e.g., or, -ir), and vowel-consonant-e syllables (e.g., ace, -ite). The SPLIT poster is provided in Appendix G. The four syllable patterns were selected because the same patterns were available on the iPad applications used in the IAI lessons. During Phase 2, the researcher administered a one-minute word easyCBM WRF probe.

During Phase 3, partner reading as an instructional approach was implemented for the TDI lessons targeting oral reading fluency. The researcher paired students with partners based on their reading levels because two partners shared and read the same reading passage. Partner 1 read aloud a passage of his/her instructional level for 3 minutes as Partner 2 followed along. Before students read a passage, the researcher asked the students to assist their partner if his/her partner struggles with reading the passage. The researcher timed the reading and provided assistance when students had difficulties with unknown words in a passage. Partner 2 then read aloud the same passage for three minutes as Partner 1 followed along. Partner 1 then read for 1 minute, followed by Partner 2. The researcher counted the WCPM and graphed reading performance for each day. Passages read during Phase 3 were selected from Project AIM and were used with permission from the lead principal investigator. Before implementing passages from Project AIM, Flesch–Kincaid readability was checked, and only passages that were appropriate for the students' instructional levels were used. During Phase 4, the researcher administered a one-minute word easyCBM PRF probe.

Maintenance testing for WRF and PRF took place for one to two weeks after the end of the intervention. The researcher assessed the students four times over the two-week period. The researcher administered the generalization testing (i.e., the Paragraph

Construction subtest of the TORC-4; Brown et al., 2009) once two weeks after the end of the intervention.

Baseline

During the baseline phase, the participants were administered the WRF and PRF tests to identify and chart WCPM for individual words and WCPM for the continuous text. No instruction was provided during the baseline phase. Testing continued until stable baselines for each dependent variable (i.e., word identification and oral reading fluency) were obtained.

Probes for each dependent variable was scored immediately after participants finish the probes and were graded by two raters for double-checking. If the two raters found any differences between scores, they reconciled the scoring and plotted the raw scores. The total number of WCPM for individual words and the continuous text served as the raw scores that were plotted for each student.

Intervention

The 30-minute intervention was implemented in the resource classroom four or five days a week for 22 days. For word identification, four syllable patterns (i.e., closed syllables, vowel pairs syllables, vowel-r syllables, and vowel-consonant-e syllables) were taught through both TDI and IAI. From lesson 1 to lesson 4 of each TDI and IAI lesson, two syllable patterns to be taught in each session were selected and counterbalanced. During TDI and IAI lessons 5 to 11, all four types of syllable patterns were reviewed together. After 11 TDI and IAI lessons, students were able to learn all four types of syllable patterns. For oral reading fluency, one reading passage at the instructional level was implemented in each session, and different passages were selected for every session.

At the end of each session, the students received small character stickers as reinforcement for participation.

Prior to the intervention, the researcher randomly assigned four students to two groups and created an instructional schedule for both TDI and IAI. The instructional schedules for Group 1 and Group 2 are presented in Table 3.3 and 3.4. To randomly assign an instructional procedure (i.e., TDI or IAI), a regular six-sided die was used. Thus, at the end of the 22-day intervention period, all students received, based on random assignment, 11 different instructional procedures to teach word identification and oral reading fluency.

Sessions	Instructional procedures	Sessions	Instructional procedures
1	TDI	12	IAI
2	IAI	13	TDI
3	TDI	14	IAI
4	IAI	15	TDI
5	TDI	16	TDI
6	TDI	17	IAI
7	IAI	18	IAI
8	TDI	19	IAI
9	IAI	20	TDI
10	TDI	21	IAI
11	IAI	22	TDI

Table 3.3. Instructional Schedule for Group 1

Sessions	Instructional procedures	Sessions	Instructional procedures
1	IAI	12	IAI
2	TDI	13	TDI
3	IAI	14	IAI
4	TDI	15	TDI
5	TDI	16	TDI
6	IAI	17	IAI
7	IAI	18	IAI
8	TDI	19	TDI
9	IAI	20	IAI
10	TDI	21	TDI
11	IAI	22	TDI

Table 3.4. Instructional Schedule for Group 2

Teacher-directed instruction (TDI)

The TDI consisted of seven 30-minute sessions that was taught for four or five days a week over six weeks. The word-reading lesson based on a multisyllabic word identification strategy (i.e., SPLIT) was administered for the first 14 minutes and was followed by the passage-reading lesson for the second 14 minutes. For word identification, each lesson consisted of five segments: (a) Preview: students were provided in advance with an organizer and were informed about what they learn; (b) Engage Prior/Informal Knowledge: students reviewed syllable patterns taught in the previous session using CO3V Poster (see Appendix H), which presents six syllable patterns; (c) Demonstrate: students marked a slash mark (/) between the syllables and identified each syllable pattern on the word list; (d) Practice: students practiced

identifying words on the word list; and (e) Independent Practice: students read a one-minute probe. During lessons 1 and 3, two different syllable patterns of the four syllable patterns (i.e., closed syllables, vowel pairs syllables, vowel-r syllables, and vowel-consonant-e syllables) were taught in each lesson. During lessons 2 and 4, students reviewed what they have learned in the previous lesson (i.e., lesson 1 for lesson 2, and lesson 3 for lesson 4) and read a short passage, which contained at least one of each one-, two-, or three-syllable word reflecting the two syllable patterns taught in the previous lesson. During lessons 5 to 11, students reviewed all four syllable patterns and identify multisyllabic words with the SPLIT strategy. Word identification lesson 4 is provided in Appendix I.

For the oral reading fluency activity for TDI (i.e., partner reading), each lesson consisted of four segments: (a) Preview, (b) Engage Prior/Informal Knowledge: students read high frequency sight words, (c) Practice: students read a passage in their instructional level for three minutes using partner reading, and (d) Independent Practice: students read the same passage for 1 minute. Oral Reading Fluency lesson 4 is provided in Appendix K. In partner reading, Partner 1 read a passage aloud for three minutes first and Partner 2 followed along on his or her copy of the assigned passage. Partner 2 then read aloud the same passage for three minutes as Partner 1 followed along. Then Partner 1 read aloud again for 1 minute as the researcher monitored time and counted the number of WCPM on a reading passage, and then Partner 2 followed the procedure. At the end of the lesson, the researcher administered the one-minute PRF probe. Prior to intervention, students were paired up with their partner according to their reading level evaluated during the pretest by the researcher. Partners shared the same reading passage. A sample reading passage from the Project AIM and a lesson for oral reading fluency are provided in Appendix J.

iPad-assisted instruction (IAI)

Prior to the intervention, students had an orientation session for 30 minutes and received a brief training on how to use the iPad (e.g., opening and operating three reading applications). Throughout the IAI lessons, students wore headphones in order to not disturb other students and they were asked not to talk each other. For IAI, three reading iPad applications were used: *K12 Timed Reading Practice* (K12 Inc., 2010) for oral reading fluency, and *Howie Finding Vowel* (PlaySmart-Kids, 2012) and *ABC Phonics Word Family Writing* (Hien Ton, 2011) for word identification. The two apps used for word identification were implemented based on the instructional schedule, which is presented in Table 3.5.

Sessions	Syllable Patterns	Applications	What to Teach
1	• Closed • V-c-e	• *Find Vowel* • *ABC Writing*	• Level 1: Short vowels • -ake, -ale, -ame, -ape-, -ate, -ice, -ide, -ine, -oke
2	• Closed • V-c-e	• *Find Vowel* • *ABC Writing*	• Level 1: Short vowels • -ake, -ale, -ame, -ape-, -ate, -ice, -ide, -ine, -oke
3	• V-r • V-pairs	• *Find Vowel* • *ABC Writing*	• Level 3: Bossy R's • -ain, -ail, -eat, -eel, -een, -eep, -eet, -oat, -oot
4	• V-r • V-pairs	• *Find Vowel* • *ABC Writing*	• Level 3: Bossy R's • -ain, -ail, -eat, -eel, -een, -eep, -eet, -oat, -oot
5-11	• Closed • V-c-e • V-r • V-pairs	• *Find Vowel* • *ABC Writing* • *Find Vowel* • *ABC Writing*	• Level 1: Short vowels • -ake, -ale, -ame, -ape-, -ate, -ice, -ide, -ine, -oke • Level 3: Bossy R's • -ain, -ail, -eat, -eel, -een, -eep, -eet, -oat, -oot

Table 3.5. Apps Schedule

K12 Timed Reading Practice is an application that allows students who are in grades K-4 to practice fluency by reading short, timed stories. The application includes more than 250 short stories and poems that are grouped by grade-level and Flesch-Kincaid reading levels (between 0.0 and 4.7) (see Figure 3.1). Before students received any instruction, the researcher set-up the grade-level based on the students' instructional reading levels identified in the PRF pretest so that the students could read appropriate passages. The researcher identified the readability (i.e., Flesch-Kincaid reading levels) of passages in the students' instructional reading levels.

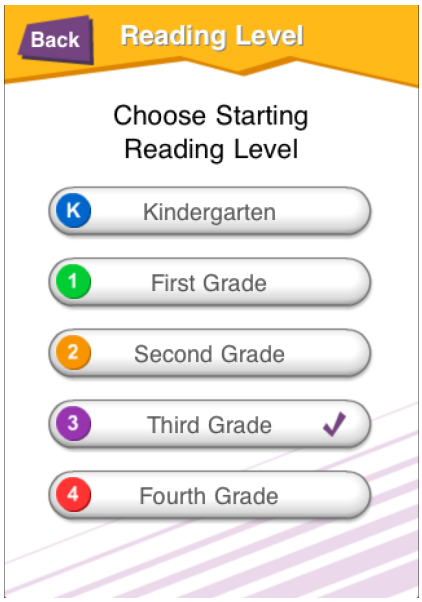


Figure 3.1. Overview of *K12 Timed Reading Practice*

The application allowed the researcher to keep track of the stories read and how many words per minute the students achieve (see Figure 3.2). Students were asked to save their results (i.e., words per minute) before moving to the next story. Before the first reading, the researcher asked the students to try to use their knowledge of letter sounds to identify a word when they came across an unknown word or a difficult word in a story.

Given that the application allowed the researcher to keep track of the stories that students read, the students could continue to read the next story in their instructional reading level in the following session.

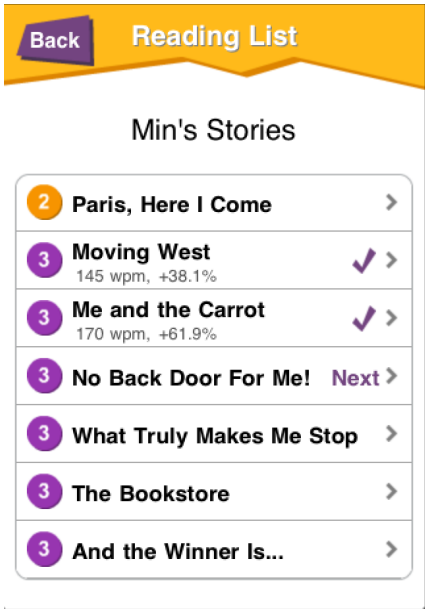


Figure 3.2. Functions of *K12 Timed Reading Practice*

ABC Phonics Word Family Writing focuses on word families (i.e., similar phonics spelling patterns) to help students improve their word identification skills. Students used the application to learn to read by finding common sounds among a set of presented words. In the study, this application was used for two of the four syllable patterns (i.e., vowel-consonant-e and vowel pairs). During each IAI session, the researcher provided students with an index card that shows a list of sounds to help them easily navigate and find the app section that they practiced in each session. The index card is presented in Table 3.6. For example, for vowel-consonant-e, students were asked to practice only word sets that include -ake, -ale, -ame, -ape-, -ate, -ice, -ide, -ine, -oke, and for vowel

pairs, they practiced word sets including -ail, -ain, -eat, -eel, -een, -eep, -eet, -oat, -oot, which were presented on the students' index cards. On a screen of the application, there was a word list on the left side and a blank section on the right side, on which the students could write each word with their finger and move on to the next word (see Figure 3.3).

Today we are studying	
-ain -ail -eat -eel -een -eep -eet -oat -oot	with *ABC writing*
Level 1: Short vowels	with *Find Vowel*

Table 3.6. Apps Index Card

If students needed to listen to the word pronounced, they clicked the "speak" button at the top of the screen and repeated it if needed. When they finished the last word of the set (e.g., a set of -ake, a set of -ale), they navigated and moved forward until they reached the next set on the index card. Then, they kept working the sets of words until the researcher informed them that it was time to stop working on the application at the end of the time limit.

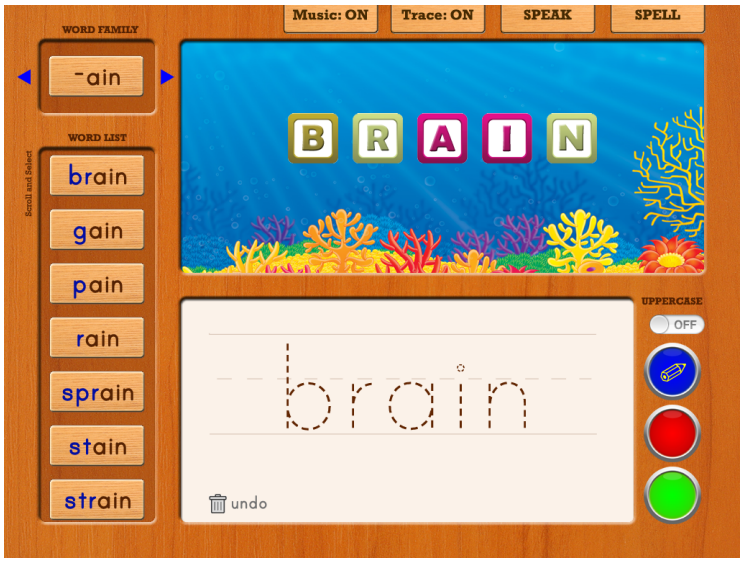


Figure 3.3. Overview of *ABC Phonics Word Family Writing*

The other application utilized for word identification is *Howie Finding Vowel*, a vowel game to improve the students' reading skills by having them distinguish and recognize distinct words (e.g., fan, fin, fine, fun). Students learned new words by using phonics to put sounds together and made them (e.g., /c/ /a/ /t/, cat). Words in the application were sounded out based on common phonics rules such as Short Vowel, Long Vowel, Bossy R's, and other Vowel Team words. In this study, however, the application was used to teach two syllable patterns: Short Vowel and Bossy R's (i.e., Vowel-r). The application includes a set-up option that allowed the researcher to select the types of syllable patterns to be used (i.e., Short Vowel or Bossy R's). In the vowel game of the application, students selected a missing vowel in each word by listening to the word spoken by the program, finding the correct vowel sound(s), and "feeding" a monster (i.e., Howie) a hotdog (see Figure 3.4). The application provided a self-correction feature that allowed students to find the correct answer on their second try (see Figure 3.5).

The researcher selected the instructional content (i.e., types of syllable patterns for word identification instruction and the readability of passages for oral reading fluency instruction) prior to each lesson. During IAI, students worked with each application for about 12 minutes per day. *ABC Phonics Word Family Writing* and *Howie Finding Vowel* were used during the first 12 minutes (six minutes each) of each session, and *K12 Timed Reading Practice* for the succeeding 12 minutes. At the end of each lesson (i.e., word identification and oral reading fluency), the researcher administered the one-minute reading probe (i.e., easyCBM WRF and PRF). A sample IAI lesson is presented in Appendix L.

Figure 3.4. Overview of *Howie Finding Vowel*

Figure 3.5. Self-correction Feature of *Howie Finding Vowel*

Maintenance

The maintenance of TDI and IAI for word identification and oral reading fluency was measured four times for one to two weeks after the end of the intervention. To determine if TDI and IAI influenced the participants' word identification and oral reading fluency over time, the participants worked on two one-minute daily probes, easyCBM WRF and PRF. The daily probes with alternate forms (1-9) administered during the baseline and intervention phases were also used for the maintenance phase.

For example, if a participant used Form 4 in the last intervention session, Form 5 was used for the first maintenance test, and Form 5 was used for the second maintenance test. For the third and fourth maintenance test, Forms 6 and 7 were administered. No instruction was provided in the maintenance phase. Table 3.7 summarizes the procedures and timelines for each student.

Session(s)	Phases	Tasks	Minutes
1	Pretest	• Orientation • Word Attack subtest of the WJ-III and easyCBM PRF	20-25
	Baseline	• EasyCBM WRF and PRF	20
22	Intervention	• Learn Lessons • Daily probes (i.e., easyCBM WRF and PRF)	30
1	Maintenance and Generalization	• Maintenance testing • Generalization measure	25
3	Maintenance	• Maintenance testing	15

Table 3.7. Procedures and Timelines

Fidelity of implementation

Fidelity of implementation was checked four times across the sessions during the 22 days of intervention to evaluate the quality (i.e., fidelity) of specific implementation performance indicators. Quality of Implementation (QoI) indicators were used to present the degree to which the researcher followed scripted procedures (i.e., adherence to the intervention) throughout the TDI and IAI lesson sections.

For the TDI approach, adherence to the scripted lessons was assessed for each segment of the lesson (e.g., Preview, Engage Prior/Informal Knowledge, Practice, Independent Practice). Performance in each segment was rated on a 1- to 4-point scale as follows:

1. Interventionist did not follow the script at all.

2. Interventionist somewhat followed the script (many deviations observed).
3. Interventionist closely followed the script (some deviations observed).
4. Interventionist followed the script exactly.

An overall rating was also assessed, ranging from 1 (Poor) to 4 (Excellent).

For IAI, fidelity was also assessed using the same 4-point Likert-type system as follows:

1. The interventionist provided a review to the students on how to use the iPad and the application.
2. The interventionist let students review skill sets from the previous lesson (e.g., The teacher set-up the application on skill sets learned in the previous session to let students practice at the beginning of the lesson).
3. The interventionist kept monitoring the students' use of the iPad and their work.
4. The interventionist provided appropriate support and feedback (no teaching) when students had questions or problems (see procedures for examples of support and feedback).
5. The interventionist administered the probe and followed the written administration procedures.

An overall rating was also provided for IAI fidelity, ranging from 1 (Poor) to 4 (Excellent). Using a fidelity rating form (see Appendix M), two doctoral students in special education independently rated intervention lessons to establish treatment integrity. All lessons were audio-recorded, and four lessons were randomly selected for procedural reliability testing.

In all cases, scores of 3 or 4 points were awarded in each of the categories. The average fidelity rating for TDI was 97.92% and 98.75% for IAI. Therefore, a high degree

of fidelity was established in the implementation of the two instructional procedures, TDI and IAI.

SOCIAL VALIDITY

Students' perspectives about intervention

Following the completion of the intervention, students were interviewed to determine their preferences on the instructional procedures administered (i.e., TDI or IAI). Six questions were asked:

1. Which did you prefer, the teacher-directed lesson or the iPad-assisted lesson? (Did you like them about the same?)
2. Why did you prefer the lesson? (Why did you like both?)
3. What did you think about the other lesson? What factors made you not choose the other lesson as the better one?
4. Which lesson did you think helped you learn better?
5. Which kept you busier—the teacher-directed lesson or the iPad-assisted lesson?
6. Which one did you look forward to most—the teacher-directed lesson or the iPad-assisted lesson?

Finally, the students were asked if they had any other comments regarding the two methods of teaching that they experienced.

Students' perspectives about reading

To examine changes in the students' perspectives regarding their reading, a questionnaire were given to them before and after the intervention. The questionnaire includes 14 questions regarding their perspectives about their reading performances (e.g., I am a good reader, Reading is interesting and exciting, My friends like reading more

than I do) and asks students to mark an X in the box that is closest to the way they feel. The questionnaire incorporates four types of smiley faces to help students identify their perspectives, ranging from "Yes, definitely!" to "Closer to No." The questionnaire is provided in Appendix N.

DATA ANALYSIS

Visual analysis

Traditionally, single-case researchers have relied on visual analysis to find evidence of any relation between an independent variable and an outcome variable and to determine the strength of the relation (Kennedy, 2005; Kratochwill et al., 2010; Kratochwill et al., 2013).

To evaluate the effects, six features were used to examine the data patterns: level, trend, variability, immediacy of the effect, overlap, and consistency of data patterns across similar phases (Horner, Swaminathan, Sugai, & Smolkowski, 2012; Kratochwill et al., 2010). The six features were examined individually and collectively to determine a causal relation between an independent variable and outcome variable.

First, "level" refers to the central tendency (e.g., mean, median) of the data within a phase (Horner et al., 2005; Horner et al., 2012; Kratochwill et al., 2010; Kratochwill et al., 2013) and is generally calculated as the mean or median (Kennedy, 2005). As an initial assessment of effects, the change in level is evaluated by comparing the level of the first phase to that of the second phase (Horner et al., 2012; Riley-Tillman & Burns, 2009). The level of data within a condition allows for the estimation of the central tendency and for the comparison of patterns between conditions (Kennedy, 2005). Second, "trend" refers to the slope of the straight line that best fits the data within a phase (Horner et al., 2005; Horner et al., 2012; Kratochwill et al., 2010; Kratochwill et al.,

2013). The closer to the trend line the data points within the phase are, the more stable the data are considered to be (Horner et al., 2012). According to Kennedy, there are two elements that must be evaluated for trend: slope and magnitude. Slope is the upward (positive), flat, or downward (negative) inclination of the data within a phase. Magnitude is estimated as high, medium, or low; a high-magnitude slope indicates a rapidly increasing or decreasing pattern of the data. Kennedy suggested two ways of quantitatively estimating the trend: least-squares regression and split-middle technique. Third, "variability" refers to the deviation of the data around the best-fit straight line (Horner et al., 2005; Horner et al., 2012; Kratochwill et al., 2010; Kratochwill et al., 2013). In other words, variability is the degree to which the data points are scattered and is typically referred to as being high, medium, or low (Kennedy, 2005). If the data points are dispersed widely around the trend line, they reflect a data set with high variability.

In addition to considering the level, trend, and variability of data within each phase, the researcher also analyzed the effects by examining the immediacy of the effect, overlap, and consistency of the data in similar phases (Horner et al., 2012; Kratochwill et al., 2010). "Immediacy of the effect" refers to the change in level following the manipulation of an independent variable (Horner et al., 2012; Kratochwill et al., 2010). If more immediate change is observed, it is more compelling that the change in the level has resulted from the manipulation of the independent variable (Kratochwill et al., 2010; Kratochwill et al., 2013; Riley-Tillman & Burns, 2009). The immediacy of the effect is demonstrated when the pattern of data is quickly altered (Kennedy, 2005).

"Overlap" refers to the proportion of data points in Phase 2 that overlaps with the data points in Phase 1 (Horner et al., 2012; Kratochwill et al., 2010). The low overlap of data points suggests the more convincing demonstration of an effect of intervention (Kratochwill et al., 2010). Overlap is typically calculated by the percentage or degree to

which the data points in two phases (e.g., baseline and intervention phases) share similar quantitative values (Kennedy, 2005). Finally, "consistency of data in similar phases" is examined by looking at the data patterns (i.e., level, trend) from phases within the same conditions (Kratochwill et al., 2010). Determining the consistency of data patterns involves an analysis of data from all of the phases within the same or similar conditions (e.g., all baseline phases, all intervention phases). In the study, the consistency of data in similar phases can be examined by looking at data patterns within the baseline phases and intervention phases (i.e., TDI and IAI).

The six features in visual analysis were used to compare the data patterns for each phase with the actual data patterns observed across all phases of the design following the manipulation of the independent variable. The purpose of visual analysis was to examine whether there are at least indications of an effect and build an inference that the change of the outcome variable involves a functional relation with manipulation of the independent variable (Kratochwill et al, 2013). All of the aspects of visual analysis were considered as a package, not in isolation (Riley-Tillman & Burns, 2009).

Most researchers using single-case designs generally apply visual analysis for the inferences of effects, but there have been several quantitative methods proposed (Kratochwill et al., 2010). One of the methods is to find the percentage of non-overlapping data, percentage of all non-overlapping data, or percent exceeding the median.

Non-overlapping data points

The percentage of non-overlapping data (PND) was calculated by counting the data points in the intervention that are higher than the highest data points in the baseline, dividing that by the total number of data points in the intervention and then multiplying

this number by 100 (Kennedy, 2005). Scruggs and Mastropieri (1998) defined effect sizes of PND greater than 70% as effective, between 50% and 70% PND as questionably effective, and less than 50% PND as ineffective. The PND method has three advantages (Scruggs & Mastropieri, 1998). First, it can be calculated using a pencil and ruler on a printed graph. Second, it involves acceptability; PND's overlapping data is involved in most visual analyses. The third advantage is its applicability because the PND is applicable to any single-case design. Scruggs and Mastropieri (2013) also found that the PND could very easily be calculated and achieve a high degree of reliability.

Later, Parker, Hagan-Burke, and Vannest (2007) introduced the idea of finding the percentage of all non-overlapping data (PAND) as an alternative to PND. While both PND and PAND involve non-overlapping data between phases, the PAND uses all of the data from both phases and is calculated by dividing the number of overlapping data points by the total number of data points. For example, if a study included 15 baseline data points and 15 intervention data points, with 3 data points overlapped with the highest baseline data point, then the PAND is calculated by dividing 3 by 30, which equals .10. (i.e., 10% of overlapping data). To compute the percentage of all data that does not overlap, the 10% is subtracted from 100%, which equals 90%. The PAND can be converted to a phi coefficient based on Pearson's *Phi* and Phi^2 (Cohen, 1988). Given sampling distributions of *Phi* and Phi^2, p values and statistical power estimation are available (Cohen, 1988); the PAND can therefore be considered an effect size (Parker & Vannest, 2009). To compute the phi coefficient, however, at least 20 data points are required.

Since the use of the PND was proposed, there have been many efforts in single-case research using the PND and various alternative methods suggested. To date, the PND has led to the most sensible conclusions in a variety of subject areas in single-case

research, so it remains the most useful and versatile out of all of the methods proposed for single-case designs (Scruggs & Mastropieri, 2013).

Along with the non-overlap indices, Parker and Vannest (2009) presented the Non-overlap of All Pairs (NAP) as a new application of the Area Under the Curve (AUC) non-overlap index. All intervention data points were compared to all baseline data points to provide an effect size that appears superior to the other non-overlapping indexes. It offers (a) better discriminability, (b) less human errors, (c) stronger validation by visual judgments and R^2, (d) greater score precision, and (e) narrower confidence intervals (CIs). NAP summarizes data overlap between data points in each phase and reflects the number of comparison pairs that show no overlap, divided by the total number of comparisons (Parker & Vannest, 2009). NAP was calculated for both instructional procedures, TDI and IAI.

Tau-U

To calculate effect sizes, the Tau-U (Parker, Vannest, Davis, & Sauber, 2011) was computed. Tau-U is a recently developed non-overlap method by Parker et al. (2011) as a derivation of Kendall's Rank Correlation and the Mann-Whitney U test between groups. Tau-U combines non-overlap between the phases that control for confounding baseline trend with the trend from within the intervention phase.

To determine the statistical significance for Tau-U values, CI_{90} was used. In the study, statistical significance between Tau-U values was determined by computing $CI_{83.4}$ to test the equality of two parameters if the standard errors are equal (Goldstein & Healy, 1995). According to Goldstein and Healy, two means are significantly different at the 5% level. When the standard errors of two scores are equal, the non-overlapping 83.4% CI is the same as a Z test of the scores at the .05 level (Goldstein & Healy, 1995).

According to Parker et al. (2011), Tau-U offers several advantages to other effect size indexes. It (a) provides more statistical power than any other non-overlap (dominance) index, (b) is consistent with visual analysis, (c) is not affected by the ceiling effect shown by other non-overlap methods, (d) can control the undesirable phase A trend, (e) yields more modest results relative to simple overlap by including the phase B trend, (f) works as an alternative to both regression-based models and to non-overlap models, and (g) is flexible because it calculates trend only, non-overlap between phases only, or both of them together (i.e., trend and non-overlap between phases).

Chapter 4: Results

The purpose of this study was to examine and compare the effectiveness of teacher-directed instruction (i.e., teacher-directed instruction without using an iPad, TDI) and iPad-assisted instruction (IAI) on the word identification and oral reading fluency of 5th grade students with reading learning disabilities (RLD). Following the intervention, maintenance and generalization testing along with two student interviews were conducted; during the interview, four students were asked questions about their perspectives toward the instructional procedures and their reading. This research was guided by the following research questions:

1. Which instructional procedure, TDI or IAI, is more effective in increasing the word identification performance of 5th grade students with RLD?
2. Which instructional procedure, TDI or IAI, is more effective in improving the oral reading fluency performance of 5th grade students with RLD?
3. How do 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention?
4. How do 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to their reading comprehension?
5. What are the perspectives of 5th grade students with RLD about TDI or IAI after the intervention?
6. What are the perspectives of 5th grade students with RLD toward reading?

The results were reported based on standards (with and without reservations) for single-case research designs (SCDs) by Kratochwill et al. (2010). Kratochwill and colleagues suggest the rules to determine whether a study provides (a) *Strong Evidence*, (b) *Moderate Evidence*, or (c) *No Evidence* of a causal relation. If SCDs include at least one instance of a non-effect, the study is categorized as having *Moderate Evidence*.

Demonstrating a non-effect involves the (a) failure to establish consistency in a pattern within any phase, an (b) undesirable overlap between observed and projected patterns of the dependent variable between the baseline and intervention phases, and a (c) long latency between the introduction of the independent variable and a change in the dependent variable that does not demonstrate evidence of a causal relation. However, latency between the introduction of the independent variable and a change in the dependent variable (i.e., immediacy effect) should be analyzed within the context of academic learning especially cognitive strategy instruction; teaching cognitive strategies requires an investment of instructional time for students until the effect is clearly established.

RESEARCH QUESTION 1

Research Question 1 examined the effects of the instructional procedures, TDI and IAI, on increasing the word identification of 5th grade students with RLD. The results suggested that *moderate evidence* (see Kratochwill et al., 2010) was established between the baseline and the intervention. The relative effects of TDI and IAI on word identification were inconsistent across students. Figure 4.1 displays the number of words correct per minute (WCPM) as measured by the EasyCBM word reading probe for word identification. In addition to student performance on word identification, the Word Attack subtest of the Woodcock-Johnson III Tests of Achievement [WJ III ACH] (Woodcock et al., 2001) was administered before and after the intervention; the results are as follows.

Word Attack Subtest of the WJ-III for the Student Sample

In the current study, pre- and post-tests (before and after intervention) of the Word Attack subtest of the WJ-III (Woodcock et al., 2001) were administered. In the Word Attack subtest, a standard score range of 70–79 is considered as "low;" standard score ranges of 80–89 or 90–110 are considered as "low average" or "average,"

respectively. For Student 1, he received a raw score of 15 from both pre-testing and post-testing; his raw score of 15 and standard score of 87 are considered as being "low average." Similarly, there was no difference in raw scores between the pre- and post-testing results for Student 2; his raw score of 16 (from both pre-testing and post-testing) and standard score of 88 are considered as being "low average." Student 3's scores from pre- and post-testing showed some degree of decrease; her standard score of 82 (low average) on the pre-test decreased to 78 (low) on the post-test. Student 4 demonstrated an increase in his raw score from the pre-test to the post-test (i.e., from 14 to 15); however, there was no difference between his standard scores (88, low average) on the pre- and post-tests. Results from the pre- and post-tests of WJ-III Word Attack are presented in Table 4.1.

Student	Pre-test			Post-test		
	Raw	GE	SS (68% Band)	Raw	GE	SS (68% Band)
1	15	2.9	87 (85–90)	15	2.9	87 (85–90)
2	16	3.1	88 (86–91)	16	3.1	88 (86–91)
3	11	2.4	82 (79–85)	9	2.1	78 (75–81)
4	14	2.8	88 (85–90)	15	2.9	88 (86–91)

Note. GE = Grade Equivalent Scores, SS = Standard Score 68% Band

Table 4.1. Results from Pre- and Post-tests of the WJ-III Word Attack for Four Students

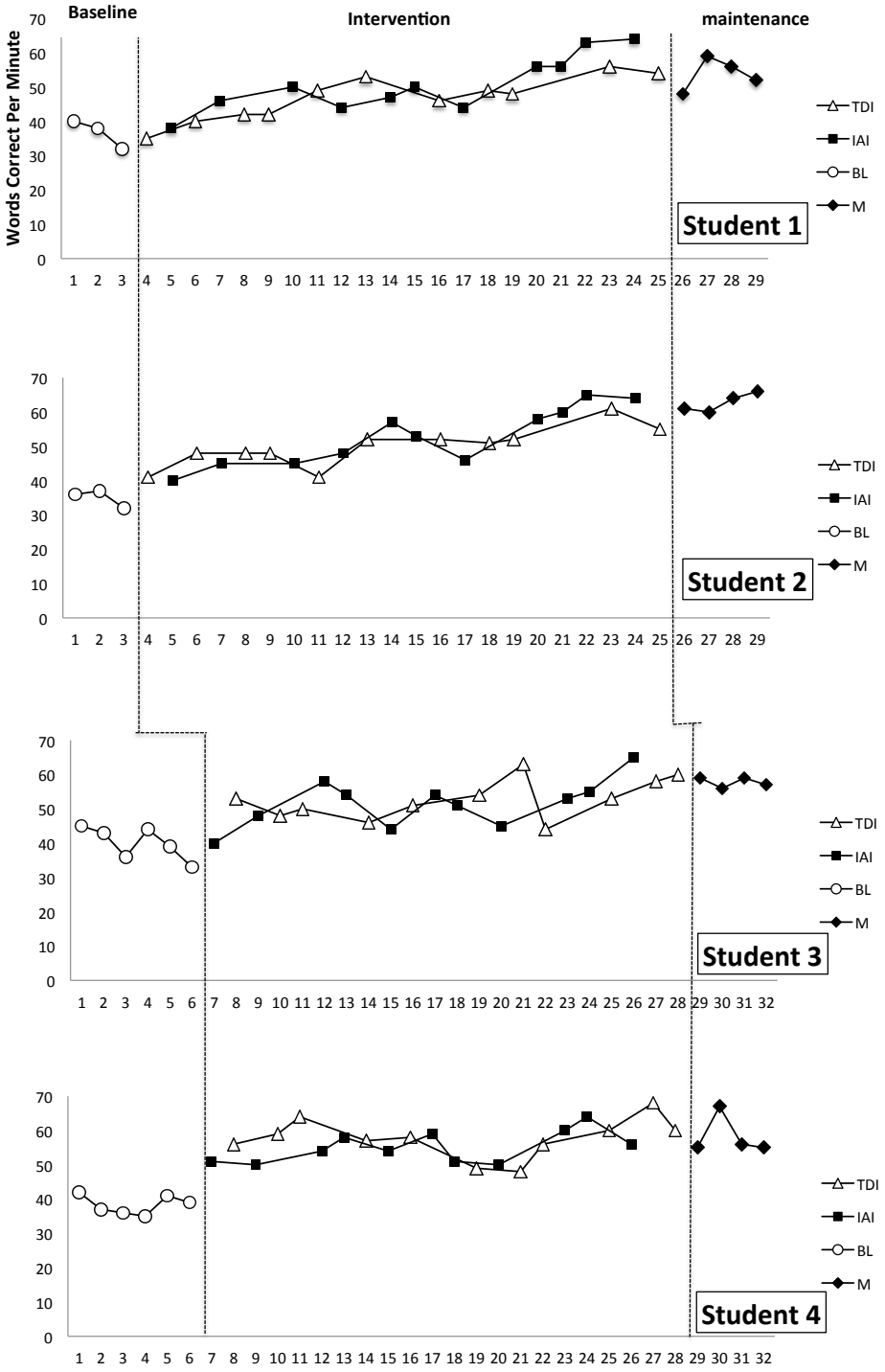


Figure 4.1. Number of words correct per minute probe for word identification across the baseline, intervention, and maintenance phases for students

Visual Analysis for the Student Sample

Student 1. Student 1 began the intervention after a stable baseline was established; he entered the intervention on the 4th session (i.e., after three baseline sessions). The baseline trend direction and stability were observed to be decreasing and stable after three baseline probes with a mean WCPM of 36.6. Throughout the baseline condition, Student 1's scores (see Figure 4.1) were initially low and continued on at low and stable levels (M = 36.6, SD = 4.2, range = 32–40).

Baseline vs. Intervention. Compared to his WCPM during baseline, Student 1 showed a moderate level increase (mean scores of 46.7 WCPM for TDI and 50.7 WCPM for IAI) during intervention. Specifically, Student 1's scores for both instructional procedures exceeded the average baseline score (M = 36.6, SD = 4.2) upon the implementation of the intervention and continued at moderate and increasing levels throughout the remainder of the intervention condition. Minimal immediacy effect (+3 WCPM for TDI and +6 WCPM for IAI) was observed through the comparison of the last baseline data points and the first intervention data point of each approach (see Tables 4.2 and 4.3). For example, the last baseline data point for Student 1 was 32 WCPM, and the first data points for TDI and IAI were 35 and 38 WCPM, respectively; the differences between (a) the last baseline data point (32 WCPM) and the first data point for TDI (35 WCPM) and (b) the last baseline data point (32 WCPM) and the first data point for IAI (38 WCPM) were reported.

Phase	Baseline	TDI	IAI
M	36.6	46.7	50.7
SD	4.2	6.5	8.2
Phase Length (Sessions)	3	11	11
Level Range	32–40	35–56	38–64
Level Change	40-32 (-8)	35-54 (+19)	38-64 (+26)

Note. M = Mean, SD = Standard deviation

Table 4.2. Descriptive Analysis (within phase) for Student 1

TDI vs. IAI. Differences between the two intervention conditions for Student 1 were minimal; based on a visual analysis of his graph, a clear experimental control between the two instructional procedures was not demonstrated. The average intervention score for IAI (M = 50.7) slightly exceeded that of TDI (M = 46.7). His first intervention day with IAI (Session 5) saw an increase of 6 WCPM from the last day of the baseline with an overall phase mean of 53.4 WCPM. The first intervention with TDI resulted in an increase of 3 WCPM from the last day of the baseline. As evidenced by differences in the mean scores of WCPM for both instructional procedures, IAI appeared to be relatively more effective; however, the differences were not sufficiently clear to identify more effective instructional procedures between TDI and IAI. Tables 4.2 and 4.3 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases (i.e., between TDI and IAI).

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(32-35) +3	(32-38) +6

Table 4.3. Descriptive Analysis (between adjacent phases) for Student 1

Student 2. Student 2, who received intervention with Student 1 in Group 1, initiated the intervention after a stable baseline with a deceasing trend was established (M = 35.0, SD = 2.6, range = 32–37); he entered the intervention on the 4th session (i.e., after three baseline sessions). Student 2's baseline data points were initially low and continued on at stable levels.

Baseline vs. Intervention. Student 2 showed a moderate level increase during TDI (M = 49.9, SD = 5.8, range = 41–61) and IAI (M = 52.8, SD = 8.5, range = 40–66) relative to the baseline. Student 2's scores for TDI and IAI exceeded the average baseline data (M = 35.0, SD = 2.6) upon the implementation of the intervention and continued at moderate and increasing levels. A moderate immediacy effect was observed through the comparison of the last baseline data point and the first intervention data point (see Table 4.4).

TDI vs. IAI. A visual analysis of his graph shows that the differences between the two instructional procedures (i.e., TDI and IAI) for Student 2 are minimal. The average intervention score for IAI (M = 52.8) was slightly higher than that for TDI (M = 49.9); differences in the mean scores of WCPM for TDI and IAI indicate that IAI appeared to be relatively more effective. The differences between the two instructional procedures were not sufficiently clear to determine which instructional procedure was more effective.

Phase	Baseline	TDI	IAI
M	35.0	49.9	52.8
SD	2.6	5.8	8.5
Phase Length (Sessions)	3	11	11
Level Range	32–37	41–61	40–66
Level Change	36-32 (-4)	41-55 (+14)	40-64 (+24)

Table 4.4. Descriptive Analysis (within phase) for Student 2

His first intervention day with TDI (Session 4) and IAI (Session 5) saw an increase of 9 WCPM for TDI and 8 WCPM for IAI from the last day of the baseline (WCPM of 32). Tables 4.4 and 4.5 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases (i.e., between TDI and IAI).

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(32-41) +9	(32-40) +8

Table 4.5. Descriptive Analysis (between adjacent phases) for Student 2

Student 3. Student 3 began the intervention at Session 7 after a stable baseline was established; she entered the intervention on the 7th session (i.e., after six baseline sessions). The baseline trend direction and stability were observed to be decreasing and stable after six baseline probes with a mean WCPM of 40. Throughout the baseline

condition, Student 3's data points showed a stable level and a primarily decreasing trend with minimal variability (M = 40, SD = 4.8, range = 33–45).

Baseline vs. Intervention. Compared to her WCPM during baseline, Student 3 showed a level increase (mean scores of 52.7 WCPM for TDI and 51.5 WCPM for IAI) during intervention. Specifically, Student 3's scores for TDI and IAI exceeded the mean score of the baseline (M = 40, SD = 4.8, range = 33–45) upon the implementation of TDI and IAI and continued on at moderate and increasing levels throughout the remainder of the intervention condition. An immediacy effect (+20 WCPM) was observed through the comparison of the last baseline data points and the first intervention data point for TDI; a moderate immediacy effect (+7 WCPM) was found between the last baseline data points and the first intervention data point for IAI (see Table 4.6).

Phase	Baseline	TDI	IAI
M	40	52.7	51.5
SD	4.8	5.8	7.0
Phase Length (Sessions)	6	11	11
Level Range	33–45	44–63	40–65
Level Change	45-33 (-12)	53-60 (+7)	40-65 (+25)

Table 4.6. Descriptive Analysis (within phase) for Student 3

TDI vs. IAI. Modest differences were found in the mean score of WCPM between the two instructional procedures for Student 3; based on a visual analysis of her graph, relatively unclear experimental control between TDI and IAI was demonstrated. The

average intervention score for TDI (M = 52.7) slightly exceeded that of IAI (M = 51.5). Her first intervention day with IAI (Session 7) saw an increase of 7 WCPM from the last day of the baseline with an overall phase mean of 40 WCPM. The first intervention with TDI (Session 8) resulted in an increase of 20 WCPM from the last day of the baseline. As evidenced by the differences in the mean scores of WCPM for TDI and IAI, TDI appeared to be relatively more effective; however, the differences between levels for the two approaches were not sufficiently clear to identify whether TDI or IAI was more effective in improving word identification for Student 3. Tables 4.6 and 4.7 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases (i.e., between TDI and IAI).

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(33-53) +20	(33-40) +7

Table 4.7. Descriptive Analysis (between adjacent phases) for Student 3

Student 4. Student 4 began the intervention after a stable baseline was established; he entered the intervention on the 7th session (i.e., after six baseline sessions). The baseline data points were observed to be stable after six baseline probes with a mean WCPM of 38.3. Throughout the baseline condition, Student 4's scores were initially low and continued on at low and stable levels (M = 38.3, SD = 2.8, range = 35–42).

Baseline vs. Intervention. Compared to his WCPM during baseline, Student 4 showed a level increase during the intervention. Specifically, Student 4's scores for TDI and IAI exceeded the average baseline score (M = 38.3, SD = 2.8, range = 35–42) upon

the implementation of the intervention and continued on at moderate and increasing levels throughout the remainder of the intervention condition. An immediacy effect (+17 WCPM for TDI and +12 WCPM for IAI) was observed through the comparison of the last baseline data points and the first intervention data point for TDI and IAI (see Table 4.8).

Phase	Baseline	TDI	IAI
M	38.3	57.7	55.2
SD	2.8	5.8	4.7
Phase Length (Sessions)	6	11	11
Level Range	35–42	48–68	50–64
Level Change	42-39 (-3)	56-60 (+4)	51-56 (+5)

Table 4.8. Descriptive Analysis (within phase) for Student 4

TDI vs. IAI. The differences between the two intervention conditions (i.e., TDI and IAI) for Student 4 were minimal; the average intervention score for TDI (M = 57.7) slightly exceeded that of IAI (M = 55.2). His first intervention day with IAI (Session 7) saw an increase of 12 WCPM from the last day of the baseline with an overall phase mean of 55.2 WCPM. The first intervention with TDI resulted in an increase of 17 WCPM from the last day of the baseline. As evidenced by differences in the mean scores for the WCPM of both instructional procedures, TDI appeared to be relatively more effective; however, the differences were minimal and insufficiently clear to identify the more effective instructional procedure between TDI and IAI. Tables 4.8 and 4.9

summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases (i.e., between TDI and IAI).

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(39-56) +17	(39-51) +12

Table 4.9. Descriptive Analysis (between adjacent phases) for Student 4

Non-Overlapping Data Points

To examine the effect size by identifying the non-overlapping data points, two methods for data analysis, the percentage of non-overlapping data (PND) and non-overlap of all pairs (NAP), were conducted for the students' word identification. When the analysis of non-overlapping data points was combined with a visual analysis, mixed results were obtained. More information from the analysis follows.

The percentage of non-overlapping data

According to Scruggs, Mastropieri, Cook, and Escobar (1986), interventions with a mean effect size exceeding 90 PND are considered "highly effective," those with a mean effect size between 71 PND and 90 PND are considered "moderately effective," and those with a mean effect size between 51 PND and 70 PND are considered "minimally effective."

For Student 1, the PND was calculated at 82% (i.e., moderately effective) for TDI and 91% (i.e., highly effective) for IAI. For Student 2, PND was calculated for both TDI and IAI at 100%, which is considered highly effective. Student 3's PND was calculated at 91% (i.e., highly effective) for TDI and 73% (i.e., minimally effective) for IAI. For

Student 4, PND was calculated at 100% for both TDI and IAI, indicating the intervention was highly effective for the student's word identification. In particular, for Students 2 and 4, both TDI and IAI were highly effective in improving word identification. For Student 1, while the TDI was moderately effective, the IAI was highly effective. For Student 3, however, TDI was more effective than IAI. When TDI was compared to IAI, there were no effects of TDI over IAI for all of the students. However, this result should be interpreted with caution because the limitation of PND includes that it is heavily based upon one data point (i.e., the highest) from phase A (i.e., IAI), ignoring all the rest of the data points from the phase (Parker et al., 2007). The results are presented in Table 4.10.

Student	Baseline vs. TDI	Baseline vs. IAI	IAI vs. TDI
1	9/11= 82%	10/11 = 91%	0/11 = 0%
2	11/11 = 100%	11/11 = 100%	0/11 = 0%
3	10/11 = 91%	8/11 = 73%	0/11 = 0%
4	11/11 = 100%	11/11 = 100%	1/11 = 9%

Table 4.10. The Percentage of Non-Overlapping Data for Word Identification

Non-overlap of all pairs

With NAP, all data points during the intervention were compared to all baseline data points for overlap to provide a valid effect size that appears superior to other non-overlapping indexes (Parker & Vannest, 2009). NAP summarizes the data overlap between each phase and reflects the number of pairs (i.e., comparison pairs of Phase 1 and Phase 2) that show no overlap; then it is divided by the total number of comparison pairs. Percentages of non-overlapping data for both instructional procedures (i.e., TDI and IAI) were computed. The results of NAP are presented in Table 4.11. For Students 2

and 3, both TDI and IAI appeared to have 100% non-overlap compared to the baseline. For Student 1, NAP between the baseline and IAI was higher than between the baseline and TDI. For Student 4, however, NAP between the baseline and TDI was greater than between the baseline and IAI, 98% to 92%.

Student	Baseline vs. TDI	Baseline vs. IAI
1	92	95
2	100	100
3	98	92
4	100	100

Table 4.11. Non-Overlap of All Pairs for Word Identification

Tau-U

Tau-U (a) combines non-overlap between the phases (e.g., baseline vs. TDI, baseline vs. IAI) and (b) controls for the confounding baseline trend with the trend from within the intervention phase. A visual comparison of two effect sizes with $CI_{83.4}$ is equivalent to $p = 0.05$ (95% confidence level) between the two scores (Goldstein & Healy, 1995; Payton, Greenstone, & Schenker, 2003). Statistical significance between Tau-U values was determined by computing $CI_{83.4}$ to identify overlap for the upper and lower limits between the effect sizes.

Tau-U scores range from 0 to 1. According to Parker et al. (2011), scores below 0.3 represent a "small" effect, scores between 0.4 and 0.6 represent a "moderate" effect, and scores larger than 0.6 represent a "large" effect. Tau-U values for each student are shown in Table 4.12. For example, regarding TDI for word identification, the Tau-U value of Student 1 was 0.85, $CI_{90} = 0.208 <> 1.489$, and $p < 0.05$; regarding IAI for word identification, the Tau-U value was 0.91, $CI_{90} = 0.269 <> 1.549$, and $p < 0.05$. Results

from the Tau-U analysis suggest the gains on word identification from TDI and IAI for all four students in the present study demonstrated a "large" effect.

	TDI			IAI		
Student	Tau	CI_{90}	*p*	Tau	CI_{90}	*p*
1	0.85	0.208 < > 1.489	< 0.05	0.91	0.269 < > 1.549	< 0.05
2	1.0	0.360 < > 1.640	< 0.05	1.0	0.360 < > 1.640	< 0.05
3	0.95	0.459 < > 1.451	< 0.01	0.85	0.352 < > 1.344	< 0.01
4	1.0	0.504 < > 1.496	< 0.01	1.0	0.504 < > 1.496	< 0.01

Table 4.12. Tau-U Results Examining Effect Sizes for Word Identification

RESEARCH QUESTION 2

Research Question 2 examined the effects of instructional procedures, TDI and IAI, on increasing the oral reading fluency of 5th grade students with RLD. The results indicate *moderate* evidence (see Kratochwill et al., 2010) was established between baseline and intervention. However, the relative effects of TDI and IAI on oral reading fluency were inconsistent across the students. Student progress on oral reading fluency throughout the study (i.e., baseline, intervention, and maintenance) is presented in Figure 4.2.

Visual analysis

Student 1. Student 1 began the intervention for oral reading fluency after a stable baseline was established; he entered the intervention on the 4th session (i.e., after three baseline sessions). Baseline data points were observed to be stable after three baseline probes with a mean WCPM of 71.3. Throughout the baseline condition, Student 1's scores were initially low and continued on at low and stable levels (M = 71.3, SD = 7.2, range = 63–76).

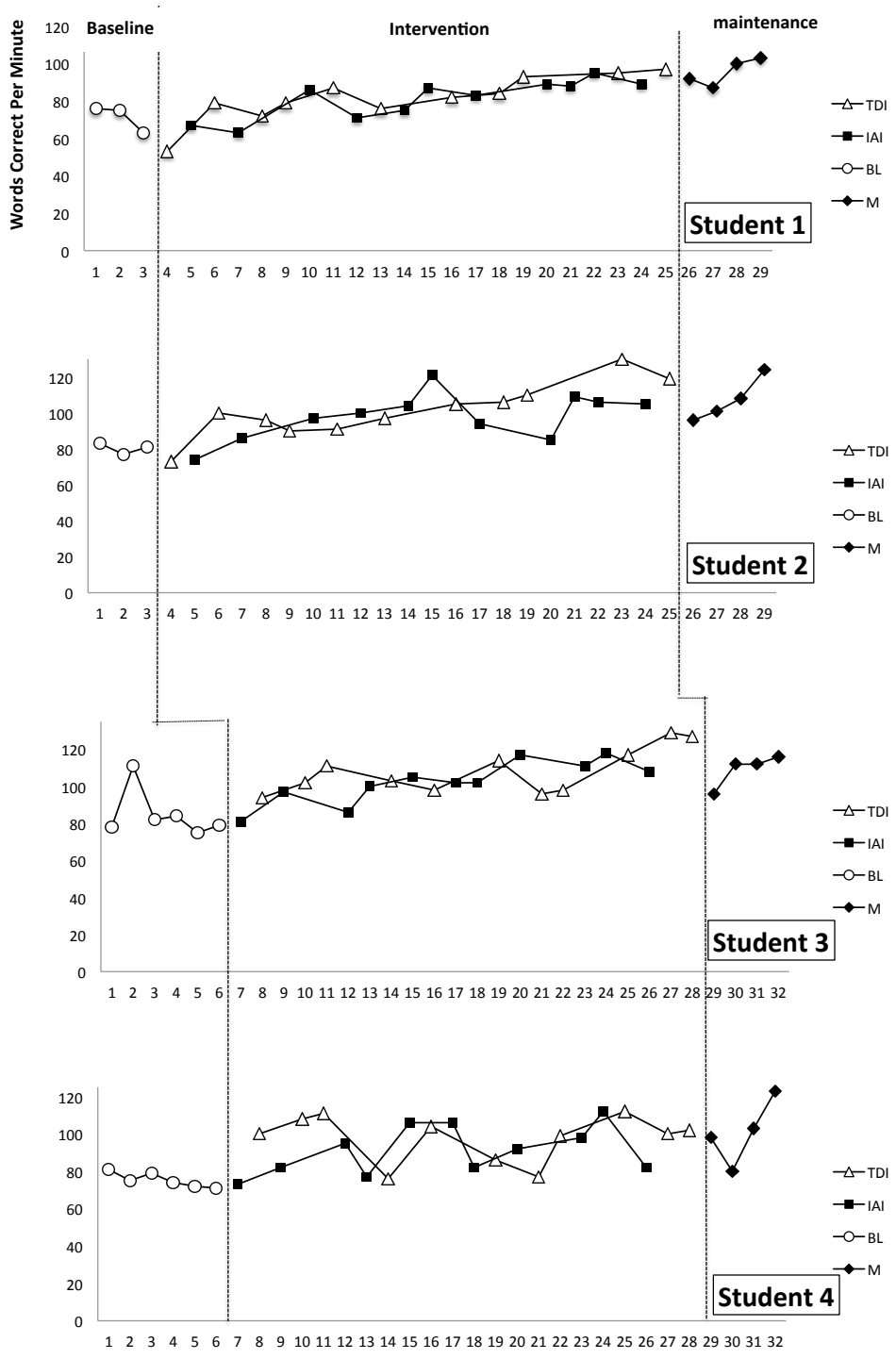


Figure 4.2. Number of words correct per minute probe for oral reading fluency across the baseline, intervention, and maintenance phases for students

Baseline vs. Intervention. Compared to his WCPM during baseline, Student 1 showed a level increase during the intervention. Specifically, Student 1's scores for TDI and IAI exceeded the average baseline score (M = 71.3, SD = 7.2, range = 63–76) upon the implementation of the intervention and continued on at moderate and increasing levels throughout the remainder of the intervention condition. Although there was no immediacy effect between TDI and the baseline, there was a slight increase (+4 WCPM) observed through the comparison of the last baseline data points and the first intervention data point for IAI (see Table 4.13).

Phase	Baseline	TDI	IAI
M	71.3	81.5	81.2
SD	7.2	12.4	10.5
Phase Length (Sessions)	3	11	11
Level Range	63–76	53–97	63–95
Level Change	76-63 (-13)	53-97 (+44)	67-89 (+22)

Table 4.13. Descriptive Analysis (within phase) for Student 1

TDI vs. IAI. Differences between the two intervention conditions (i.e., TDI and IAI) for Student 1 are minimal; the average intervention score for TDI (M = 81.5) slightly exceeded that of IAI (M = 81.2). Interestingly, his first intervention day with TDI (Session 5) saw a decrease of 10 WCPM from the last day of the baseline; however, the mean score with TDI (M = 81.5) exceeded that of the baseline (M = 71.3). The first intervention with IAI resulted in an increase of 4 WCPM from the last day of the baseline. As evidenced by the differences in the mean scores for WCPM for both

instructional procedures, TDI appeared to be relatively more effective; however, the differences were very minimal and are not sufficiently clear to identify the more effective instructional procedure between TDI and IAI. Tables 4.13 and 4.14 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases TDI and IAI.

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(63-53) -10	(63-67) +4

Table 4.14. Descriptive Analysis (between adjacent phases) for Student 1

Student 2. Student 2 began the intervention at Session 4 after a stable baseline was established; he entered the intervention on the 4th session (i.e., after three baseline sessions). Throughout the baseline condition, Student 2's data points showed a stable level with minimal variability (M = 80.3, SD = 3.1, range = 77–83).

Baseline vs. Intervention. Compared to his WCPM during the baseline, Student 2 showed a level increase (mean scores of 101.5 WCPM for TDI and 98.3 WCPM for IAI) during intervention. Specifically, Student 2's scores for TDI and IAI exceeded the mean score of the baseline (M = 80.3, SD = 3.1, range = 77–83) upon the implementation of TDI and IAI and continued on at moderate and increasing levels throughout the remainder of the intervention condition. Despite the level increase during the intervention relative to the baseline, there was no immediacy effect observed through the comparison of the last baseline data points and the first intervention data point for TDI and IAI (see Table 4.15).

Phase	Baseline	TDI	IAI
M	80.3	101.5	98.3
SD	3.1	15.3	13.1
Phase Length (Sessions)	3	11	11
Level Range	77–83	73–130	74–121
Level Change	83-81 (-2)	73-119 (+46)	74-105 (+31)

Table 4.15. Descriptive Analysis (within phase) for Student 2

TDI vs. IAI. When TDI was compared to IAI, modest differences were found in the mean score of the WCPM between the two instructional procedures for Student 2. Because there was no clear visible differentiation (i.e., a lack of overlap between data points in two treatments; Horner & Odom, 2013) between TDI and IAI, experimental control between the two instructional procedures was insufficient. The average intervention score for TDI (M = 101.5) slightly exceeded that of IAI (M = 98.3). Additionally, there was no clear difference in terms of immediacy effect between the two instructional procedures (-8 WCPM for TDI and -7 WCPM for IAI). As evidenced by the differences in the mean scores of the WCPM for TDI (M = 101.5, SD = 15.3, range = 73–130) and IAI (M = 98.3, SD = 13.1, range = 74–121), TDI appeared to be relatively more effective; however, the differences between the levels of the two instructional procedures were not sufficiently clear to identify whether TDI or IAI was more effective in improving oral reading fluency. Tables 4.15 and 4.16 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases TDI and IAI.

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(81-73) -8	(81-74) -7

Table 4.16. Descriptive Analysis (between adjacent phases) for Student 2

Student 3. Student 3 initiated the intervention after a relatively stable baseline with some variability was established (M = 84.8, SD = 13.2, range = 75–111); she entered the intervention on the 7th session (i.e., after six baseline sessions). Student 3's baseline data points showed an increasing trend for the first two data points but continued at low and stable levels, showing a decreasing trend.

Baseline vs. Intervention. Student 3 showed a moderate level increase during TDI (M = 108.1, SD = 12.4, range = 94–129) and IAI (M = 102.5, SD = 11.5, range = 81–118) relative to the baseline. Student 3's scores for TDI and IAI exceeded the average baseline data (M = 84.8, SD = 13.2, range = 75–111) upon the implementation of the intervention and continued on at moderate and increasing levels; a moderate immediacy effect was observed through the comparison of the last baseline data point and the first intervention data point (see Table 4.17).

TDI vs. IAI. Based on a visual analysis of her graph, the differences between the two instructional procedures (i.e., TDI and IAI) for Student 3 are minimal. The average intervention score for TDI (M = 108.1) was slightly higher than that of IAI (M = 102.5); the differences in the mean scores of the WCPM for TDI and IAI indicate that TDI appeared to be relatively more effective. The differences between the two instructional procedures were not sufficiently clear to determine which instruction type was more effective. Her first intervention day for TDI (Session 8) and IAI (Session 7) saw an

increase of 15 WCPM for TDI and 2 WCPM for IAI from the last day of the baseline (i.e., WCPM of 79). Tables 4.17 and 4.18 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases TDI and IAI.

Phase	Baseline	TDI	IAI
M	84.8	108.1	102.5
SD	13.2	12.4	11.5
Phase Length (Sessions)	6	11	11
Level Range	75–111	94–129	81–118
Level Change	78-79 (+1)	94-127 (+33)	81-108 (+27)

Table 4.17. Descriptive Analysis (within phase) for Student 3

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(79-94) +15	(79-81) +2

Table 4.18. Descriptive Analysis (between adjacent phases) for Student 3

Student 4. Student 4 began the intervention after a stable baseline was established; he entered the intervention on the 7th session (i.e., after six baseline sessions) The baseline trend direction and stability were observed to be decreasing and stable after three baseline probes with a mean WCPM of 75.3. Throughout the baseline condition, Student 4's scores were initially low and continued on at low and stable levels (M = 75.3, SD = 3.9, range = 71–81).

Baseline vs. Intervention. Compared to his WCPM during baseline, Student 4 showed a moderate level increase (i.e., mean scores of 97.7 WCPM for TDI and 91.4 WCPM for IAI) during intervention. Specifically, Student 4's mean scores for TDI (M = 97.7, SD = 12.6, range = 76–112) and IAI (M = 91.4, SD = 13.1, range = 73–112) exceeded the average baseline score (M = 75.3, SD = 3.9, range = 71–81) upon the implementation of the intervention and continued on at moderate and increasing levels throughout the remainder of the intervention condition. A clear immediacy effect (+29 WCPM) was observed through the comparison of the last baseline data points and the first intervention data point for TDI. A minimal immediacy effect (+2 WCPM) was observed through the comparison of the last baseline data points and the first intervention data point for IAI (see Table 4.19).

Phase	Baseline	TDI	IAI
M	75.3	97.7	91.4
SD	3.9	12.6	13.1
Phase Length (Sessions)	6	11	11
Level Range	71–81	76–112	73–112
Level Change	81-71 (-10)	100-102 (+2)	73-82 (+9)

Table 4.19. Descriptive Analysis (within phase) for Student 4

TDI vs. IAI. Differences between the two intervention conditions for Student 4 are minimal; based on a visual analysis of his graph, a clear experimental control between the two instructional procedures was not demonstrated. The average intervention score for TDI (M = 97.7) slightly exceeded that of IAI (M = 91.4). His first intervention day

with TDI (Session 8) saw an increase of 29 WCPM from the last day of the baseline. The first intervention with IAI (Session 7) resulted in an increase of 2 WCPM from the last day of the baseline. As evidenced by the differences in the mean scores of the WCPM for both approaches, TDI appeared to be relatively more effective; however, the differences were not sufficiently clear to identify the more effective approach between TDI and IAI. Tables 4.19 and 4.20 summarize the descriptive analysis within phase (i.e., baseline and intervention) and between adjacent phases TDI and IAI.

Phase Comparison	Comparing the Effects of TDI over Baseline	Comparing the Effects of IAI over Baseline
Change in Level	(71-100) +29	(71-73) +2

Table 4.20. Descriptive Analysis (between adjacent phases) for Student 4

Non-Overlapping Data Points

To derive the effect sizes of student performance on oral reading fluency, two methods for data analysis (i.e., PND and NAP) that involve the non-overlapping data points were conducted. When the analysis of non-overlapping data points was combined with visual analysis, the results indicated that TDI appeared to be more effective than IAI in building the students' oral reading fluency.

The percentage of non-overlapping data

When calculating and interpreting the results of PND, a mean effect size of PND exceeding 90 is considered highly effective, a mean effect size of PND between 71 and 90 is considered moderately effective, and a mean effect size of PND between 51 and 70 is considered minimally effective (Scruggs et al., 1986).

For Student 1 and his instructional probes on oral reading fluency, the PND was

calculated at 73% (i.e., moderately effective) for TDI and 64% (i.e., minimally effective) for IAI. For Student 2, the PND was calculated for both TDI and IAI at 91%, which indicates highly effective. Student 3's PND was calculated at 36% for TDI and 18% (i.e., minimally effective for both) for IAI; one of her baseline data points was unusually higher than the others and significantly impacted the results of the PND. For Student 4, the PND was calculated at 82% for both TDI and IAI, indicating the intervention was moderately effective on the student's oral reading fluency.

For Students 2 and 4, both TDI and IAI were similarly effective in building their oral reading fluency. For Student 1, while the TDI was moderately effective, the IAI was minimally effective. For Student 3, because of one outlier data point during the baseline, neither TDI nor IAI appeared to be effective in improving oral reading fluency.

When TDI was compared to IAI, there were no effects of TDI over IAI for all of the students' oral reading fluency. Because PND is heavily based upon the highest data point from phase A (i.e., IAI) and ignores all the rest of the data points from the phase (Parker et al., 2007), the result should be interpreted with caution. The results are presented in Table 4.21.

Student	Baseline vs. TDI	Baseline vs. IAI	IAI vs. TDI
1	8/11= 73%	7/11 = 64%	1/11 = 9%
2	10/11 = 91%	10/11 = 91%	1/11 = 9%
3	4/11 = 36%	2/11 = 18%	2/11 = 18%
4	9/11 = 82%	9/11 = 82%	0/11 = 0%

Table 4.21. The Percentage of Non-Overlapping Data for Oral Reading Fluency

Non-overlap of all pairs

Based on NAP, all intervention data points during TDI and IAI were compared to all the baseline data points for overlap to provide a valid effect size (Parker & Vannest, 2009). NAP reflects the number of pairs that show no overlap, and then it is divided by the total number of comparison pairs. The results of NAP are presented in Table 4.22. For Student 2, both TDI and IAI appeared to have a 91% non-overlap compared to the baseline. For Student 3, NAP between the baseline and IAI was higher than NAP between the baseline and TDI. For Students 1 and 4, however, NAP between the baseline and TDI was greater than NAP between the baseline and IAI.

	Baseline vs. TDI	Baseline vs. IAI
Student 1	83	76
Student 2	91	91
Student 3	90	84
Student 4	94	90

Table 4.22. Non-Overlap of All Pairs for Oral Reading Fluency

Tau-U

The present study employed Tau-U to (a) combine non-overlap between phases (e.g., baseline vs. TDI, baseline vs. IAI) and to (b) control for the confounding baseline trend with the trend from within the intervention phase. Statistical significance between Tau-U values was determined by calculating $CI_{83.4}$ to examine the overlap of upper and lower limits between effect sizes.

According to Parker et al. (2011), scores below 0.3 are considered "small," scores between 0.4 and 0.6 are considered "moderate" and scores larger than 0.6 are considered

"large." As a result by Tau-U, TDI and IAI for the oral reading fluency of three students (Students 2, 3, and 4) were demonstrated to have a "large" effect.

Tau-U values for each student are shown in Table 4.23. For example, regarding TDI and IAI for oral reading fluency, the Tau-U of Student 2 was 0.82, CI_{90} = 0.178 < > 1.458, and $p < 0.05$. Results from Tau-U suggest the gains made in oral reading fluency from TDI and IAI for three students (Students 2, 3, and 4) in the present study were demonstrated as having a "large" and significant effect.

	TDI			IAI		
Student	Tau	CI_{90}	*p*	Tau	CI_{90}	*p*
1	0.67	0.026 < > 1.307	0.09	0.52	-0.125 < > 1.155	0.19
2	0.82	0.178 < > 1.458	< 0.05	0.82	0.178 < > 1.458	< 0.05
3	0.80	0.307 < > 1.299	< 0.01	0.68	0.186 < > 1.178	< 0.05
4	0.88	0.383 < > 1.375	< 0.01	0.82	0.322 < > 1.314	< 0.01

Table 4.23. Tau-U Results Examining Effect Sizes for Oral Reading Fluency

RESEARCH QUESTION 3

Research Question 3 examined how 5th grade students with RLD maintain their word identification and oral reading fluency in one week and two weeks after the end of the intervention. EasyCBM wording reading fluency (WRF) and passage reading fluency (PRF) were administered throughout the study (i.e., baseline, intervention, and maintenance). Four days one week and two weeks after the end of the intervention were randomly selected. The purpose of the maintenance testing was to determine whether TDI and IAI influenced student gains in word identification and oral reading fluency over time.

Student 1

Word identification. For word identification, his mean score during maintenance was 54 WCPM, which was the same as the last intervention data point for TDI (54 WCPM), and 10 WCPM, which had decreased compared to the last intervention data point for IAI (64 WCPM). Considering that Student 1 scored a level of 47 WCPM for TDI and 51 WCPM for IAI during the intervention phase, his maintenance performance of 54 WCPM was seven words lower and three words higher than the level of intervention data for TDI and IAI, respectively.

Oral reading fluency. For oral reading fluency, his mean score during maintenance was 96 WCPM, which showed a 1 WCPM decrease compared to the last intervention data point for TDI (97 WCPM), and 7 WCPM, which showed an increase compared to the last intervention data point for IAI (89 WCPM). Considering that Student 1 scored a level of 82 WCPM for TDI and 81 WCPM for IAI during the intervention phase, his maintenance performance of 96 WCPM was 14 and 15 WCPM higher than the level of intervention data for TDI and IAI, respectively.

Student 2

Word identification. For word identification, his mean score during maintenance was 63 WCPM, which showed a 8 WCPM increase compared to the last intervention data point for TDI (55 WCPM), and 1 WCPM, which showed an increase compared to the last intervention data point for IAI (64 WCPM). Considering that Student 2 scored a level of 50 WCPM for TDI and 53 WCPM for IAI during the intervention phase, his maintenance performance of 63 WCPM was 13 and 10 WCPM higher than the level of intervention data for TDI and IAI, respectively.

Oral reading fluency. For oral reading fluency, his mean score during maintenance was 107 WCPM, which demonstrates a 12 WCPM decrease compared to

the last intervention data point for TDI (119 WCPM), and 2 WCPM, which shows an increase compared to the last intervention data point for IAI (105 WCPM). Considering that Student 2 scored a level of 102 WCPM for TDI and 98 WCPM for IAI during the intervention phase, his maintenance performance of 107 WCPM was 5 and 9 WCPM higher than the level of intervention data for TDI and IAI, respectively.

Student 3

Word identification. For word identification, her mean score during maintenance was 58 WCPM, which was 2 WCPM less compared to the last intervention data point for TDI (60 WCPM), and 7 WCPM, which demonstrates a decrease compared to the last intervention data point for IAI (65 WCPM). Considering that Student 3 scored a level of 53 WCPM for TDI and 52 WCPM for IAI during the intervention phase, her maintenance performance of 58 WCPM was 5 and 6 WCPM higher than the level of intervention data for TDI and IAI, respectively.

Oral reading fluency. For oral reading fluency, her mean score during maintenance was 109 WCPM, which was 18 WCPM less compared to the last intervention data point for TDI (127 WCPM), and 1 WCPM, which was an increase compared to the last intervention data point for IAI (108 WCPM). Considering that Student 3 scored a level of 108 WCPM for TDI and 103 WCPM for IAI during the intervention phase, her maintenance performance of 109 WCPM was 1 and 6 WCPM higher than the level of intervention data for TDI and IAI, respectively.

Student 4

Word identification. For word identification, his mean score during maintenance was 58 WCPM, which was 2 WCPM less compared to the last intervention data point for TDI (60 WCPM), and 2 WCPM, which was an increase compared to the last intervention data point for IAI (56 WCPM). Considering that Student 4 scored a level of 58 WCPM

for TDI and 55 WCPM for IAI during the intervention phase, his maintenance performance of 58 WCPM was the same as that of TDI and 2 WCPM higher than the mean level of IAI.

Oral reading fluency. For oral reading fluency, his mean score during maintenance was 101 WCPM, which was a 1 WCPM decrease compared to the last intervention data point for TDI (102 WCPM), and 19 WCPM, which was an increase compared to the last intervention data point for IAI (82 WCPM). Considering that Student 4 scored a level of 98 WCPM for TDI and 91 WCPM for IAI during the intervention phase, his maintenance performance of 101 WCPM was 3 and 10 WCPM higher than the level of intervention data for TDI and IAI, respectively.

RESEARCH QUESTION 4

Research Question 4 examined how 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to reading comprehension. Generalization was defined as "the development of behaviors not directly trained" (Cooper, Heron, & Heward, 2007, p. 555). In this study, the *generalization* refers to a student's ability to demonstrate acquired skills across different settings. The researcher examined the generalization by identifying the extent to which four students' performance on word identification and oral reading fluency was generalized across broader reading behaviors, more specifically, on their performance on the Paragraph Construction subtest of the TORC-4 (Brown et al., 2009).

Paragraph Construction measured the students' ability to develop meaningful paragraphs from a set of sentences by rearranging the sentences in a logical order. Students first silently read a list of sentences that were not listed in logical order and then rearranged them to make the most sensible paragraph they could.

There are descriptive terms corresponding to the score ranges such as (a) very superior (scaled score of 17–20) (RCI > 130), (b) superior (scaled score of 15–16) (RCI 121–130), (c) above average (scaled score of 13–14) (RCI 111–120), (d) average (scaled score of 8–12) (RCI 90–110), and (e) below average (scaled score of 6–7) (RCI 80–89).

Based on a distribution having a mean of 10 and a standard deviation of 3, the students' scaled scores (i.e., standard scores) for Students 1 through 4, respectively, were 8, 10, 8, and 5. As can be seen, three of the four students scored above average (i.e., a standard score of 8 or higher) in reading comprehension. The students' raw scores, percentile rank, and scaled scores are listed in Table 4.24.

Student	Raw score	Scaled score
1	19	8
2	27	10
3	21	8
4	9	5

Table 4.24. Results from Paragraph Construction (Subtest 3)

RESEARCH QUESTION 5

Research Question 5 examined the perspectives of 5th grade students with RLD concerning two instructional procedures, TDI and IAI. Social validity data from the interview with the four students in the study was collected to determine their perceptions on the instructional approaches. Social validity is defined as the extent to which participants perceive a behavioral and/or academic intervention is acceptable with a validation on three levels: (a) the social significance of the goals, (b) the procedural appropriateness, and (c) the importance of the effects (Wolf, 1978). The present study

measured social validity in terms of student preferences between the two intervention approaches. Specifically, four students were asked to respond to several open-ended questions. The questions and their responses are as follows.

1. Which did you prefer, the teacher-directed lesson or the iPad-assisted lesson? (Did you like them about the same?)
    - Three students preferred IAI and one student mentioned both TDI and IAI.
2. Why did you prefer the lesson? (Why did you like both?)
    - Student 1 responded, "I like the iPad because sometimes it can be slow." Student 2 stated, "It is easier to learn with iPad because you don't have to wait for the other student so it doesn't take long." Student 3 noted that working with an iPad was easier than TDI. Student 4 offered that the iPad helped him enjoy learning, and he liked the applications.
3. What did you think about the other lesson? What factors made you not choose the other lesson as the better one?
    - The student who said he liked both TDI and IAI answered that both of them were fun. Student 4 agreed that TDI was also fun. Regarding the TDI, Student 3 stated sometimes the TDI was hard for her, and Student 2 mentioned partner reading in the TDI made him wait when he read faster than his friend.
4. Which lesson did you think helped you learn better?
    - The results were mixed; three students responded that they thought TDI helped them learn better, and only Student 2 responded that IAI helped him better.
5. Which kept you busier—the teacher-directed lesson or the iPad-assisted lesson?
    - All four students selected the TDI approach.

6. Which one did you look forward to most—the teacher-directed lesson or the iPad-assisted lesson?
    - Three students said they looked forward to both TDI and IAI, but only Student 3 said that she looked forward to IAI a bit more.

Finally, the four students were also asked if they had any other comments regarding the two instructional procedures that they experienced during the study. Student 1 mentioned that receiving the intervention during his lunchtime helped him "study more."

RESEARCH QUESTION 6

Research Question 6 examined the perspectives of 5th grade students with RLD on their own reading. At the beginning and the end of the study, the students completed a questionnaire to examine their perspectives on their reading performances and/or abilities. The evaluation employed a 4-point Likert-type scale (1 = No, definitely, 2 = Disagree, 3 = Closer to Yes, and 4 = Yes, definitely) of agreement with 14 statements. The results of the questions from pre- and post-testing are listed in Tables 4.25 and 4.26, respectively.

Out of 14 statements, 11 items involve positive attitudes toward reading (i.e., positively phrased questions) such as, "It's fun to read;" three items involve negative attitudes toward reading (i.e., negatively phrased questions) such as, "Someone who likes reading is usually weird." In a comparison of the results from the pre-test (i.e., before intervention) and the post-test (i.e., after intervention), the students showed increased positive attitudes on 7 of the 11 items that were positively phrased and decreased negative attitudes on 2 of the 3 items that were negatively phrased.

Social Validity Item	S 1	S 2	S 3	S 4	Item Average
1. It's fun to read.	3	3	4	2	3
2. I am a good reader.	4	3	4	3	3.5
3. I'm better at reading than most of my friends.	2	2	3	2	2.25
4. Reading is interesting and exciting.	3	2	4	2	2.75
5. Reading tests are usually easy for me.	2	2	2	1	1.75
6. I'd rather do reading than any other kind of homework.	1	3	3	1	2
7. I like everything else in school better than reading.	3	3	2	4	3
8. Someone who likes reading is usually weird.	1	2	1	1	1.25
9. I enjoy reading books in school during free time.	3	1	4	1	2.25
10. I read a lot outside of school.	3	2	3	2	2.5
11. I've always liked reading.	4	1	3	3	2.75
12. I enjoy reading for fun at home.	4	1	4	1	2.5
13. I like to talk about the books or stories I read.	3	2	3	2	2.5
14. My friends like reading more than I do.	2	3	3	1	2.25

Note. 1 = No, definitely, 2 = Disagree, 3 = Closer to Yes, and 4 = Yes, definitely

Table 4.25. Social Validity Questionnaire (pre-test)

Social Validity Item	S 1	S 2	S 3	S 4	Item Average
1. It's fun to read.	4	3	4	2	3.25
2. I am a good reader.	3	2	3	3	2.75
3. I'm better at reading than most of my friends.	2	2	3	2	2.25
4. Reading is interesting and exciting.	3	3	4	2	3
5. Reading tests are usually easy for me.	3	3	4	2	3
6. I'd rather do reading than any other kind of homework.	2	3	4	4	3.25
7. I like everything else in school better than reading.	4	2	3	4	3.25
8. Someone who likes reading is usually weird.	1	1	1	1	1
9. I enjoy reading books in school during free time.	3	2	3	1	2.25
10. I read a lot outside of school.	2	4	3	1	2.5
11. I've always liked reading.	3	3	4	3	3.25
12. I enjoy reading for fun at home.	3	3	4	2	3
13. I like to talk about the books or stories I read.	3	3	3	2	2.75
14. My friends like reading more than I do.	2	1	4	1	2

Note. 1 = No, definitely, 2 = Disagree, 3 = Closer to Yes, and 4 = Yes, definitely

Table 4.26. Social Validity Questionnaire (post-test)

When compared, descriptive results from the pre- and post-tests show changes in a positive directions; items such as (a) "Reading tests are usually easy for me" (from 1.75 to 3), and (b) "I'd rather do reading than any other kind of homework" (from 2 to 3.25). On the other hand, results from three items: (a) "I'm better at reading than most of my friends," (b) "I enjoy reading books in school during free time," and (c) "I read a lot outside of school" remained the same (see Table 4.27).

Social Validity Item	Pre-test	Post-test
1. It's fun to read.	3	3.25
2. I am a good reader.	3.5	2.75
3. I'm better at reading than most of my friends.	2.25	2.25
4. Reading is interesting and exciting.	2.75	3
5. Reading tests are usually easy for me.	1.75	3
6. I'd rather do reading than any other kind of homework.	2	3.25
7. I like everything else in school better than reading.	3	3.25
8. Someone who likes reading is usually weird.	1.25	1
9. I enjoy reading books in school during free time.	2.25	2.25
10. I read a lot outside of school.	2.5	2.5
11. I've always liked reading.	2.75	3.25
12. I enjoy reading for fun at home.	2.5	3
13. I like to talk about the books or stories I read.	2.5	2.75
14. My friends like reading more than I do.	2.25	2

Note. 1 = No, definitely, 2 = Disagree, 3 = Closer to Yes, and 4 = Yes, definitely

Table 4.27. Comparison of the Pre and Post-test of the Social Validity Questionnaire

Chapter 5: Discussion

The purpose of this study was to examine and compare the effectiveness of teacher-directed instruction (i.e., teacher-directed instruction without using an iPad, TDI) and iPad-assisted instruction (IAI) on the word identification and oral reading fluency of elementary students with reading learning disabilities (RLD) who have reading goals on their IEPs. The effects of the two types of instructional procedures were analyzed through visual inspection of the functional relationship between the baseline and intervention along with non-overlapping data points and Tau-U.

Students with RLD face many challenges in learning to read and exhibit weaknesses in critical reading areas such as word identification and oral reading fluency. For example, students with RLD have difficulties in achieving efficient word reading skills (Ayala & O'Connor, 2013; Gustafson et al., 2011; Jenkins, 2002) and in building oral reading fluency (Chard et al., 2002; Vaughn & Linan-Thompson, 2004).

Students who have difficulties in decoding unfamiliar words can enhance their word identification skills though strategy instruction (Bryant et al., 2008; Chard & Osborn 1999; Lenz & Hughes, 1990). To help struggling readers increase oral reading fluency, repeated reading is one of the most effective evidence-based approaches (Chard et al., 2002; Chard et al., 2009; NRP, 2000; Therrien & Kubuina, 2006).

Recently, tablet computers have emerged as an effective application of technology for classroom learning activities (Spencer, 2011). Tablet computers such as the iPad provide many advantages, including portability (Ozok et al., 2008) and accessibility (Pyper, 2011). In addition, tablet computers can be easily embedded within learning environments because of their relatively small sizes. More importantly, for today's struggling readers, tablet computers can be effective instructional tools to help

improve their reading abilities (Conn, 2012; Larson, 2010; Miranda et al., 2012). Six research questions guided this study:

1. Which instructional procedure, TDI or IAI, is more effective in increasing the word identification performance of 5th grade students with RLD?
2. Which instructional procedure, TDI or IAI, is more effective in improving the oral reading fluency performance of 5th grade students with RLD?
3. How do 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention?
4. How do 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to their reading comprehension?
5. What are the perspectives of 5th grade students with RLD about TDI or IAI after the intervention?
6. What are the perspectives of 5th grade students with RLD toward reading?

Chapter 5 discusses the results in relation to the six research questions and presents the conclusions drawn from the major findings. This chapter concludes with a discussion of the study's limitations, suggestions for future research, and implications for practice.

RESEARCH QUESTION 1

Research Question 1 examined the effect of TDI and IAI in increasing the word identification of 5th grade students with RLD. Overall, the results demonstrated a moderate effect of intervention on student performance with regard to word identification. All students increased their WCPM on instructional probes from the baseline phase to the intervention phases TDI and IAI. According to the percentage of non-overlapping data (PND), both instructional procedures (i.e., TDI and IAI) appeared to be highly effective on all four students' word identification abilities (Scruggs et al.,

1986). In particular, TDI was more effective for Students 3 and 4 than IAI, and IAI was more effective for Students 1 and 2; however, the differences between TDI and IAI were not sufficiently clear to determine that one was a more effective instructional procedure than the other for students to build their word identification abilities through. It should be noted that there was some degree of separation between TDI and IAI for Students 1, 2, and 3 for the last 3–4 data points before the maintenance phase and that the separation was increased until the students reached the maintenance phase. Because the functional relation is demonstrated by consistency and the magnitude of the separation between the two treatments (Horner & Odom, 2013), it is possible that if the intervention had lasted longer it would have shown a continuing and increasing separation with a stronger trend. Results of Tau-U suggested the students' gains in terms of word identification from TDI and IAI in the study demonstrated a significant effect on building their word identification skills (Parker et al., 2011).

The results of the study indicate that all the students in the study exhibited a slight increase in their ability to read a list of words at their instructional reading level when TDI and IAI were initiated. This finding suggests that the increase in WCPM following the TDI and IAI is a result of the intervention. These findings are consistent with previous research that found that (a) strategy instruction (Bremer, Clapper, & Deshler, 2002; Woodruff, Schumaker, & Deshler, 2002) and (b) technology-assisted instruction (Larson, 2010; Miranda et al., 2012; Pyper, 2011) increase word identification (i.e., WCPM). The primary instructional features of TDI and IAI that might account for the results of this study are discussed in the following sections.

Elements of effective instruction

In the current study, it was hypothesized that the differences between TDI and IAI include the use of the elements of effective instruction (e.g., feedback, scaffolding).

Because students with LD are a heterogeneous group, there is no one model of instructional fit (Swanson, 2001; Swanson & Deshler, 2003). Some common general guidelines underlying effective instruction for teaching students with LD have been identified in previous studies (e.g., Bulgren, Deshler, Schumaker, & Lentz, 2000; Swanson, 2001). Specifically, the meta-analysis by Swanson, Hoskyn, and Lee (1999) recommended explicit, systematic instruction combined with strategic instruction in teaching students with LD. Their findings influenced the TDI lessons used in the study, which included critical elements of the effective instructional model such as skill modeling, explicit practice, questioning, sequencing and segmentation, and scaffolding. Moderate evidence regarding the effects of TDI on the students' word identification skills indicates the positive impacts of the critical elements on helping students with LD to identify unknown and/or unfamiliar words.

First, the TDI lesson included (a) Preview, (b) Engage Prior/Informal Knowledge, (c) Demonstrate, (d) Practice, and (e) Independent Practice. Based on the structured TDI lesson, the teacher provided explicit and direct instruction during TDI; students learned how to use syllable patterns to identify unknown and/or unfamiliar words directly and clearly through the teacher (i.e., the first researcher). At the same time, students were guided in building their own learning experience by actively participating in an array of classroom activities; students in the current study had opportunities to practice what they learned with teacher assistance (during Practice) and then on their own (during Independent Practice). Teacher modeling was provided during Demonstrate and included (a) having students make a slash mark (/) between syllables, (b) asking him/her which pattern is or which patterns are in a word, (c) having him/her identify each vowel and syllable sound and blend the sounds together to form each syllable, and (d) having him/her blend the syllables together to read the word. After the teacher's skill modeling

during Demonstrate, students continued working on decoding unknown and/or unfamiliar words and using the SPLIT strategy during Practice. During the Practice stage of the TDI word identification lesson, students practiced how to use the word identification strategy (i.e., SPLIT) with a set of unfamiliar multisyllabic words. For example, during Lesson 5, students were given multisyllabic words containing four syllable patterns and were asked to use the SPLIT strategy to identify each word by following each step of the strategy. Then, the students read the words out loud by taking turns with their partner. During the process, the teacher asked the students to use the SPLIT strategy and try their best to identify the words by going through the strategy step by step.

The sequence of instruction was achieved through the structured lesson plan, where the students learned each of the word identification skills and concepts they would later employ to identify unfamiliar and/or unknown words. Specifically, TDI was provided systematically with concepts and skills that were taught in a logical order from easiest to most difficult. For example, students were taught one or two-syllable words before three or four-syllable words; closed syllables were taught as the first syllable type. From Lessons 1 through 4, students learned *only* two syllable patterns each session; then they learned to work with all of the four syllable patterns from lessons 5 to 11.

Strategy Instruction

In the current study, the strategy instruction was one of the advantages of TDI over IAI to help the students with RLD improve their word identification skills; no strategy was taught during IAI because there was no iPad application available that teaches word identification strategies. During TDI, students were taught the word identification strategy, SPLIT, which was designed to help struggling readers decode and identify unknown and/or unfamiliar words. Students learned each step of the strategy and

had opportunities to practice each of the five steps with teacher modeling and teacher assistance.

The strategy instruction in this study included (a) teaching each step of the strategy and where the strategy is applied, (b) demonstrating how to use the strategy, and (c) ensuring that students understood and could name each step of the strategy (Ellis, Deshler, Lenz, Schumaker, & Clark, 1991). To teach the strategy in the most effective manner, the teacher (a) read each line of the strategy with the students, (b) assisted the students in conducting each step (e.g., placing a line between each syllable, identifying the syllable pattern of each word presented), (c) asked several questions to check the students' understanding of each step (e.g., what is the syllable pattern of t-e-r-n? what does the next line begin with?), and (d) provided teacher modeling to show how to use the SPLIT strategy (e.g., we will read together the first line of the strategy, which begins with S. I see two syllable patterns: a closed syllable pattern and a vowel-r pattern).

The implication of this study is especially significant given the particular population of students with RLD observed. Students with RLD are required to be equipped with a repertoire of instructional strategies as a way to organize their learning experiences and as a systematic step that they can use when working on learning tasks. Thus, they need to be provided with cognitive strategy instruction that focuses on teaching them a range of cognitive and meta-cognitive strategies, processes, and mental activities to improve their learning (Dole, Nokes, & Drits, 2009). The word identification strategy can function as their mental toolbox. Consequently, the results of this study are encouraging in that the use of strategy instruction for word identification may increase students' cognitive capacity to access reading passages (see information processing theory on pp. 5–6). The moderate effects of TDI, which was implemented for 11 14–

minute sessions, imply that teachers need to spend more time helping struggling readers actively engage in the instructional process to reach more positive academic achievement.

Use of the iPad for word identification

The results of this study suggest that the use of iPad-assisted instruction for word identification is promising in helping students with RLD decode unfamiliar and/or unknown words. As demonstrated in this study, Students 1 and 2 performed better with IAI than they did with TDI; all four students demonstrated improvements in their WCPM with IAI compared to their WCPM at baseline.

It should be noted that IAI in this study, three different iPad applications (i.e., *K12 Timed Reading Practice, Howie Finding Vowel, ABC Phonics Word Family Writing*) were used; two of three applications (i.e., *Howie Finding Vowel, ABC Phonics Word Family Writing*) were used for word identification instruction. Because each iPad application has different features (e.g., visual and auditory stimuli, customized settings) and targeted concepts and/or skills (e.g., word identification, comprehension, fluency), the findings from this study should be interpreted cautiously based on the effects of the two applications (i.e., *Howie Finding Vowel, ABC Phonics Word Family Writing*) used in the present study. That is, the results of IAI for word identification may not be evidence of the effects of all instructional reading applications available in the current market.

In addition to the advantages of using an iPad for reading instruction, including images, portability, and functionality (Cahill & McGill-Franzen, 2013; Miranda et al., 2012; Ozok et al., 2008), the effects of IAI (or any tablet-assisted instruction) are linked to: (a) effective instructional components embedded in tablet computers (e.g., self-correction, scaffolding, progress monitoring, opportunities for practice), and (b) the individual student's preferences and familiarity with the iPad. In addition, it should be noted that some iPad applications that require a group of students to read and record

simultaneously are more likely to make classroom management difficult, although students generally enjoy reading as a group with the iPad applications (Retter, Anderson, & Kieran, 2013). Therefore, educators and teachers should carefully find instructional applications for their instructional purpose in a systematic and structured way; by utilizing a rubric, they can evaluate iPads based on the content level, the objectives of a given lesson, and the types of applications available (Ok, Kim, Kang, & Bryant, in press); the two applications used in this study were carefully selected based on the rubric.

Although no clear differentiation between the baseline and IAI was evidenced in the students' word identification, a high level of engagement was informally observed, as evidenced by a reduction of off-task behaviors and noise level. Despite the meager gains in their word identification abilities during IAI, the students (a) were eager to learn how to find a correct answer to feed a monster when they used *Howie Finding Vowel* and (b) enjoyed writing and listening to each set of words when they worked with *ABC Phonics Word Family Writing*. In addition, the students asked the researcher to download similar reading applications with cute characters (e.g., Angry Birds, Pokémon) and asked if they could continue working with the reading iPad applications even after a session was over; the result is aligned with previous studies indicating that students revealed more eagerness, engagement, and motivation when they worked with iPads (Hutchison et al., 2012; Larson, 2010; Retter et al., 2013).

RESEARCH QUESTION 2

Research Question 2 examined the effect of TDI and IAI in increasing the oral reading fluency performance of 5th grade students with RLD. Overall, the results demonstrated moderate evidence in building oral reading fluency of 5th grade students with RLD from baseline to intervention probes. All four students increased their WCPM on instructional probes (i.e., easyCBM passage reading) from the baseline phase to the

instructional phases TDI and IAI. Comparing the mean scores of TDI to that of IAI for each student, TDI appeared to be more effective than IAI in improving the oral reading fluency for all four students. Based on data analysis by PND and NAP, TDI was more effective than IAI for three students (i.e., Students 1, 3, and 4); for Student 2, there was no difference in the effects of TDI or IAI. However, when examining the relative effects of TDI and IAI, the differences between them were not sufficiently clear to determine the more effective procedure in building oral reading fluency. According to Tau-U, both TDI and IAI were demonstrated to be significantly effective for three students (i.e., Students 2, 3, and 4) in increasing their WCPM of passage reading (Parker et al., 2011).

The results of the study demonstrated a modest increase in the students' passage reading at their instructional reading level when TDI and IAI were implemented. This finding suggests that the increase in WCPM was a result of the intervention with TDI and IAI. These findings are consistent with previous research that found (a) repeated reading (e.g., Begeny, Daly III, & Valleley, 2006; Gortmaker, Daly III, McCurdy, Persampieri, & Hergenrader, 2007; Musti-Rao, Hawkins, & Barkley, 2009; Nelson, Alber, & Gordy 2004; Persampieri, Gortmaker, Daly III, Sheridan, & McCurdy, 2006; Welsch, 2007) and (b) tablet-assisted instruction (Larson, 2010; Miranda et al., 2012; Pyper, 2011) increase the oral reading fluency of struggling readers. The instructional features of intervention that influenced the findings of the current study are discussed below.

Repeated reading

The results in the study support the theoretical framework of LaBerge and Samuels (1974) that repeated reading builds reading fluency. Repeated reading has been considered an effective approach to provide remedial reading instruction to students with LD (Chard et al., 2002; NPR, 2000; Rasinski et al., 2006; Therrien, 2004). The results of this study also support the findings of Chard et al. (2002), indicating that repeated reading

is an effective procedure that aids students with a low reading fluency rate. There have been several studies that examined the effects of oral reading fluency interventions for students with LD (e.g., Begeny et al., 2006; Gortmaker et al., 2007; Musti-Rao et al., 2009; Nelson et al., 2004; Persampieri et al., 2006; Welsch, 2007); they demonstrated the positive impacts of repeated reading on increasing the oral reading fluency of students with LD.

In the current study, the lesson for oral reading fluency consisted of (a) Preview, (b) Engage Prior/Informal Knowledge, (c) Practice, and (d) Independent Practice. During Engage Prior/Informal Knowledge, students read a list of sight words out loud with their partner in the same group; the teacher followed along and provided error correction where needed. During Practice, students participated in repeated reading with their partner; each student read an assigned text for three minutes. While Reader 1 (the more advanced reader) was reading the text, Reader 2 was asked to follow along and provide assistance if he/she could. When students struggled with unfamiliar words, the teacher provided the word. When Reader 1 finished reading after three minutes, the students reversed roles, and Reader 2 started reading the same text. After six minutes spent on partner reading, each student participated in a repeated reading practice that asked him/her to read the same text for one minute. The repeated reading of the study was conducted according to the general steps suggested in the previous studies (Musti-Rao et al., 2009; Therrien, 2004); instructional components for repeated reading interventions were suggested in Therrien's meta-analysis, such as cued reading, corrective feedback, help from an adult or peer, and charting. The general repeated reading practices involve several steps that include: (a) the student sits with his/her partner with a text at his/her instructional reading level, (b) the student and his/her partner take turns reading each

paragraph of a given text, and (c) at the end of the reading, they read the practiced passage for one minute.

According to Kratochwill et al.'s standard for single-case research designs, there was no strong evidence established for student gains in oral reading fluency following TDI. The "moderate" effects of TDI on oral reading fluency may be attributed to several factors. First, although the main feature of TDI was teacher teaching (without using technology), the use of technological tools such as text-to-speech software may provide effective supplementary instruction for students who need more intensive and remedial fluency instruction. Second, although all four students in the study were identified as having a RLD, a more advanced reader (without RLD) may have played a role as a fluent model, thereby increasing the improvements of struggling readers with RLD. That is, error correction and assistance from a partner who also has RLD potentially might not be the most effective resource; therefore, one-on-one teacher modeling may be more effective, even though it may take more time and be less economically practical for teachers to conduct in a classroom.

Despite the students' improvement on their oral reading fluency in the study, the students' reading fluency rates were significantly below the 50th percentile benchmark score for oral reading fluency. Given the percentile rank associated with the score, the students' oral reading fluency performance at the 50th percentile rank can generally be interpreted as an *average* performance for the student group at their grade at the point in time when their performance was measured. Student performance below the 50th percentile rank is equivalent to a performance that is *below average* (Riverside, 2013). According to benchmark scores for 5th grade students using the EasyCBM passage reading, 5th grade students are classified as being *below average* readers if they read below 166 WCPM. Table 5.1 provides a comparison between the students' recorded

fluency rate on a grade level passage from the EasyCBM and the 50th percentile benchmark score for oral reading fluency. The comparison indicates that Students 1, 2, 3, and 4 read a grade level passage at approximately 69, 80, 78, and 84 WCPM, respectively, which is below the 50th percentile benchmark score (i.e., 166 WCPM).

Student	Student performance (WCPM)	20th percentile benchmark score (WCPM)	50th percentile benchmark score (WCPM)
1	69	131	166
2	80	131	166
3	78	131	166
4	84	131	166

Note. WCPM = words correct per minute

Table 5.1. Comparison between the students' fluency rate and the 20th and 50th percentile benchmark scores

Use of the iPad for oral reading fluency

Although the mean scores of the intervention compared to the baseline of all four students demonstrated that TDI was relatively more effective in building their oral reading fluency, there was minimal difference between the mean scores of TDI and IAI for Student 1. Student improvement on oral reading fluency during IAI relative to the baseline indicates that IAI is a viable approach to help students with RLD with increasing their oral reading rates, as evidenced by their WCPM during IAI.

One of the significant differences between TDI and IAI for oral reading fluency instruction was the feedback and error correction provided by a teacher. One iPad application used for oral reading fluency was *K12 Timed Reading Practice.* This

application allowed students to read texts at their instructional reading level and record their WCPM. However, *K12 Timed Reading Practice* (a) focused on silent reading practice for students and (b) was not equipped with a recording function that recorded the students' reading and allowed them or their teachers to listen to and/or review the students' passage reading performance; the lack of a recording function suggests that the application needs more functions for feedback or error correction. In addition, this iPad application did not provide any images for each topic, a quiz at the end of each text, key words, or dictionary functions.

While reading each passage, however, the students were able to check how much time had passed and how many words they read in a minute, which was shown as a WCPM; this provided the teachers and students with opportunities to monitor progress. More importantly, one of the advantages of using an iPad for reading instruction is its customization capabilities; it provide target students with a variety of texts at different reading levels so that the students can work with reading material at an appropriate reading level (Larson, 2010). By using a touchscreen, which is a common feature of tablet computers (Hutchison et al., 2012), the students were able to easily (a) choose reading texts at their instructional reading level, (b) move on to the next page, (c) click buttons to get more help (if the application provided additional help such as a dictionary or reading texts), and (d) review their WCPM for each text.

Although there was minimal gain in terms of the students' oral reading fluency relative to the baseline, the findings are consistent with recent studies (e.g., Cahill & McGill-Franzen, 2013; Larson, 2010; Miranda et al., 2012; Pyper, 2011) that suggest that technology may provide a novel and motivating approach for supporting students' academic performances. The customization function allowed the researcher and students to choose appropriate reading passages based on the students' instructional reading levels

and to change font sizes and/or paces. Moreover, the iPad application for oral reading fluency easily records and keeps records of their reading performances by using WCPM and graphs. For teachers who want to check student progress in a systematic and consistent way, the tracking record system of iPad applications will be helpful to them for identifying their students' reading difficulties and deficits and for planning next steps (e.g., which skills to place more emphasis on, which reading strategy to use during instruction).

RESEARCH QUESTION 3

Research Question 3 examined how 5th grade students with RLD maintain their word identification and oral reading fluency for one to two weeks after the end of the intervention. All four students maintained their intervention gains in word identification and oral reading fluency over the two-week maintenance phase (i.e., no instruction). The level of all four students' maintenance data points were higher than that of their baseline data points; there were minimal differences (i.e., slight increase or slight decrease from the last intervention data point) between the maintenance and intervention phases. Differences between the mean scores of the maintenance and intervention phases for all four students varied but only minimally.

One of the goals of the present study was to contribute to the growing evidence base suggesting that increases in word identification and oral reading fluency as a function of TDI and IAI are maintained over time (i.e., one week and two weeks after the end of the intervention). Thus, it was hypothesized that the students' word identification and oral reading fluency, as evidenced by WCPM, with both instructional procedures (i.e., TDI and IAI) would exceed that of the baseline condition.

The maintenance data indicates that the students' gains in word identification and oral reading fluency were not only maintained over time, but also that the gains on oral

reading fluency even increased during the maintenance phase (as evidenced by a level increase compared to the mean scores during intervention). For word identification, the results were mixed; Students 2 and 3 demonstrated a level increase during maintenance compared to intervention, and Student 2 showed an increasing trend during the maintenance phase. For oral reading fluency, all four students demonstrated a level increase during maintenance relative to intervention and an increasing trend, suggesting the effects of the intervention maintained over time. Had there been more sessions with the intervention and maintenance, the maintenance phase may have seen more increasing trends and a higher level in the mean fluency rate.

The students' improvement in WRCM for oral reading fluency may be attributed to several factors. First, it is likely that sufficient practice opportunities of passage reading during TDI (i.e., repeated reading with a partner) and IAI (i.e., independent silent reading) allowed the students to generalize their improved reading skills in different situations (e.g., reading textbooks in school, reading for fun at home) even after the intervention; their practice opportunities in different settings with their improved fluent reading may have given them additional chances to continue building their reading fluency skills. In addition, since no instruction occurred during the maintenance phase, their gains in oral reading fluency indicate that the students were able to read independently using concepts and/or skills acquired through TDI and IAI. It is critical to support struggling readers in becoming independent and skilled readers with the increased use of reading strategies.

RESEARCH QUESTION 4

Research Question 4 examined how 5th grade students with RLD generalize their improvements in word identification and oral reading fluency to reading comprehension. For the generalization measure, the Paragraph Construction subtest of the *Test of Reading*

Comprehension – Fourth Edition (TORC-4; Brown et al., 2009) was administered. On the Paragraph Construction subtest, students rearranged sentences to form a coherent paragraph after initially reading a list of sentences that are not in logical order silently.

The performances of three students (i.e., Students 1, 2, and 3) were determined to be "average" (scaled score of 8–12); the performance of one student (i.e., Student 4) was categorized as "below average" (scaled score of 6–7). The results suggest that TDI and IAI may have a positive impact on an important area that was not directly taught as part of the instruction (i.e., reading comprehension) and may improve a student's ability to effectively comprehend what he/she reads; however, this result should be cautiously interpreted because the students also received regular reading instruction (including comprehension instruction) in their general education classroom and special education classroom. For example, the regular reading instruction in the special education classroom occurred in a small group setting (five students) four days a week for 30 minutes and included reading a text and discussing the meaning of the text.

This finding is consistent with previous findings suggesting a tight correlation between reading fluency and reading comprehension (Burns et al., 2004; Hitchcock, Prater, & Dowrick, 2004; Tam, Heward, & Heng, 2006; Welsch, 2007). Reading fluency is a critical component as a bridge from decoding to comprehension (Rasinski, 2004) because a skilled reader needs to understand how to read accurately and quickly to facilitate reading comprehension (Allor & Chard, 2011). Based on the theory of automaticity (LaBerge & Samuels, 1974), when students are equipped with an "ability to read the words in text not only accurately but also automatically or effortlessly" (Morrow et al., 2013, p. 69), they are more likely to comprehend reading texts appropriately.

In Therrien's meta-analysis (2004), he examined the effect of reading instruction (i.e., repeated reading) in increasing reading fluency and comprehension along with the

critical instructional components of repeated reading. For example, if the instruction intends to promote reading fluency and comprehension for a particular passage, cued reading practices and repeated readings of the passage (three to four times) are needed; if the purpose is to improve overall reading fluency and comprehension, corrective feedback needs to be provided and repeated reading until the performance meets the criterion should occur.

RESEARCH QUESTION 5

Research Question 5 examined the TDI- and IAI-related perspectives of 5th grade students with RLD who also have reading IEP goals. After the intervention, a student interview was conducted to determine their preferences on the instructional procedures administered (i.e., TDI or IAI). The students were asked the following six questions:

1. Which did you prefer, the teacher-directed lesson or the iPad-assisted lesson? (Did you like them about the same?)
2. Why did you prefer the lesson? (Why did you like both?)
3. What did you think about the other lesson? What factors made you not choose the other lesson as the better one?
4. Which lesson did you think helped you learn better?
5. Which kept you busier—the teacher-directed lesson or the iPad-assisted lesson?
6. Which one did you look forward to more—the teacher-directed lesson or the iPad-assisted lesson?

Finally, the students were asked if they had any other comments regarding the two methods of teaching that they experienced.

The overall average rating of the researcher-developed social validity questionnaire generally showed positive student views on their experience of intervention

phase of the study (i.e., TDI and IAI) and found that students felt that the intervention was helpful in improving their reading skills (i.e., word identification and oral reading fluency).

Three of the four students preferred the IAI, and one student mentioned he liked both TDI and IAI. For the question that asked why they chose a specific instructional procedure, Students 3 and 4 answered that they liked the iPad (from IAI) because it was fun and easy to work with. The other students (Students 1 and 2) mentioned the customized settings and individualized pace of learning as attractive features of the iPad application. More specifically, Student 1 (who showed the lowest mean score of WCPM in both word identification and oral reading fluency) was in favor of the iPad because the pace of the iPad-assisted instruction was easily adjustable and could be slowed down for him. The results concur with previous studies that noted the increased customizable features of an iPad and its possibility as a new method of individualized instruction (e.g., Larson, 2010; Moody, 2010; Spencer, 2011).

On the other hand, Student 2 (who showed the second highest mean of WCPM in oral reading fluency, followed by Student 3, and who worked with Student 1 in the same group) answered that he preferred working with the iPad (IAI) as opposed to working without the iPad (TDI) because he did not have to wait for his partner (Student 1) to finish his reading; Student 1's reading rate was significantly lower than that of Student 2. Specifically, during TDI instruction for oral reading fluency, the students engaged in the 3-minute reading and followed along while their peer partner read a passage. In Group 1, Student 2 was a relatively more advanced reader than Student 1. Student 2 mentioned the differences in the reading rate between himself and his partner, saying, "TDI takes longer if I read faster than my friend" even though three minutes was equally assigned to each student during the partner reading. Tablet technology such as the iPad may provide the

answer to this challenge of the partner reading activity for students with different reading levels; Simpson, Walsh, and Rowsell (2013) suggest that elementary school students with mixed reading abilities could equally partake in iPad reading practices together, and the students were more inclined to work with their partner when they worked with the iPad than with printed texts. When the students were asked to go to a certain website, choose an article to read, and share with the class what they have found, the students worked collaboratively by checking each other's work on their screens. For example, one student tapped on a website and expanded the item of interest on the website to display the information to the other student; then, the other student tapped on another item to share with his/her partner. Future research should find better ways to examine and facilitate the dynamic interactions of pairs of students with different reading levels.

For the question asking which instructional procedure helped them learn better, two students answered IAI, and the other two students answered TDI; the two students who answered TDI noted that the SPLIT strategy was helpful. For the question that asked about which instructional procedure kept them busier, all the students answered that it was TDI that kept them more occupied. Student 4 answered that the 3-minute partner reading especially kept him busy. It is interesting that all students identified TDI as more engaging instruction that kept them relatively busier; the results are consistent with previous findings (e.g., Allen, 1998; Bremer et al., 2002; Brown, 2006; Guthrie & Wigfield, 2000). For those students who struggle with decoding words, they find reading stressful and avoid the task of reading. The opportunity to apply strategies, however, can afford struggling readers purposeful and authentic reinforcement (Allen, 1998) because word identification strategies provide students with LD with a mental toolbox as a way to tackle their challenges in content area reading, and by developing their skills in word identification, they can achieve more success in content area classes (Bremer et al.,

2002). When it comes to student engagement in TDI, Brown (2006) suggests peer talk (in partner reading) encourages students to engage in reading activity meaningfully; for example, peer talk supports students in sounding out difficult words together and resolving word difficulties by telling one another the unfamiliar words.

When students in this study were asked which instructional procedure they looked forward to more, one student answered IAI and the other three students answered TDI. For the final comment, Student 1, who participated in the study during his lunchtime, mentioned he was excited to learn during intervention because he was able to receive "extra help." Students' engagement and their reading achievement can be synergistic because the more students achieve or feel success in reading, the more they are engaged; the more they are engaged in reading, the more they achieve. Therefore, reading engagement should be cultivated as an essential component of reading instruction (Guthrie, McGough, Bennett, & Rice, 1996) and is required to comprehensively include not only behavioral engagement (e.g., participation in class activities, concentration, effort) but also emotional (e.g., reporting interest, enjoyment, fun, and excitement; having positive relationships with teachers and peers) and cognitive engagement (e.g., applying metacognitive strategies, solving problems) (Fredricks et al., 2011).

RESEARCH QUESTION 6

Research Question 6 examined the perspectives of 5th grade students on their own reading; these students have RLD and also have reading IEP goals. Pre- and post-test questionnaires were given to the students before and after the intervention. The questionnaire included 14 questions regarding their perspectives on their reading performances (e.g., "I am a good reader," "Reading is interesting and exciting," "My friends like reading more than I do") and asked the students to report their perspectives, ranging from "Yes, definitely!" to "No, definitely." The evaluation employed a 4-point

Likert-type scale (1 = No, definitely, 2 = Disagree, 3 = Closer to Yes, 4 = Yes, definitely).

Comparing the results from the pre-test (i.e., before intervention) to the post-test (i.e., after intervention), the students showed (a) increased positive attitudes on 7 of the 11 items that had been positively phrased, such as, "It's fun to read" and (b) decreased negative attitudes on 2 of the 3 items that had been negatively phrased, such as, "Someone who likes reading is usually weird." Some degree of significant differences between the pre- and post-test were found in items such as (a) "Reading tests are usually easy for me" (from a scale of 1.75 on the pre-test to 3 on post-test) and (b) "I'd rather do reading than any other kind of homework" (from a scale of 2 on pre-test to 3.25 on the post-test).

A student's reading attitude plays a pivotal role in the development of lifelong reading skills (Lazarus & Callahan, 2000). The four students in the study mentioned that "reading is fun" and "they enjoy reading for fun at home," suggesting that intervention increased the students' positive attitudes toward reading. Intervention in the study increased student perspectives on reading as a source of excitement and interest. According to Lipson and Wixson (1992), a student's reading attitude is critical because it is "a central factor affecting reading performance" (p. 141). Therefore, educators and caregivers of students who are learning how to read need to consistently highlight the pleasure of reading so that the students themselves will continue enjoying reading voluntarily beyond elementary school. Fletcher, Grimley, Greenwood, and Parkhill (2012) argue that teachers should be aware that students may not consider reading "cool" and that they should develop a range of reading strategies to make reading activities fun.

The majority of the students in the study noted that they enjoy reading for fun at home; intervention increased their positive attitudes toward having more time for reading

at home. Based on the findings, educators and caregivers should continue to encourage reading practices, especially as a form of entertainment. At home, student activities such as playing video games tend to take precedence over reading activities; caregivers need to help their children make quality time for reading outside of school. Similarly, a student's afterschool activities should include reading as a part of the program.

Three out of four students in the study felt that reading tests are usually easy for them. In the post-test, immediately after the intervention, more students felt that reading tests were usually easy when compared to their attitudes before the intervention. During the intervention, the students took a statewide-standardized test that included reading. On the pre-test (before the intervention), all four students answered that they generally disagreed with the statement that reading tests were usually easy for them. On the post-test (i.e., after intervention), however, three of the four students agreed that the reading tests were usually easy.

The students' positive attitudes toward their reading should not be reliant on teacher assistance or the reading programs provided. For their reading success, it is critical for the students to practice and implement reading strategies and to comprehend reading texts independently. Retelling activities or discussions about a book (e.g., through a Book Club) are good examples of ways to encourage students to develop independent reading skills. During the post-test, three of the four students in the current study noted that they liked to talk about the books or stories they read. It seems to be helpful for educators to embed short discussions about reading materials into their reading instruction so that they can check students' understanding of their reading and provide appropriate assistance. By asking students to talk about the book or stories they read (i.e., retelling), students have opportunities to more actively engage in reading activities. Specifically, during intervention, the students liked to share their thoughts and

experiences relevant to the topic or characters they read about in the text; they told the researcher that (a) they have read similar stories to what they were reading during the study and (b) they had the same feelings that the main character of a given story had. Teachers need to know when and how to initiate and lead discussions and how to assist students in better comprehending books or stories.

The relationships among students' reading attitudes, motivation to reading, and reading achievement have been examined in previous studies (e.g., Byrne, 2007; Fletcher et al., 2012; Smith, Smith, Gilmore, & Jameson, 2012) that have revealed mixed results because of the complex interaction of various factors. Unfortunately, a student's positive reading attitude tends to decline across the elementary school years gradually and steadily (McKenna, Kear, & Ellsworth, 1995). Taken together with the findings from previous studies, it is suggested that teachers need to help students mitigate the deterioration of their positive attitudes toward reading, which often occurs during upper elementary school or middle school.

Limitations

There are four particular limitations in this study that warrant examination. First, although the study employed a combined design (i.e., an alternating treatments design combined with a multiple baseline design across four students in two groups) and individual student data was collected, replications occurred only twice across the two groups of two students. In the single-case research design that was employed in this study, effect replication is important to control threats to internal validity, and the criterion of three replications is suggested to "meet evidence" standards (Kratochwill et al., 2010). Although no formal basis has supported the criterion of three replications, the criterion is more of a conceptual norm that is recommended as a methodological standard for single case designs (Kratochwill & Levin, 2010). Because (a) replications are

important for experimental control (Horner et al., 2005; Horner & Odom, 2013) and (b) confidence in the validity of the effects demonstrated can be improved by replication of the effects (Horner & Spaulding, 2010), at least three replications across the students are recommended.

Second, the iPad applications did not provide the same error correction and feedback as the teacher did during TDI. One iPad application used for word identification (i.e., *Howie Finding Vowel*) informed students of correct answers and provided students with a second try. During the IAI for oral reading fluency that used *K12 Timed Reading Practice*, the application recorded a student's WCPM for each passage but did not provide error correction or feedback. On the other hand, during TDI for oral reading fluency, students participated in 3-minute partner reading and were given feedback and error correction by the teacher or his/her peer partner. Although the intention of the study was to compare the effects of (a) learning with a teacher and peers to that of (b) learning with the iPad itself, the study could diminish the threats to internal validity by managing the IAI intervention to more closely align with the TDI intervention.

Third, having only 14-minute instruction sessions for each word identification and oral reading fluency activity was not sufficient to build reading skills. Specifically, the SPLIT strategy was taught for only 10 minutes, because 4 minutes were spent on daily progress monitoring. The 10-minute strategy instruction was not sufficient for the students to get familiar with the steps in SPLIT and to learn how to use the strategy to identify unknown and/or unfamiliar words. More importantly, due to a field trip, state-based assessments of academic readiness, and the general school schedule (e.g., fire drills, early release), interventions were not regularly conducted (e.g., three sessions per week in Week 9 and one session per week in Week 10). The time between intervention

sessions may have influenced the effects of the intervention itself. Thus, the study may have benefited from a longer period to conduct intervention on a more regular basis.

Another limitation was the students, themselves. There were some days when the students were not feeling well (due to the unusually bad weather in the area) or were having a bad day for unknown reasons. Finally, the availability of a distraction-free classroom for 100% of the intervention sessions was another limitation. The classroom where the study was conducted was shared with another session led by a special education teacher with other students with special needs. Although the teacher taught the student in the corner of the same classroom, the four students in the study had to ignore some distractions from the other session.

Future Research

The findings of this study provide several suggestions for future research. First, the effects of iPad applications on word identification and oral reading fluency should be further explored by examining their effects with a larger sample of elementary school students with LD. Additionally, to ensure internal validity and establish experimental control of single-case research designs, at least three demonstrations of replication and/or randomization should be achieved (Kratochwill et al., 2010; Kratochwill & Levin, 2010). Kratochwill and Levin suggested incorporating randomized experimental schemes into single-case designs as a way of drawing conclusions that are more valid. For example, *randomized* multiple-baseline design involves randomly assigning each unit to a staggered sequence. This strengthens the internal validity of the research design relative to the previous non-randomized multiple-baseline design that has no indication of randomly assigning the unit replicates to the staggered intervention start points. If a randomized multiple-baseline design is employed then, each group of students would be exposed to the sequential introduction of intervention in a random order.

Second, future research needs to consider (a) the development of iPad reading applications that include effective instructional components such as corrective feedback (Chard et al., 2002), skill modeling, and scaffolding (Swanson & Deshler, 2003) and (b) combined instruction (i.e., TDI combined with IAI). The combined instruction allows students to receive feedback and error correction from a teacher and then to practice reading skills with an iPad, which potentially ensures higher engagement and higher levels of motivation. In this study, the relative effects of TDI and IAI were examined by comparing students' TDI outcomes to their outcomes with IAI. In both TDI and IAI, the learning contents, such as syllable patterns, were consistent across both instructional procedures; however, because of the primary purpose of the study (i.e., examining the effects of the iPad application itself) and the limited number of iPad reading applications teaching syllable patterns, the content taught through both instructional procedures was not exactly identical. In addition, effective instructional components that were embedded in TDI (i.e., the instruction by a teacher) did not exist in IAI. For example, students were helped by error correction and feedback from their teacher and peers during TDI; they did not receive such help during IAI.

Third, the relative effects of TDI and IAI should be further explored through longer intervention sessions. That is, in-depth examination that focuses only on either word identification or oral reading fluency should be conducted, thereby an increase in the time for the intervention is required. This study examined the effects of two instructional procedures on word identification and oral reading fluency. Each word identification or oral reading fluency lesson was taught for approximately 14 minutes. Considering the lesson components of the study (e.g., preview, engage prior knowledge, demonstrate, practice, and independent practice), a 14-minute session was insufficient.

Future research should examine a longer period of instruction with TDI and IAI in order to draw a more valid conclusion.

Finally, the high percentage of word overlap between instruction and progress monitoring should be examined. In this study, four students received TDI and IAI for over six weeks, and their word identification and oral reading fluency were measured by EasyCBM word reading and passage reading, which were not used during instruction. A high word overlap between passages for instruction and passages for progress monitoring was not intended and was not part of the research question; the materials for instruction and progress monitoring were different from each other, which indicate that there was relatively low word overlap. Typically, high word overlap passages include approximately 80% or more of the same words that students practiced during instruction (Daly, Martens, Dool, & Hintze, 1998). Based on previous studies that support the use of passages with a high percentage of word overlap (e.g., Daly, Bonfiglio, Mattson, Persampieri, & Foreman-Yates, 2005; Daly, Martens, Hamler, Dool, & Eckert, 1999; Persampieri et al. 2006), future research should examine the relative effects of TDI and IAI by ensuring a high percentage of word overlap between passages for instruction and passages for progress monitoring exists.

Implications for Practice

There were practical implications for this study. First, teachers can use an iPad reading application as a tool to teach word identification and oral reading fluency. During the interview with the four students, they noted that they found working with the iPad helped them to learn reading in a fun and easy manner. One student mentioned the individualized pace of iPad applications as an advantage of using iPads for reading. In addition, student interview data revealed that all students preferred IAI over TDI; for the question about the treatment they preferred, three students were in favor of IAI and one

student mentioned both TDI and IAI. The results from word identification and oral reading fluency activities during IAI demonstrated moderate experimental control. With the customization function of iPad applications according to an individual student, reading passage levels, font size, font color, and contents can be customized.

Second, a rubric for finding good iPad applications can be used by teachers who would like to embed tablet technologies into their everyday reading instructions. When IAI was compared to TDI, some instructional features such as error correction, scaffolding, and feedback were found to be relatively lacking in IAI. Teachers can utilize the rubric to find good iPad applications that incorporate effective instructional components and better fit their lesson objectives. Because of the differences in instructional components that TDI and IAI include, teachers can focus on the specific features of each iPad application and decide how best iPad-assisted reading instruction could be implemented.

Third, teachers can consider students' instructional reading levels when pairing students for partner reading. In this study, while the students worked independently in IAI, they worked with their partner in a group during TDI. Specifically, they participated in 3-minute partner reading (i.e., reading a passage for three minutes and taking turns) and the first reader followed along and provided feedback when his/her partner (i.e., the second reader) read the passage. In the student interview, the more advanced reader (Student 2) in Group 1 noted that he preferred IAI because of its customizable pace; according to him, he did not have to "wait" until his partner finished his reading as he did during TDI. Although each student was equally assigned three minutes to read the text, Student 1's less fluent reading made Student 2 think the TDI necessarily took more time. Teachers need to consider any potential influence as well as student reading level when pairing students.

Fourth, teachers can use partner reading to improve students' oral reading fluency by pairing less proficient readers with more proficient readers. The more proficient reader reads the passage first, followed by his/her partner. The partners continue taking turns until they complete the passage. Students should be given multiple opportunities to read the same text; research suggests rereading passages at least twice is more effective in enhancing oral reading fluency than reading a passage only once (O'Shea, Sindelar, & O'Shea, 1987; Sindelar, Monda, & O'Shea, 1990). Although students showed a level increase on oral reading fluency during intervention relative to baseline, their mean WCPM scores during intervention were still below the 50th percentile benchmark score for oral reading fluency. Therefore, teachers of upper elementary students should be advised to continue teaching word identification and oral reading fluency skills even though content area reading instruction is the instructional focus for students who are beyond primary grades. To actively engage students in reading, the teacher should ask them what the text is about (Jenkins, Heliotis, Stein, & Haynes, 1987) and provide students with questions (student- or teacher generated) to help them respond to the text (Vaughn & Linan-Thompson, 2004).

Finally, feedback and error correction from a higher-performing peer or teacher should be considered. Lack of detailed and prompt feedback of technology-assisted instruction has been discussed in studies that examined the effects of computer-assisted instruction over 30 years ago (e.g., Brudenell & Carpenter, 1990; Cartwright & Derevensky, 1976; Day & Payne, 1987; Richardson, 1994); the findings from the current study suggest that technology-assisted instruction today still lacks the detailed and prompt feedback relative to teacher-directed instruction. During TDI for word identification in the study, four students were provided error correction when they were practicing the SPLIT strategy. Specifically, Step 1 of SPLIT, *See the syllable patterns*,

required students to identify syllable patterns of given words (e.g., cookbook, interesting, dreamer) and required the teacher to provide several pieces of immediate feedback. While students need to understand syllables and identify syllable patterns (Bryant et al., 1999; Bryant et al., 2008; Lenz & Hughes, 1990) to decode unfamiliar words, systematic feedback and error correction should be ensured in direct, explicit, and systematic instruction to help the students reduce the number of mispronunciations, omissions, and substitutions that may occur when reading challenging texts.

Summary

The purpose of this study was to examine and compare the effectiveness of TDI and IAI on the word identification and oral reading fluency of elementary school students with RLD who have reading goals on their IEPs. Given the importance of numerous challenges students with RLD face when it comes to word identification (Ayala & O'Connor, 2013; Gustafson et al., 2011; Jenkins, 2002; Shaywitz & Shaywitz, 2005) and oral reading fluency (Chard et al., 2002; Vaughn & Linan-Thompson, 2004; Shaywitz & Shaywitz, 2008), teaching a word identification strategy (Bos & Vaughn, 2009; Bryant et al., 2008; Chard & Osborn, 1999; Combs, 2011; Ehri, 2005; Gaskins & Ehri, 1996; Lenz & Hughes, 1990) and repeated reading practices (Chard et al., 2002; Chard et al., 2009; NRP, 2000; Therrien & Kubuina, 2006) warrant further research.

The results of the study revealed moderate evidence that TDI and IAI are effective in improving the word identification and oral reading fluency of students, as evidenced by their higher scores on instructional probes during the intervention and maintenance phase compared to the baseline. Although there was no clear differentiation between the two instructional procedures, TDI and IAI, the level of change from the baseline to the intervention phase supports the effects of TDI and IAI. Additionally, student perspectives about intervention and their reading demonstrated that the students

had preferences for both instructional procedures, and they increased their positive attitude toward their reading following the intervention. The findings of the study suggest that strategy instruction and repeated reading practices are promising ways to help students with RLD, and that tablets can be incorporated in the classroom as a new way of effective teaching.

Appendices

APPENDIX A

Parental Permission for Child Participation in Research and Child Assent

You are being asked to allow your child to participate in a research study. This form provides you with information about the study. We will provide you with a copy of this form to keep for your reference, and will also describe this study to you and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your child's participation is entirely voluntary and you may refuse to allow your child to participate or withdraw your child from participation without penalty or loss of benefits to which you are otherwise entitled. The researcher will provide you with a copy of this consent for your records.

Title of Research Study:

A Comparison of the Effects of Reading Interventions on the Word Identification and Oral Reading Fluency of 5th Grade Students with Learning Disabilities
IRB PROTOCOL # 2013-11-0020

Principal Investigator, UT affiliation, and Telephone Number:

Min Kyung Kim, M.Ed., Principal Investigator, Doctoral Student, The Meadows Center for Ed. Risk, The University of Texas at Austin, 512-800-3305.

Diane P. Bryant, Ph.D., Investigator, Research Professor, The Meadows Center for Ed. Risk, The University of Texas at Austin, 512-784-7346.

What is the purpose of this study?

The purpose of this study is to investigate the effect of iPads on the reading performance of students with learning disabilities (LD).

What will be done if your child takes part in this research study?

The instruction will take place at the UT Elementary School during lunch hours. The tutoring will begin in January and may last for 5 weeks. Each intervention session will occur 5 days per week for 30 minutes each session for the duration of 5 weeks (total 22 sessions). At the end of every session, your child will be assessed using a Reading Curriculum Based Measure.

If you provide consent for your child to be in this study, we will ask the following:

- That your child is present during the entire intervention time.
- The instruction sessions will be audio recorded.
- That you allow us to review your child's school record to get information about your child including
    - Age, birth date
    - Ethnicity
    - Free/Reduced Lunch Status
    - ELL Status

    - Special Education Status
    - Texas Assessment of Knowledge and Skills scores (from previous years)
    - State of Texas Assessments of Academic Readiness or some other test score (if applicable)
    - Individualized Education Program information
    - Achievement testing information
- That you allow your child to participate and receive two types of instruction, including iPad-assisted instruction (IAI) and teacher-directed instruction (TDI) from the teacher using a research-based lesson and activities to assist in the learning process. All activity sheets will contain an ID number for confidentiality.

Project Duration:
The project will begin in January and will last for about 5 weeks. Each intervention session will occur 5 days per week for 30 minutes each session for the duration of 5 weeks (total 22 sessions). The intervention may run more than 5 weeks depending on accuracy and mastery of the learning materials.

Total estimated time to participate: your child will not be asked to spend more than 30 minutes each session. His/her instructional day will not be disturbed.

What are the possible discomforts and risks?
The possible risks and discomforts your child may experience during participation in this study are expected to be minimal and no greater than in everyday life. We will work closely with the child to make the experience positive and at any time a student and/or parent may remove the student from the intervention. This observation study may involve risks that are currently unforeseeable. If you wish to discuss the information above or any other risks you or your students may experience, you may ask questions now or call Ms. Kim using the contact information listed above.

What are the possible benefits to you or to others?
First of all, even though there may be no direct benefits for participants in the study, your child may benefit from receiving instruction using iPads in learning. Determining the effects of using an iPad for academic improvement of participants who have LD will lead to a better understanding of effective instructional practices. Also, descriptions of exemplary instructional practices using an iPad will serve as a model for other teachers or schools who provide students with LD with lessons in various subjects. Finally, the success of effective instructional practices associated with the use of an iPad will suggest that the use of this device is worth serious consideration and research in similar contexts.

What if your child is injured because of the study?
We cannot see any reason why your child would be injured during this project. If your child becomes sick during intervention time, we will contact your child's teacher immediately.

If you do not want your child to take part in this study, what other options are available to you?
Your child's participation in this study is entirely voluntary. Your child is free to refuse to be in

the study, and your refusal will not influence current or future relationships with The University of Texas at Austin or The UT Elementary School.

Compensation:

- All students who return this form will receive a small item like a pencil if they decide to participate or decide not to participate.
- Beyond the benefits previously mentioned, additional compensation will not be offered to students who participate in this research study.

Confidentiality and Privacy Protections:

- A unique ID number will be assigned to each child. This number will be used instead of your child's name on all documents.
- All identifying information will be kept in a locked filing cabinet located within a locked office.
- Only two researchers involved with the study will have direct access to identifying information.
- At the end of the study, all identifying information will be destroyed.

The records of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin and members of the Institutional Review Board have the legal right to review your child's research records and will protect the confidentiality of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify your child as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your child's participation call the researchers conducting the study. Their names and phone numbers are at the top of this form. If you have questions about your child's rights as a research participant, complaints, concerns, or questions about the research please contact The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects, (512) 471-8871 or email: orsc@uts.cc.utexas.edu.

You may keep a copy of this consent form.

You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow him or her to participate in the study. You may discontinue his or her participation at any time. Please check one of the boxes below, sign and return to researcher.

Signatures:

You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. You voluntarily agree to have your child participate in this study. By signing this form, you are not waiving any of your legal rights.

Printed Legal Name of Your Child	**Date**

Signature of Parent of Legal Guardian	**Date**

Student Agreement for Study Participation

***Parents: After reading the permission form, please remember to read the form to your child or discuss the information with him/her.**

I agree to be in a study about instruction using iPads. This study was explained to my parents or guardians and they said that I could be in it. The only people who will know about what I say and do in the study will be the people in charge of the study.

If I agree to be in this study, the people in charge of the study will look at activity sheets that I will do during the instruction. I may be selected to participate in short lessons that might help me with my schoolwork and the researchers will want to see how I am doing.

The teacher will also have an audio recorder recording his or her teaching. If he or she talks directly with me, the instruction also may be recorded but my name will not be used. No one will be able to know who I am in the recording.

Writing my name on this page means that the page was read to me and that I agree to be in the classroom while the UT researcher is observing my class and do not mind if the instruction is recorded while the researcher is working directly with me. If I decide to quit the study, all I have to do is tell the person in charge.

_____ _____

Child's Signature **Date**

APPENDIX B

EasyCBM Word Reading (Student Copy)

Student Copy **Form 3-1**

Word Reading

I	way	great	all	sun	but	work	under
left	ball	below	always	took	new	move	who
side	dollars	found	passed	watch	rich	crops	another
father	history	isn't	ready	amount	trails	matter	waves
shape	early	clear	sense	cannot	taxes	square	vowel
base	single	difference	even	ago	suddenly	pair	cattle
probably	caught	control	return	serve	heavy	president	realize
branches	action	exciting	suppose	equal	force	mind	thick
chance	blood	business	capital	human	coast	fair	governor
settled	tube	understand	entered	electric	silent	value	spread
ten	don't	dropped	under	top	bill	small	when
I'm	myself	deep	anyone	name	open	clean	farming
getting	didn't	journal	through	really	anything	wait	pair
fossil	realize	community	federal	caught	practice	general	resources
century	senior	irrigate	commercial	astronaut	urban	divided	though
crisis	mulch	adapt	military	canyon	rise	human	lifted
terms	special	independent	straight	control	protest	uncle	members
hours	terror	followed	strange	branches	chance	current	silent
observe	increase	supply	coast	captain	brought	entered	island
English	printed	square	thought	journal	complete	compare	believe
movement	blood	shoulder	value	factories	among	wire	rhythm
received	cultivate	legal	spread	statement	thick	silent	reached

EasyCBM Word Reading (Assessor Copy)

Assessor Copy **Form 3-1**

Student Name: _____ Date: _____

Word Reading

Directions: Place the "Word Reading Student Copy" probe in front of the student and say, **"Please read from this list of words. Read across the page and then on to the next row."** Demonstrate by sweeping your finger from left to right across the first two rows of words. Start timing when the student begins reading. Mark a bracket] after the last word read. If a student self corrects, write S.C. above the word and count as correct. If they say an incorrect word, mark a ~~slash~~ through the word, and count as incorrect. If they hesitate more than 3 seconds, supply the word and count as incorrect. If a student skips a words, circle the word and count it as incorrect. **Note: This is a 60 second timed test.**

I	way	great	all	sun	but	work	under	8
left	ball	below	always	took	new	move	who	16
side	dollars	found	passed	watch	rich	crops	another	24
father	history	isn't	ready	amount	trails	matter	waves	32
shape	early	clear	sense	cannot	taxes	square	vowel	40
base	single	difference	even	ago	suddenly	pair	cattle	48
probably	caught	control	return	serve	heavy	president	realize	56
branches	action	exciting	suppose	equal	force	mind	thick	64
chance	blood	business	capital	human	coast	fair	governor	72
settled	tube	understand	entered	electric	silent	value	spread	80
ten	don't	dropped	under	top	bill	small	when	88
I'm	myself	deep	anyone	name	open	clean	farming	96
getting	didn't	journal	through	really	anything	wait	pair	104
fossil	realize	community	federal	caught	practice	general	resources	112
century	senior	irrigate	commercial	astronaut	urban	divided	though	120
crisis	mulch	adapt	military	canyon	rise	human	lifted	128
terms	special	independent	straight	control	protest	uncle	members	136
hours	terror	followed	strange	branches	chance	current	silent	144
observe	increase	supply	coast	captain	brought	entered	island	152
English	printed	square	thought	journal	complete	compare	believe	160
movement	blood	shoulder	value	factories	among	wire	rhythm	168
received	cultivate	legal	spread	statement	thick	silent	reached	176

 # Correct _____

APPENDIX C

EasyCBM Passage Reading (Student Copy)

Student Copy **Form 4-1**

Victor was nine years old when he visited his very first amusement park. He went with his friends Joe, Jim, and Tom. Joe's parents drove them to the park early in the day. The boys were excited and wanted to make the most of the experience. They wanted to have plenty of time to ride each ride. They had a great idea of how they could do this. They had decided to start at one end of the park and ride each ride, one after the other, until they had worked their way across the entire amusement park. This way they would not miss anything!

The boys rode every one of the roller coasters. They held their hands up high in the air as the roller coaster climbed up the tracks. Then they screamed, keeping their hands raised, as the roller coaster sped down the hill and whipped around the steep curves. The boys enjoyed each ride! They also rode the bumper cars and loved crashing into one another while rapidly racing around the track. It was exciting, jolting and loud - all at the same time. The haunted house was Tom's favorite ride! Every few seconds, something would jump out of the darkness and scare the boys. They screamed until their throats were sore. Before realizing it, two hours had passed and the boys had to rush to meet Joe's parents. They did not want to be late. They were already planning to ask if they could return next weekend.

EasyCBM Passage Reading (Assessor Copy)

Assessor Copy **Form 4-1**

Student Name: _____ Date: _____

1. Place the Student Copy in front of the student. Point to the names on the Student Copy as you read them:

   "**This is a story about Victor, Joe, Jim and Tom. I want you to read this story to me. You'll have 1 minute to read as much as you can. When I say "begin," start reading aloud at the top of the page. Do your best reading. If you have trouble with a word, I'll tell it to you. Do you have any questions? Begin.**"
2. Start the timer.
3. While the student is reading, mark errors with a slash (/).
4. At 1 minute, mark the last word read with a bracket (]).
5. When the student gets to a logical stopping place, say "**Stop**."

Victor was nine years old when he visited his very first amusement	12
park. He went with his friends Joe, Jim, and Tom. Joe's parents drove	25
them to the park early in the day. The boys were excited and wanted to	40
make the most of the experience. They wanted to have plenty of time to	54
ride each ride. They had a great idea of how they could do this. They had	70
decided to start at one end of the park and ride each ride, one after the	86
other, until they had worked their way across the entire amusement park.	98
This way they would not miss anything!	105
The boys rode every one of the roller coasters. They held their	117
hands up high in the air as the roller coaster climbed up the tracks. Then	132
they screamed, keeping their hands raised, as the roller coaster sped down	144
the hill and whipped around the steep curves. The boys enjoyed each ride!	157
They also rode the bumper cars and loved crashing into one another while	170
rapidly racing around the track. It was exciting, jolting and loud - all at the	184
same time. The haunted house was Tom's favorite ride! Every few seconds,	196
something would jump out of the darkness and scare the boys. They	208
screamed until their throats were sore. Before realizing it, two hours had	220
passed and the boys had to rush to meet Joe's parents. They did not want	235
to be late. They were already planning to ask if they could return next	249
weekend.	250

Total Words Read:_____ - # of Errors:_____ = CWPM:_____

APPENDIX D

Scoring Instruction for easyCBM Word Reading

Word Reading Fluency (WRF) – Kindergarten through Third Grade

1. Place the student copy marked "Word and Sentence Reading" in front of the student. Begin with **Word Reading** then move on to **Sentence Reading.**
2. Read the directions to the student exactly as written on the assessor copy.
3. Put a slash through any word the student misses. You may want to use a cover sheet to reveal only the words in the row or sentence the student is reading. If the student is unable to read any words in the first three rows, discontinue the test. Note this on the test. **This is a 60 second timed test.**
4. Start the stopwatch when the student says the first word as you begin each test.
5. Place a bracket after the last word read.

Word Reading Scoring Directions

1. If the student does not get any words correct within the first three rows, discontinue the test and record a score of zero.
2. If the student hesitates for three seconds on a word, the word is scored incorrect and the word is provided to the student.
3. If the student makes an error then self corrects within 3 seconds, the assessor writes "SC" above the word and it is not counted as an error.
4. If a word or an entire row is skipped, the assessor should help the student find his/her place. This would not be counted as an error if the student reads the word correctly.

Errors are marked by putting a slash through any missed words.

Examples: **sc**

the	or	will	number
of	about	remain	no

APPENDIX E

Scoring Instruction for easyCBM Passage Reading

Passage Reading Fluency (PRF) – First Grade through Eighth Grade

1. Read the directions to the student exactly as written on the assessor copy.
2. Go over all proper nouns in the passage before beginning the timing.
3. This is a **one minute timed test**.
4. Begin timing when the student says the first word of the reading passage.
5. Place a bracket after the last word read.
6. If the student does not read any words correctly in the first line of the first passage, discontinue the task and record a score of zero.
7. If a student does not supply a word within 3 seconds, the word is provided and the error is marked with a slash through the word.
8. Omitted words are scored as incorrect and marked with a slash through the word.
9. If a student hesitates or struggles with a word for 3 seconds, tell the student the word and mark the word as incorrect.
10. If the student makes an error then self corrects within 3 seconds the assessor writes "SC" above the word and it is not counted as an error.
11. Inserted words are ignored and not counted as errors.
12. At the end of the test, the assessor should fill in the spaces indicating Total Words Read, Errors, and Total Correct Words.

APPENDIX F

Flesch–Kincaid readability for EasyCBM Passage Reading

Grade Level	Passage #	F-K Level
1	1	1.6
1	2	1.4
1	3	1.3
1	4	1.5
1	5	1.5
1	6	1.6
1	7	1.1
1	8	1.2
1	9	1.1
2	1	2.6
2	2	1.9
2	3	2.4
2	4	2.4
2	5	2.1
2	6	2.3
2	7	2.6
2	8	2.4
2	9	2.2
3	1	3.7
3	2	3.5
3	3	3.6
3	4	3.7
3	5	3.2
3	6	3.5
3	7	3.4
3	8	3.5
3	9	3.7
4	1	4.1
4	2	4.3
4	3	4.4
4	4	4.2
4	5	4.4
4	6	4.1
4	7	4.3
4	8	4.0
4	9	4.5

APPENDIX G

SPLIT Poster

SPLIT

- **S**ee the syllable patterns.
- **P**lace a line between each syllable.
- **L**ook at each syllable.
- **I**dentify the syllable sounds.
- **T**ry to say the word.

CO3V Poster

C = Closed (pan, that)

O = Open (so, he)

3V =

Vowel pair (meal, pail)

Vowel-*r* (star, dirt)

Vowel-consonant-*e* (make, rope)

APPENDIX I

Sample TDI Lesson 4 for Word Identification

Total Time: 14 minutes

Lesson 4

Syllable Patterns

Lesson Objectives	Students will recognize common syllable patterns and use that pattern to identify multisyllabic words.	
Instructional Materials	**Teacher**	**Student**
	• Multisyllabic word list • EasyCBM • TM1, TM2	• Multisyllabic word list containing up to two syllable patterns • SB1, SB2

Preview

Say: **Today we will learn how to find a common syllable pattern and use that pattern to identify the whole word.**

Engage Prior/Informal Knowledge Time: 2 min

Review a vowel-r and a vowel pair syllable.

Say: **Today we will work with syllable patterns: Vowel-r and vowel pair syllables. With a vowel-r, the vowel makes an unexpected sound – it doesn't make its common sound nor say its own name. In a vowel-r syllable, what letter comes after the vowel,** *(student name)***?** *(Student name)***, with a vowel-r syllable, does the vowel make its common sound, a long sound, or an unexpected sound?** *(unexpected sound)* **A vowel pair syllable has two vowels side by side. How many vowels does a vowel pair syllable have?** *(two)* **And they're side** *(pause; by side) (Student name)***, give me examples of the two vowels that you might see in a vowel pair syllable?** *(ea, ee, oo or other pair)*

On the white board, write *thir/teen*. *Give one student a marker.*

Say: **Underline the vowel-r syllable.** *(thir; Then give the other student the marker.)*

Say: **Underline the vowel pair syllable.** *(teen)*

Demonstrate Time: 4 min

Have SB1: Peter Likes to Play in the Rain and TM1: Peter Likes to Play in the Rain
Show SB1 to each student, which contains at least one one-, two-, or three-syllable words with vowel-consonant-e and vowel pair syllable.

Model how to circle a vowel-r syllable word as an example and have the students circle another vowel-r syllable word in the passage.

Say: **Now I will show you how to find and circle a word with a vowel-r syllable. I found "Peter" with the vowel-r syllable. Find another word with a vowel-r syllable and circle it. Then say it.**

Give each student a chance to find, circle, and say a vowel-r syllable.

Model how to underline a vowel pair syllable word as an example and have the students underline a vowel pair syllable word.

Say: **Now I will find and underline a word with a vowel pair syllable. I found "rain." Find another word that has a vowel pair syllable and underline it.**

Have the students underline and say a vowel pair syllable word. Check for understanding. Then have the students circle and name all vowel-r syllable words and underline and say all vowel pair syllable words. Listen as best you can to the students' pronunciation of the words.

Practice — Time: 4 min

Have the students go back to the beginning of the passage and read the entire passage after identifying the vowel-r and the vowel pair syllable words.

Say: **Review for 1 minute the circled and underlined words before you start reading. Then we will go back to the beginning of the sentence and read the sentences.** *Pause 1 minute.*
*(Student name)***, read the first sentence out loud** *(check for understanding)***.**
*(Student name)***, read the next sentence out loud.**

Follow along and provide error correction when needed. Check to make sure the student stops reading at the end of the sentence. Now show the students SB2: List of Vowel-r and Vowel Pair Syllable Words. Follow along with TM2: List of Vowel-r and Vowel Pair Syllable Words. Have them take turns reading words aloud, and check for understanding and provide needed error correction.

Independent Practice — Time: 4 min

Place the "EasyCBM 3-9" probe in front of the student and start the audio recorder.

Say: **Read from this list of words. Read across the page and then on to the next row.**

Demonstrate by sweeping your finger from left to right across the first two rows of words. Start timing when the student begins reading. Mark a bracket] after the last word read. If a student self-corrects, write S.C. above the word and count as correct. If they say an incorrect word, mark a slash through the word, and count as incorrect. If they hesitate more than 3 seconds, supply the word and count as incorrect. If a student skips a word, circle the word and count it as incorrect. Note: This is a 60-second timed test.

Later, determine the number of words read correctly in 1 minute and chart results.

APPENDIX J

Sample reading passage from AIM project

Being Afraid

"And when I did remember," Grandfather went on, "I had the most awful time making myself wriggle out from under the bed and go looking for my father or my mother to ask them to go out and find Melvin for me."

"Grandfather!"

"I told you I was afraid. This is a true story you're hearing so I have to tell the truth."

"Of course," said Thomas, admiring his grandfather for telling a truth like that. "Did you find them?"

"I did not. They had gone out someplace for an hour or so, but I'd forgotten. Thomas, fear does strange things to people … makes them forget everything but how afraid they are. You wouldn't know about that, of course."

Thomas stroked his cat and said nothing.

"In any case," Grandfather went on, "there I was alone and afraid in the kitchen, and there was my poor little dog alone and afraid in the storm."

"What did you do?" Thomas demanded. "You didn't leave him out there, did you, Grandfather?"

"Thomas – I put on my raincoat and opened the kitchen door and stepped out on the back porch just as a flash of lightning shook the whole sky and a clap of thunder barreled down and a huge man appeared out of the darkness, holding Melvin in his arms! That man was seven feet tall and had a face like a crack in the ice."

"Grandfather! You said you were telling me a true story."

"It's true, because that's how he looked to me. He stood there, scowling at me, and said, 'Son, is this your dog?' And I nodded, because I was too scared to speak. 'If you don't take better care of him, you shouldn't have him at all,' said the terrible man. He pushed Melvin at me and stormed off into the dark."

APPENDIX K

Sample TDI Lesson for Oral Reading Fluency

Total Time: 14 minutes

Lesson 4

Partner Reading

Lesson Objectives	• Students will build reading fluency through repeated paired reading.	
Instructional Materials	**Teacher**	**Student**
	• List of sight words • Copies of reading passages • Copy of easyCBM passage • Timer	• Copies of reading material (sight words and passages) • Copy of easy CBM passage

Preview

Say: **Now we will spend time reading words and sentences. I want you to do your best reading.**

Engage Prior/Informal Knowledge — Time: 2 min

Give the students the SB1: List of Sight Words for choral reading. Follow along with TM1: List of Sight Words.

Say: **Together I want you to read this list of words out loud, one at a time. Ready, begin.** (*Follow along and provide error correction where needed.*)

Practice — Time: 8 min

Give each student a copy of the "Being Afraid" reading passage and a timer, and preset the timer to 3 minutes.

Say: *Student name (the more advanced reader),* **when I say 'Begin," I want you to read the passage for 3 minutes. If you get to the end of the passage, start over from the beginning.** *Student name (the less advanced reader)* **I want you to follow along as** *(the more advanced reader)* **reads out loud. If** *(the more advanced reader)* **struggles with a word, provide it if you can, or I will if you don't know the word.**

Start the timer when the reader says the first word. Follow along and provide error correction when needed. Check to make sure the student stops reading after 3 minutes. When finished, have the students reverse roles.

Independent Practice Time: 4 min

Say: *Student name (the more advanced reader),* **when I say "Begin," I want you to read the passage again, but this time for 1 minute, until I say, "Stop."** *Student name (the less advanced reader)* **I want you to follow along as** *(the more advanced reader)* **reads. If** *(the more advanced reader)* **struggles with a word, I will help.**

Repeat the process for the second reader.

Work with the Observer to administer the 1-minute easyCBM passage probe to each student. Later, determine the number of words read correctly in 1 minute and chart results on the Excel Sheet.

APPENDIX L

Sample IAI Lesson

Total Time: 30 minutes

Lesson 3

iPad Applications for Word ID

Lesson Objectives	Students will use their knowledge of sound-symbol relationships to identify single syllable or multisyllabic words.	
Instructional Materials	**Teacher**	**Student**
	• ABC Writing (vowel pairs) and Word Family (short vowels) • List of Objectives • easyCBM Assessor copy of Form 3-9	• iPad • ABC Writing (vowel pairs) and Word Family (short vowels) • EasyCBM Student copy of Word Form 3-9

Word Reading — Time: 10 min

Open ABC writing to the Word Family -ain and give the following instructions. Show students an index card and tell them what they are learning today.

Say: **To help us read words, we will use programs with the iPad. For the first 5 minutes, we will work on ABC Writing. There is a word list on the left side.** *(point to it)* **You can write each word with your finger and move on to the next word. If you want to listen the word, click the "SPEAK" on the top. Let's begin now. When you finish the last word, move forward** (demonstrate) **until you get to the next one on the card** *(point to the next combination on the list*)**. Then keep working on the words and list until I say, "Stop."**

After 5 minutes, say, "Stop." Open Find Vowel Level1: Short vowels and give the following instructions.

Say: **Now it is time to do the next activity with a different program. For the next 5 minutes, you will work on the Find Vowel. It is a very fun game. Your mission is to give a hot dog to a monster by listening to the word and dragging the letters to the blank space to spell the word. If you want to listen to a word one more time, click the speaker button** *(point to the speaker)***. Listen to each word carefully, and drag the missing letters to the space to spell the word. Let's begin now.**

Independent Practice — Time: 4 min

Place the "Word Reading Student Copy" probe in front of the student and start the audio recorder. Then say, "Please read from

Say: **Please read from this list of words. Read across the page and then on to the next row.**

Demonstrate by sweeping your finger from left to right across the first two rows of words. Start timing when the student begins reading. Mark a bracket] after the last word read. If a student self-corrects, write S.C. above the word and count as correct. If they say an incorrect word, mark a slash through the word, and count as incorrect. If they hesitate more than 3 seconds, supply the word and count as incorrect. If a student skips a word, circle the word and count it as incorrect. Note: This is a 60-second timed test. Later, determine the number of words read correctly in 1 minute and chart results.

Passage Reading: Timed-reading — Time: 10 min

Have two iPads and headphones. Open Timed Reading and have the student open his/her program. Open Reading List to the next story of what he/she read last time.

Say: **Now we are going to work on reading stories using the iPad. For 10 minutes, both of you will work on reading some interesting stories. When you get to the end of a page for a story, press the "right arrow" to go to the next page *(demonstrate)*. If you want to stop, press the "Pause" button and then "resume" button to keep reading. Or you can press the left arrow *(point to it)* to go back a page. On the top right of the iPad *(point to the timer)*, you can see how long your reading takes. When you finished reading a whole story, press Done** *(demonstrate)* **and you will see how many words you are reading per minute. Then press "Save" and move on to the next story. Remember to read the whole story. If you come to a word you don't know, try to use your knowledge of letter sounds to identify the word. Then keep reading. Let's begin now.**

For the last 2 minutes, have each student read aloud.
Return to the contents page and select the next story.

Independent Practice — Time: 4 min

Place the Student Copy Form in front of the student. Point to the names on the Student Copy as you read them:

Say: **I want you to read this story to me. You'll have 1 minute to read as much as you can. When I say "begin," start reading aloud at the top of the page. Do your best reading. If you have trouble with a word, I'll tell it to you. Do you have any questions? Begin.**"

Start the timer. While the student is reading, mark errors with a slash (/). At 1 minute, mark the last word read with a bracket (]).

When the student gets to a logical stopping place, say "**Stop**."Later, determine the number of words read correctly in 1 minute and chart results.

APPENDIX M

Fidelity checklists

Fidelity Checklist: Teacher Directed – Word reading

A. Observation Information

Directions: Please complete the following information about the group you are observing.

1. Teacher: 2. Date: 3. Group #:

4. Observer: 5. Observed Lesson:

6. Starting time: 7. Ending time:

B. Fidelity Checklist Directions: Obtain a copy of the intervention lessons for the observation. Place a check beside the corresponding box to indicate if the teacher followed the instructional procedures of the implementation. Ratings key:

1: Interventionist did not follow the script at all.
2: Interventionist somewhat followed the script [many deviations observed].
3: Interventionist closely followed the script [some deviations observed].
4: Interventionist followed the script exactly.

C. Timing Directions: Record the number of minutes taken for each section.

Notes:

Preview -- Time: _____/NA
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Engage Prior/Informal Knowledge -- Time: _____/2 minutes
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Demonstrate -- Time: _____/8 minutes
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Practice -- Time: _____/8 minutes
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Independent Practice -- Time: _____/4 minutes
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Overall, how would you rate this teacher's overall fidelity for the intervention lesson? Circle one.

Poor	Fair	Good	Excellent

Did not include Overall rating in Total

Total Score: _____ + _____ + _____ + _____ + _____ = ____

Comments:

Fidelity Checklist: Teacher Directed – Passage Reading

A. Observation Information

Directions: Please complete the following information about the group you are observing.

1. Teacher: 2. Date: 3. Group #:

4. Observer: 5. Observed Lesson:

6. Starting time: 7. Ending time:

B. Fidelity Checklist Directions: Obtain a copy of the intervention lessons for the observation. Place a check beside the corresponding box to indicate if the teacher followed the instructional procedures of the implementation. Ratings key:

1: Interventionist did not follow the script at all.
2: Interventionist somewhat followed the script [many deviations observed].
3: Interventionist closely followed the script [some deviations observed].
4: Interventionist followed the script exactly.

C. Timing Directions: Record the number of minutes taken for each section.

Notes:

Preview -- Time: _____

1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Engage Prior/Informal Knowledge -- Time: _____/2 minutes

1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Practice -- Time: _____/8 minutes

1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Independent Practice -- Time: _____/4 minutes
1 2 3 4

Approximate % of lesson section completed on time period: _____

Notes:

Overall, how would you rate this teacher's overall fidelity for the intervention lesson?
Circle one.

Poor	Fair	Good	Excellent
		3	

Did not include Overall rating in Total

Total Score: _____ + _____ + _____ + _____ + _____ = ____

Comments:

Fidelity Checklist: iPad-Assisted – Word reading

A. Observation Information

Directions: Please complete the following information about the group you are observing.

1. Teacher: 2. Date: 3. Group #:

4. Observer: 5. Observed Lesson:

6. Starting time: 7. Ending time:

B. Fidelity Checklist Directions: Obtain a copy of the intervention lessons for the observation. Place a check beside the corresponding box to indicate if the teacher followed the instructional procedures of the implementation. Ratings key:

1: Interventionist did not follow the script at all.
2: Interventionist somewhat followed the script (many deviations observed).
3: Interventionist closely followed the script (some deviations observed).
4: Interventionist followed the script exactly.

During the instruction The teacher…	Yes	No	Rating
Provided a review to the students on how to use the iPad and the application.			1 2 3 4
Let students review previous skill sets from the previous lesson (e.g., The teacher set-up the application on skill sets learned in the previous session to let students practice at the beginning of the lesson).			1 2 3 4
Kept monitoring students' use of the iPad and their work.			1 2 3 4
Provided appropriate support and feedback (no teaching) when students had questions or problems (see procedures for examples of support and feedback).			1 2 3 4
Administered the probe and followed the written administration procedures.			1 2 3 4

Overall, how would you rate this teacher's overall fidelity for the intervention lesson? Circle one.

Poor	Fair	Good	Excellent
1	2	3	4

I do not include the overall in the Total Score.

Total Score: _____ + _____ + _____ + _____ + _____ = _____

Comments:

Fidelity Checklist: iPad-Assisted – Passage reading

A. Observation Information

Directions: Please complete the following information about the group you are observing.

1. Teacher: 2. Date: 3. Group #:

4. Observer: 5. Observed Lesson:

6. Starting time: 7. Ending time:

B. Fidelity Checklist Directions: Obtain a copy of the intervention lessons for the observation. Place a check beside the corresponding box to indicate if the teacher followed the instructional procedures of the implementation. Ratings key:

1: Interventionist did not follow the script at all.
2: Interventionist somewhat followed the script (many deviations observed).
3: Interventionist closely followed the script (some deviations observed).
4: Interventionist followed the script exactly.

During the instruction The teacher…	Yes	No	Rating
Provided a review to the students on how to use the iPad and the application.			1 2 3 4
Let students review previous skill sets from the previous lesson (e.g., The teacher set-up the application on skill sets learned in the previous session to let students practice at the beginning of the lesson).			1 2 3 4
Kept monitoring students' use of the iPad and their work.			1 2 3 4
Provided appropriate support and feedback (no teaching) when students had questions or problems (see procedures for examples of support and feedback).			1 2 3 4
Administered the probe and followed the written administration procedures.			1 2 3 4

Overall, how would you rate this teacher's overall fidelity for the intervention lesson? Circle one.

Poor	Fair	Good	Excellent
1	2	3	4

I do not include the overall in the Total Score.

Total Score: _____ + _____ + _____ + _____ + _____ = _____

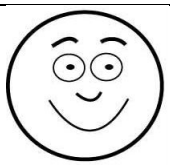
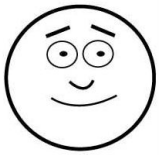
Comments:

APPENDIX N

Perspectives about Reading

DIRECTIONS: Mark an X in the box that is closest to the way you feel. There are no right or wrong answers. The teacher will read example 1 and 2. This statement doesn't mean that spelling is easy for the teacher, but for you.

If you would say, "Yes, definitely!" put an X in the first box.
If you would say, "No, definitely!" put an X in the last box.
If you would say, "Closer to Yes" put an X in the second box.
If you would say, "Closer to No" put an X in the third box.

				
Example 1. Spelling Writing is easy for me.				
Example 2. I would rather go to the movies than play video games.				
1. It's fun to read.				
2. I am a good reader.				
3. I'm better at reading than most of my friends.				
4. Reading is interesting and exciting.				
5. Reading tests are usually easy for me.				
6. I'd rather do reading than any other kind of homework.				
7. I like everything else in school better than reading.				
8. Someone who likes reading is usually weird.				
9. I enjoy reading books in school during free time.				
10. I read a lot outside of school.				
11. I've always liked reading.				
12. I enjoy reading for fun at home.				
13. I like to talk about the books or stories I read.				
14. My friends like reading more than I do.				

References

Allen, L. (1998). An integrated strategies approach: making word identification instruction work for beginning readers. *Reading Teacher, 52*(3), 254-268.

Allor, J. H., & Chard, D. J. (2011). A comprehensive approach to improving reading fluency for students with disabilities. *Focus on Exceptional Children, 43*(5), 1-12.

Alonzo, J., & Tindal, G. (2012). *Teachers' manual for regular easyCBM: Getting the most out of the system*. Retrieved from http://www.easycbm.com/static/files/pdfs/info/easyCBM_Teachers_Manual.pdf

Alonzo, J., Tindal, G., Ulmer, K., & Glasgow, A. (2006). *easyCBM online progress monitoring assessment system*. Eugene, OR: Center for Educational Assessment Accountability. Retrieved from http://easycbm.com

Alper, S., & Raharinirina, S. (2006). Assistive technology for individuals with disabilities: A review and synthesis of the literature. *Journal of Special Education Technology, 21*(2), 47-64.

Anderson-Inman, L., & Knox-Quinn, C. (1996). Computer-based study strategies for students with learning disabilities: Individual differences. *Journal of Learning Disabilities, 29*(5), 461-484.

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: a proposed system and its control processes. In K.W. Spence (ed.), *The Psychology of Learning and Motivation: Advances in Research and Theory, Vol. 2* (pp. 89–195). New York: Academic Press.

Ayala, S. M., & O'Connor, R. (2013). The effects of video self-modeling on the decoding skills of children at risk for reading disabilities. *Learning Disabilities Research & Practice (Wiley-Blackwell), 28*(3), 142-154. doi:10.1111/ldrp.12012

Barlow, D. H., & Hayes, S. C. (1979). Alternating treatments design: One strategy for comparing the effects of two treatments in a single subject. *Journal of Applied Behavior Analysis, 12*(2), 199-210. doi:10.1901/jaba.1979.12-199

Bashir, A. S., & Hook, P. E. (2009). Fluency: A key link between word identification and comprehension. *Language, Speech & Hearing Services in Schools, 40*(2), 196-200. doi:10.1044/0161-1461

Begeny, J. C., Daly III, E. J., & Valleley, R. J. (2006). Improving oral reading fluency through response opportunities: A comparison of phrase drill error correction with repeated readings. *Journal of Behavioral Education, 15*(4), 229-235. doi:10.1007/s10864-006-9028-4

Blythe, J. M. (2006). Computer-based phonological skills training for primary students with mild to moderate dyslexia: A pilot study. *Australian Journal of Educational & Developmental Psychology*, 639-649.

Bonifacci, P., & Snowling, M. J. (2008). Speed of processing and reading disability: A cross-linguistic investigation of dyslexia and borderline intellectual functioning. *Cognition, 107*(3), 999-1017.

Bos, C. S., & Vaughn, S. (2009). *Strategies for teaching students with learning and behavior problems. (7th ed.)*. Boston, MA: Allyn and Bacon.

Bremer, C. D., Clapper, A. T., & Deshler, D. D. (2002). Improving word identification skills using strategic instruction model (SIM) strategies. *Research to Practice Brief, 1*(4). Retrieved from http://www.ncset.org/publications/viewdesc.asp?id=720

Brown, S. (2006). Investigating Classroom Discourse Surrounding Partner Reading. *Early Childhood Education Journal, 34*(1), 29-36. doi:10.1007/s10643-006-0109-8

Brown, V. L., Hammill, D., & Wiederholt, J. L (2009). *Test of Reading Comprehension – Fourth Edition.* Austin, TX: Pro-Ed.

Brudenell, I., & Carpenter, C. (1990). Adult learning styles and attitudes toward computer assisted instruction. *Journal of Nursing Education, 29*(2), 79-83.

Bryant, B. R., Kim, M., Ok, M., Kang, E., Bryant, D. P., Lang, R., & Son, S. (in press). A comparison of reading interventions for 4th grade students with learning disabilities. *Behavior Modification*.

Ok, M., Kim, M., Kang, E., & Bryant, B. R. (in press). How to find good apps: An evaluation rubric for apps for teaching students with learning disabilities. *Intervention in School and Clinic*.

Bryant, D. P., & Bryant, B. R. (1998). Using assistive technology adaptations to include students with learning disabilities in cooperative learning activities. *Journal of Learning Disabilities, 31*(1), 41-54.

Bryant, D. P., Smith, D. D., & Bryant, B. R. (2008). *Teaching students with special needs in inclusive classrooms.* New York, NY: Pearson Education.

Bryant, D. P., Ugel, N., Thompson, S., & Hamff, A. (1999). Instructional strategies for content-area reading instruction. *Intervention in School & Clinic, 34*(5), 293-302.

Bryant, D. P., Vaughn, S., Linan-Thompson, S., Ugel, N., Hamff, A., & Hougen, M. (2000). Reading outcomes for students with and without reading disabilities in general education middle-school content area classes. *Learning Disability Quarterly, 23*(4), 238-252. doi:10.2307/1511347

Bulgren, J. A., Deshler, D. D., Schumaker, J. B., & Lenz, B. (2000). The use and effectiveness of analogical instruction in diverse secondary content classrooms. *Journal of Educational Psychology, 92*(3), 426-441. doi:10.1037/0022-0663.92.3.426

Burns, M. K., Dean, V. J., & Foley, S. (2004). Preteaching unknown key words with incremental rehearsal to improve reading fluency and comprehension with children identified as reading disabled. *Journal of School Psychology, 42*, 303-314. doi:10.1016/j.jsp.2004.04.003

Byrne, B. (2007). Theories of learning to read. In M. J. Snowling & C. Hulme (Eds.), *The Science of Reading: A Handbook* (pp. 104–119). Malden, MA: Blackwell.

Cahill, M., & McGill-Franzen, A. (2013). Selecting 'app' ealing and 'app' ropriate book apps for beginning readers. *Reading Teacher, 67*(1), 30-39. doi: 10.1002/TRTR.1190

Cartwright, G. F., & Derevensky, J. L. (1976). An attitudinal study of computer-assisted testing as a learning method. *Psychology in the Schools, 13*(3), 317-321.

CAST (2011). *Universal Design for Learning Guidelines version 2.0.* Wakefield, MA: Author. Retrieved from http://www.udlcenter.org/aboutudl/udlguidelines

Chall, J. S. (1983). *Stages of reading development*. New York: McGraw-Hill.

Chard, D., & Osborn, J. (1999). Phonics and word recognition instruction in early reading programs: Guidelines for accessibility. *Learning Disabilities Research and Practice, 14*, 107-117.

Chard, D., Ketterlin-Geller, L., Baker, S., Doabler, C., & Apichatabutra, C. (2009). Repeated reading interventions for students with learning disabilities: status of the evidence. *Exceptional Children, 75*(3), 263-281.

Chard, D., Vaughn, S., & Tyler, B. J. (2002). A synthesis of research on effective interventions for building reading fluency with elementary students with learning disabilities. *Journal of Learning Disabilities, 36*, 386-406. doi: 10.1177/00222194020350050101

Cohen, A. L., Torgesen, J. K., & Torgesen, J. L. (1988). Improving speed and accuracy of word recognition in reading disabled children: An evaluation of two computer program variations. *Learning Disability Quarterly, 11*(4), 333-341. doi:10.2307/1510780

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Hillsdale, NJ: Lawrence Erlbaum.

Combs, B. (2011). *Assessing and addressing literacy needs: Cases and instructional strategies*. Thousand. Oaks, CA: SAGE Publications, Inc.

Compton, D. L., Fuchs, L. S., Fuchs, D., Lambert, W., & Hamlett, C. (2012). The cognitive and academic profiles of reading and mathematics learning disabilities. *Journal of Learning Disabilities, 45*(1), 79-95.

Conn, C. (2012). Research cutting-edge inventions using a cutting-edge invention. *Learning & Leading With Technology, 40*(1), 34-37.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed). Columbus: Merrill.

Courtad, C., & Bouck, E. C. (2013). Assistive technology for students with learning disabilities. *Advances in Special Education, 25*, 153-173. doi:10.1108/S0270-4013(2013)0000025011

Daane, M. C., Campbell, J. R., Grigg, W. S., Goodman, M. J., & Oranje, A. (2005). *Fourth-grade students reading aloud: NAEP 2002 special study of oral reading* (NCES 2006-469). U.S. Department of Education. Institute of Education Sciences, National Center for Education Statistics. Washington, DC: Government Printing Office.

Dallery, J., Cassidy, R. N., & Raiff, B. R. (2013). Single-case experimental designs to evaluate novel technology-based health interventions. *Journal of Medical Internet Research, 15*(2), 1-17. doi:10.2196/jmir.2227

Daly, E. J., Bonfiglio, C. M., Mattson, T., Persampieri, M., & Foreman-Yates, K. (2005). Refining the experimental analysis of academic skills deficits: Part I. An investigation of variables that affect generalized oral reading performance. *Journal of Applied Behavior Analysis, 38*, 485–497.

Daly, E. J., Martens, B. K., Hamler, K. R., Dool, E. J., & Eckert, T. L. (1999). A brief experimental analysis for identifying instructional components needed to improve oral reading fluency. *Journal of Applied Behavior Analysis, 32*, 83–94.

Daly, E. J., Martens, B. K., Dool, E. J., & Hintze, J. M. (1998). Using brief functional analysis to select interventions for oral reading. *Journal of Behavioral Education, 8*(2), 203-218. doi:10.1023/A:1022835607985

Day, R., & Payne, L. (1987). Computer-managed instruction: An alternative teaching strategy. *Journal of Nursing Education, 26*(1), 30-36.

Denton, C. A., Wexler, J., Vaughn, S., & Bryan, D. P. (2008). Intervention provided to linguistically diverse middle school students with severe reading difficulties. *Learning Disabilities Research and Practice, 23*(2), 79-89. doi: 10.1111/j.1540-5826.2008.00266.x

Dhar, M., Been, P. H., Minderaa, R. B., & Althaus, M. (2008). Distinct information processing characteristics in dyslexia and ADHD during a covert orienting task: An event-related potential study. *Clinical Neurophysiology, 119*(9), 2011-2025. doi:10.1016/j.clinph.2008.05.027

Dole, J. A., Nokes, J. D., & Drits, D. (2009). Cognitive strategy instruction. In S. E. Israel & G. G. Duffy (Eds.), *Handbook of research on reading comprehension* (pp. 347-372). New York: Routledge.

Drummond, K. (2005). About reading disabilities, learning disabilities, and reading difficulties. LD Online. Retrieved from http://www.pbs.org/launchingreaders/brain/helpfularticles_1.html

Edyburn, D. L. (2000). Assistive technology and mild disabilities. *Focus on Exceptional Children, 32*(9), 1-24.

Edyburn, D. L. (2007). Technology-enhanced reading performance: Defining a research agenda. *Reading Research Quarterly, 42*(1), 146-152.

Edyburn, D. L. (2013). Critical issues in advancing the special education technology evidence base. *Exceptional Children, 80*(1), 7-24.

Ehri, L. (2004). Teaching phonemic awareness and phonics: An explanation of the national reading panel meta-analysis. In P. McCardle & V. Chhabra, *The voice of evidence in reading research* (pp. 153–186). Baltimore: Paul H. Brookes.

Ehri, L. (2005). Learning to read words: Theory, findings, and issues. *Scientific Studies of Reading, 9*(2), 167-188. doi:10.1207/s1532799xssr0902_4.

Ellis, E. S., Deshler, D. D., Lenz, B. K., Schumaker, J. B., & Clark, E L. (1991). An instructional model for teaching learning strategies. *Focus on Exceptional Children, 23*(6), 1-24.

Ellis, P. D. (2010). *The essential guide to effect sizes: Statistical power, meta-analysis and the interpretation of research results*. Cambridge University Press.

Esteves, K. J., & Whitten, E. (2011). Assisted reading with digital audiobooks for students with reading disabilities. *Reading Horizons, 51*(1), 21-40.

Ferdig, R. E. (2007). Editorial: Examining social software in teacher education. *Journal of Technology and Teacher Education (JTATE)*, 15(1), 5-10.

Fletcher, J., Grimley, M., Greenwood, J., & Parkhill, F. (2012). Motivating and Improving Attitudes to Reading in the Final Years of Primary Schooling in Five New Zealand Schools. *Literacy, 46*(1), 3-16.

Fredricks, J., McColskey, W., Meli, J., Mordica, J., Montrosse, B., and Mooney, K. (2011). *Measuring student engagement in upper elementary through high school: a description of 21 instruments*. (Issues & Answers Report, REL 2011–No. 098). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast. Retrieved from http://ies.ed.gov/ncee/edlabs.

Garrison, D., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet And Higher Education, 7*(2), 95-105.

Gaskins, I. W., & Ehri, L. C. (1996). Procedures for word learning: Making discoveries about words. *Reading Teacher, 50*(4), 312-327.

Goldstein, H., & Healy, M. J. R. (1995). The graphical presentation of a collection of means. *Journal of the Royal Statistical Society, 581*, 175-177.

Gortmaker, V. J, Daly III, E. J., McCurdy, M., Persampieri, M. J., & Hergenrader, M. (2007). Improving reading outcomes for children with learning disabilities: Using brief experimental analysis to develop parent tutoring interventions. *Journal of Applied Behavior Analysis, 40*, 203-221. doi: 10.1901/jaba.2007.105-05

Gustafson, S., Falth, L., Svensson, I., Tjus, T., & Heimann, M. (2011). Effects of three interventions on the reading skills of children with reading disabilities in grade 2. *Journal of Learning Disabilities*, *44*(2), 123-135.

Guthrie, J. T., & Wigfield, A. (2000). Engagement and motivation in reading. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson & R. Barr (Eds.), *Handbook of reading research* (Vol. III, pp. 403-422). Mahway, N. J.: Lawrence Erlbaum Associates, Inc.Guthrie, McGough, Bennett, & Rice, 1996

Hebert, B. M., & Murdock, J. Y. (1994). Comparing three computer-aided instruction output modes to teach vocabulary words to students with learning disabilities. *Learning Disabilities Research and Practice, 9*(3), 136-41.

Hien Ton (2011). ABC Phonics Word Family Writing [Mobile application software]. Retrieved from http://itunes.apple.com/

Hindson, B., Byrne, B., & Fielding-Barnsley, R. (2005). Assessment and early instruction of preschool children at risk for reading disability. *Journal of Educational Psychology, 97*(4), 687-704.

Holcombe, A., Wolery, M., & Gast, D. L. (1994). Comparative single-subject research: Description of designs and discussion of problems. *Topics in Early Childhood Special Education, 14*, 119-145.

Horner, R. H., & Odom, S. (2013). *Constructing single-case research designs: Logic and options*. Retrieved from http://www.nccsite.com/events/SCDInstitute2013/wp-content/uploads/2013/04/Horner-Odom-2013.pdf

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*(2), 165-179.

Horner, R. H., Swaminathan, H., Sugai, G., & Smolkowski, K. (2012). Considerations for the systematic analysis and use of single-case research. *Education & Treatment of Children (West Virginia University Press), 35*(2), 269-290.

Horner, R., & Spaulding, S. (2010). Single-case research designs. In N. J. Salkind (Ed.), *Encyclopedia of research design* (pp. 1386–1394). Thousand Oaks, CA: SAGE.

Huang, S., Clark, N., & Wedel, W. (2013). Teaching tips: The use of an iPad to promote preschoolers' alphabet recognition and letter sound correspondence. *Practically Primary, 18*(1), 24-26.

Hudson, R., Lane, H., & Pullen, P. (2005). Reading fluency assessment and instruction: What, why, and how? *The Reading Teacher, 58*, 702-714. doi:10.1598/RT.58.8.1

Hudson, R., Pullen, P., Lane, H., & Torgesen, J. (2009). The complex nature of reading fluency: A multidimensional view. *Reading & Writing Quarterly, 25*(1), 4-32. doi:10.1080/10573560802491208

Hutchison, A., Beschorner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the iPad for literacy learning. *Reading Teacher, 66*(1), 15-23. doi:10.1002/TRTR.01090

Individuals with Disability Education Act [IDEA]. (2004). Retrieved from http://www.p12.nysed.gov/specialed/idea/108-446.pdf

International Reading Association. (2009). *New literacies and 21st-century technologies: A position statement of the International Reading Association.* Newark, DE: Author.

Israel, M., Maynard, K., & Williamson, P. (2013). Promoting literacy- embedded, authentic STEM instruction for students with disabilities and other struggling learners. *Teaching Exceptional Children, 45*(4), 18-25.

Jenkins, J. R., Heliotis, J., Stein, M. L., & Haynes, M. (1987). Improving reading comprehension by using paragraph restatements. *Exceptional Children, 54*, 54-59.

Jenkins, J., & O'Connor, R. (2002). *Early identification and intervention for young children with reading/learning disabilities*. Retrieved from http://www.nrcld.org/resources/ldsummit/jenkins.pdf

Jerman, O., Reynolds, C., & Swanson, H. (2012). Does growth in working memory span or executive processes predict growth in reading and math in children with reading disabilities? *Learning Disability Quarterly, 35*(3), 144-157.

Jimenez, J. E., Ortiz, M., Rodrigo, M., Hernandez-Valle, I., Ramirez, G., Estevez, A., & ... Trabaue, M. (2003). Do the effects of computer-assisted practice differ for children with reading disabilities with and without IQ-achievement discrepancy? *Journal of Learning Disabilities, 36*(1), 34-47.

Johnson, D., & Swanson, H. (2011). Cognitive characteristics of treatment-resistant children with reading disabilities: A retrospective study. *Journal of Psychoeducational Assessment, 29*(2), 137-149. doi:10.1177/0734282910380189

Johnson, E. S., Humphrey, M., Mellard, D. F., Woods, K., & Swanson, H. (2010). Cognitive processing deficits and students with specific learning disabilities: A selective meta-analysis of the literature. *Learning Disability Quarterly, 33*(1), 3-18.

Jones, K. M., & And, O. (1987). Using computer guided practice to increase decoding fluency in learning disabled children: A study using the Hint and Hunt I program. *Journal of Learning Disabilities, 20*(2), 122-128.

K12 Inc. (2010). K12 Timed Reading Practice [Mobile application software]. Retrieved from http://itunes.apple.com/

Kame'enui, E. J., & Simmons, D. C. (2001). Introduction to this special issue: The DNA of reading fluency. *Scientific Studies of Reading, 5*, 203-210.

Kast, M., Baschera, G., Gross, M., Jancke, L., & Meyer, M. (2011). Computer-based learning of spelling skills in children with and without dyslexia. *Annals of Dyslexia, 61*(2), 177-200.

Kennedy, C. H. (2005). *Single-case designs for educational research*. Boston: Allyn and Bacon.

Kostewicz, D. E., & Kubina Jr., R. M. (2010). A comparison of two reading fluency methods: Repeated readings to a fluency criterion and interval sprinting. *Reading Improvement, 47*(1), 43-63.

Kratochwill, T. R., & Levin, J. R. (2010). Enhancing the scientific credibility of single-case intervention research: Randomization to the rescue. *Psychological Methods, 15*, 122–144.

Kratochwill, T. R., Hitchcock, J. H., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial & Special Education, 34*(1), 26-38. doi:10.1177/0741932512452794

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation*. Retrieved from What Works Clearinghouse website: http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf.

LaBerge, D., & Samuels, S.J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293-323. doi:10.1016/0010-0285(74)90015-2

Larson, L. C. (2010). Digital readers: The next chapter in e-book reading and response. *Reading Teacher, 64*(1), 15-22. doi:10.1598/RT.64.1.2

Lazarus, B., & Callahan, T. (2000). Attitudes toward reading expressed by elementary school students diagnosed with learning disabilities. *Reading Psychology, 21*(4), 271-282. doi:10.1080/027027100750061921

Lenz, B., & Hughes, C. A. (1990). A word identification strategy for adolescents with learning disabilities. *Journal of Learning Disabilities, 23*(3), 149-158.

Leslie, J. C., & O'Reilly, M. F. (1999). *Behavior analysis: Foundations and applications to psychology.* New York: Harwood Academic.

Lipson, M. Y., & Wixson, K. K. (1992). *Assessment and instruction of reading disability: An interactive approach*. New York: Harper Collins.

McClanahan, B., Williams, K., Kennedy, E., & Tate, S. (2012). A breakthrough for Josh: How use of an iPad facilitated reading improvement. *Techtrends: Linking Research and Practice to Improve Learning, 56*(3), 20-28.

McGrath, L. M., Pennington, B. F., Shanahan, M. A., Santerre-Lemmon, L. E., Barnard, H. D., Willcutt, E. G., & ... Olson, R. K. (2011). A multiple deficit model of reading disability and attention-deficit/hyperactivity disorder: Searching for shared cognitive deficits. *Journal of Child Psychology and Psychiatry, 52*(5), 547-557.

McKenna, M. C., Kear, D. J., & Ellsworth, R. A. (1995). Children's Attitudes toward Reading: A National Survey. *Reading Research Quarterly, 30*(4), 934-956.

Meisinger, E. B., Bloom, J. S., & Hynd, G. W. (2010). Reading fluency: Implications for the assessment of children with reading disabilities. *Annals of Dyslexia, 60*(1), 1-17.

Mertens, D. M. (2009). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods (3rd ed.)*. London: Sage.

Miranda, T., Johnson, K. A., & Rossi-Williams, D. (2012). E-readers: Powering up for engagement. *Educational Leadership*, 69(9), 1-3.

Moody, A. (2010). Using electronic books in the classroom to enhance emergent literacy skills in young children. *Journal of Literacy & Technology, 11*(4), 22-52.

Morrow, L. M., Wixson, K. K., & Shanahan, T. (2013). *Teaching with the common core standards for English language arts, grades 3-5.* New York, NY: Guilford Press.

Mucchetti, C. (2013). Adapted shared reading at school for minimally verbal students with autism. *Autism: The International Journal of Research & Practice, 17*(3), 358-372. doi:10.1177/1362361312470495

Musti-Rao, S., Hawkins, R. O., & Barkley, E. A. (2009). Effects of repeated readings on the oral reading fluency of urban fourth-grade students: Implications for practice. *Preventing School Failure, 54*, 12-23. doi:10.3200/PSFL.54.1.12-23

Myers, A., & Hansen, C. H. (2011). *Experimental psychology*. Wadsworth: Cengage.

National Center for Education Statistics (2011). *The Nation's Report Card: Reading 2011* (NCES 2012-457). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

National Reading Panel (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction.* Washington, DC: National Institute of Child Health and Human Development.

Nelson, J. S., Alber, S. R., & Gordy A. (2004). Effects of systematic error correction and repeated readings on the reading accuracy and proficiency of second graders with disabilities. *Education and Treatment of Children, 27*, 186-198.

O'Shea, L. J., Sindelar, P., & O'Shea, D. J. (1987). Effects of repeated readings and attentional cues on the reading fluency and comprehension of learning disabled readers. *Learning Disabilities Research, 2*, 103–109.

Ozok A., Benson D., Chakraborty J., & Norcio A. (2008). A comparative study between tablet and laptop PCs: User satisfaction and preferences. *International Journal of Human-Computer Interaction, 24*(3), 329-352.

Parker, R. I., & Vannest, K. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy, 40*(4), 357-367.

Parker, R. I., Hagan-Burke, S., & Vannest, K. (2007). Percentage of all non-overlapping data (PAND): An alternative to PND. *Journal of Special Education, 40*(4), 194-204.

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy, 42*(2), 284-299. doi:10.1016/j.beth.2010.08.006

Paulsen, K., & the IRIS Center. (2004). *Fluency and word identification: Grades 3–5*. Retrieved from http://iris.peabody.vanderbilt.edu/ case_studies/ICS-006.pdf

Payton, M. E., Greenstone, M. H., & Schenker, N. (2003). Overlapping confidence intervals or standard error intervals: What do they mean in terms of statistical significance. *Journal of Insect Science, 3*, 1– 6.

Pearman, C. J. (2008). Independent reading of CD-ROM storybooks: Measuring comprehension with oral retellings. *Reading Teacher, 61*(8), 594-602.

Persampieri, M., Gortmaker, V., Daly III, E. J., Sheridan, S. M., & McCurdy, M. (2006). Promoting parent use of empirically supported reading interventions: Two experimental investigations of child outcomes. *Journal of Behavioral Interventions, 21*, 31-57. doi:10.1002/bin.210

PlaySmart-Kids (2012). Howie Finding Vowel [Mobile application software]. Retrieved from http://itunes.apple.com/

Pressley, M., & Harris, K. R. (2008). Cognitive strategies instruction: From basic research to classroom instruction. *Journal of Education, 189*(1/2), 77-94.

Pyper, P. (2011). Get an 'app' for that. *Learning Disability Practice, 14*(7), 9.

Rashotte, C. A., & Torgesen, J. K. (1985). Repeated reading and reading fluency in learning disabled children. *Reading Research Quarterly, 20*(2), 180-188.

Rasinski, T. (2004). Creating fluent readers. *Educational Leadership, 61*(6), 46-51.

Rasinski, T., Blachowicz, C., & Lems, K. (Eds.). (2006). *Fluency instruction: Research-based best practices*. New York: The Guilford Press.

Rasinski, T., Rikli, A., & Johnston, S. (2009). Reading fluency: More than automaticity? More than a concern for the primary grades? *Literacy Research and Instruction, 48*(4), 350-361.

Raskind, W. H. (2001). Current understanding of the genetic basis of reading and spelling disability. *Learning Disability Quarterly, 24*(3), 141-157.

Retter, S., Anderson, C., & Kieran, L. (2013). iPad Use for Accelerating Gains in Reading Skills of Secondary Students with Learning Disabilities. *Journal of Educational Multimedia & Hypermedia, 22*(4), 443-463.

Richardson, G. (1994). Computer-assisted library instruction? Consider your resources, commitment, and needs. *Research Strategies, 12*(1), 45-55.

Riley-Tillman, T., & Burns, M. K. (2009). *Evaluating educational interventions: Single-case design for measuring response intervention*. New York: Guilford Press.

Riverside. (2013). *Interpreting the easyCBM progress monitoring test results.* Rolling Meadows, IL: Author. Retrieved from http://www.easycbm.com/static/files/pdfs/info/ProgMonScoreInterpretation.pdf

Saine, P. (2012). iPods, iPads, and the SMARTBoard: Transforming literacy instruction and student learning. *New England Reading Association Journal, 47*(2), 74-79.

Samuels, S. (1987). Information processing abilities and reading. *Journal of Learning Disabilities, 20*(1), 18-22.

Samuels, S. (1988). Decoding and automaticity: Helping poor readers become automatic at word recognition. *Reading Teacher, 41*(8), 756-760.

Samuels, S., & Flor, R. F. (1997). The importance of automaticity for developing expertise in reading. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 13*(2), 107-121. doi:10.1080/1057356970130202

Samuels, S., Ediger, K., & Fautsch-Patridge, T. (2005). The importance of fluent reading. *New England Reading Association Journal, 41*(1), 1-8.

Scruggs, T. E., & Mastropieri, M. A. (1998). Synthesizing single-subject research: Issues and applications. *Behavior Modification, 22*, 221–242.

Scruggs, T. E., & Mastropieri, M. A. (2013). PND at 25: Past, present, and future trends in summarizing single-subject research. *Remedial & Special Education, 34*(1), 9-19. doi:10.1177/0741932512440730

Scruggs, T. E., Mastropieri, M. A., Cook, S., & Escobar, C. (1986). Early intervention for children with conduct disorders: A quantitative synthesis of single-subject research. *Behavioral Disorders, 11*, 260–271.

Shaywitz, S. E., & Shaywitz, B. A. (2003). Dyslexia (specific reading disability). *Review in Pediatrics, 24*(5). 147-153.

Shaywitz, S. E., & Shaywitz, B. A. (2005). Dyslexia (specific reading disability). *Biological Psychiatry, 57*, 1301–1309.

Shaywitz, S. E., & Shaywitz, B. A. (2008). Paying attention to reading: The neurobiology of reading and dyslexia. *Development and Psychopathology, 20*, 1329-1349.

Shuler, C. (2012). *iLearn II: An Analysis of the Education Category of Apple's App Store* (pp. 1–34). New York: The Joan Ganz Cooney Center at Sesame Workshop.

Siegel, L. S. (2006). Perspectives on dyslexia. *Pediatrics and Child Health, 11*(9), 581-587.

Simpson, A., Walsh, M., & Rowsell, J. (2013). The digital reading path: Researching modes and multidirectionality with iPads. *Literacy, 47*(3), 123-130. doi:10.1111/lit.12009

Sindelar, P. T., Monda, L. E., & O'Shea, L. J. (1990). Effects of repeated readings on instructional- and masterly-level readers. *Journal of Educational Research, 83*, 220–226.

Smith, J. K., Smith, L. F., Gilmore, A., & Jameson, M. (2012). Students' Self-Perception of Reading Ability, Enjoyment of Reading and Reading Achievement. *Learning And Individual Differences, 22*(2), 202-206.

Snyder, T. D., & Dillow, S. A. (2011). *Digest of educational statistics 2010* (NCES 2011-015). National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education. Washington, DC.

Spear-Swerling, L. (2006). Preventing and remediating difficulties with reading fluency. *LD online*. Retrieved from http://www.ldonline.org/spearswerling/

Spencer, S. (2011). Universal design for learning: Assistance for teachers in today's inclusive classrooms. *Interdisciplinary Journal of Teaching & Learning, 1*(1), 10-22.

Stanberry, K., & Raskind, M. H. (2009). Assistive technology for kids with learning disabilities: An overview. Retrieved from http://www.readingrockets.org/article/33074/

Sterling, H. E., Robinson, S. L., & Skinner, C. H. (1997). The effects of two taped-words interventions on sight-word reading in students with mental retardation. *Journal of Behavioral Education, 7*(1), 25-32. doi:10.1023/A:1022885202901

Swanson, H. (2001). Research on interventions for adolescents with learning disabilities: A meta-analysis of outcomes related to higher-order processing. *Elementary School Journal, 101*(3), 331-348.

Swanson, H. L., Hoskyn, M., & Lee, C. (1999). *Interventions for students with learning disabilities: A meta–analysis of treatment outcome*. New York: Guilford Press.

Swanson, H., & Deshler, D. (2003). Instructing adolescents with learning disabilities: Converting a meta-analysis to practice. *Journal of Learning Disabilities, 36*(2), 124-135.

Swanson, H., Orosco, M. J., & Lussier, C. M. (2012). Cognition and literacy in English language learners at risk for reading disabilities. *Journal of Educational Psychology, 104*(2), 302-320. doi:10.1037/a0026225

Tam, K. Y., Heward, W., & Heng, M. (2006). A reading instruction intervention program for English-language learners who are struggling readers. *Journal of Special Education, 40*, 79-93.

Technology-Related Assistance for Individuals with Disabilities Act of 1988, Public Law No. 100-407, USC 2202.

Therrien, W. J. (2004). Fluency and comprehension gains as a result of repeated reading. *Remedial and Special Education, 24*, 252-261. doi:10.1177/07419325040250040801

Therrien, W., & Kubuina, R. (2006). Developing reading fluency with repeated reading. *Intervention in School & Clinic, 41*(3), 156-160. doi:10.1177/10534512060410030501

Thorkildsen, J. K., Waters, M. D., Cohen, A. L., & Torgensen, J. L. (1988). Improving sight-word recognition skills in LD children: An evaluation of three computer program variations. *Learning Disability Quarterly, 11*, 125-132.

Torgesen, J. K. (2000). Individual differences in response to early interventions in reading: The lingering problem of treatment resisters. *Learning Disabilities Research and Practice, 15*, 55–64.

van Daal, V. H. P., & van der Leij, A. (1992). Computer-based reading and spelling practice for children with learning disabilities. *Journal of Learning Disabilities, 25*(3), 186-195.

Vaughn, S., & Linan-Thompson, S. (2004). *Research-based methods of reading instruction, grades K-3*. Alexandria, VA: Association for Supervision and Curriculum Development.

Vellutino, F. R., Fletcher, J. M., Snowling, M. J., & Scanlon, D. M. (2004). Specific reading disability (dyslexia): what have we learned in the past four decades? *Journal of Child Psychology & Psychiatry, 45*(1), 2-40. doi:10.1046/j.0021-9630.2003.00305.x

Vesisenaho, M., Valtonen, T., Kukkonen, J., Havu-Nuutinen, S., Hartikainen, A., & Karkkainen, S. (2010). Blended learning with everyday technologies to activate students' collaborative learning. *Science Education International, 21*(4), 272-283.

Wang, M., Shen, R., Novak, D., & Pan, X. (2009). The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom. *British Journal of Educational Technology, 40*(4), 673-695.

Wanzek, J., & Haager, D. (2003). Teaching word recognition with blending and analogizing. *Teaching Exceptional Children, 36*(1), 32–38.

Warrington, S. (2006). Building automaticity of word recognition for less proficient readers. *Reading Matrix: An International Online Journal, 6*(1), 52-65.

Watson, M., Fore, C., & Boon, R. T. (2009). Corrective feedback of oral decoding errors for diverse learners with reading disabilities: The effects of two methods on reading fluency. *International Journal of Special Education, 24*(1), 20-31.

Waugh, R. E., Alberto, P. A., & Fredrick, L. D. (2011). Simultaneous Prompting: An Instructional Strategy for Skill Acquisition. *Education and Training in Autism And Developmental Disabilities, 46*(4), 528-543.

Wayman, M. M., Wallace, T., Wiley, H., Tichá, R., & Espin, C. A. (2007). Literature synthesis on curriculum-based measurement in reading. *Journal of Special Education, 41*, 85-120.

Wechsler, D. (2005). *Wechsler Individual Achievement Test 2nd Edition* (WIAT II). San Antonio: The Psychological Corp.

Welsch, R. G. (2007). Using experimental analysis to determine interventions for reading fluency and recalls of students with learning disabilities. *Learning Disability Quarterly, 30*, 115-129. doi:10.2307/30035546

Wise, J. C., Sevcik, R. A., Morris, R. D., Lovett, M. W., & Wolf, M. (2007). The relationship among receptive and expressive vocabulary, listening comprehension, pre-reading skills, word identification skills, and reading comprehension by children with reading disabilities. *Journal of Speech, Language, and Hearing Research, 50*(4), 1093-1109.

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how behavior analysis found its heart. *Journal of Applied Behavior Analysis, 11*, 203-214.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). Woodcock-Johnson III. Rolling Meadows, IL: Riverside.

Woodruff, S., Schumaker, J. B., & Deschler, D. (2002). *The effects of an intensive reading intervention on the decoding skills of high school students with reading deficits* (Report No. RR–15). Washington, DC: Special Education Programs (ERIC Document Reproduction Service No. ED469293)

Zumeta, R. O., Compton, D. L., & Fuchs, L. S. (2012). Using word identification fluency to monitor first-grade reading development. *Exceptional Children, 78*(2), 201-220.

Vita

Min Kyung Kim attended Ewha Girls' Foreign Language High School, Seoul, South Korea from 2000 to 2003. She attended Seoul National University of Education, Seoul, South Korea, from 2003 to 2007, earning a Bachelor of Education in Elementary Education. Min continued pursuing her graduate degree in Elementary Special Education at the Seoul National University of Education and completed her Master of Education in 2010. In August of 2011, she began her doctoral work in Special Education at the University of Texas at Austin, focusing on Learning Disabilities and Behavior Disorders, while working as a graduate research assistant at the Meadows Center for Preventing Educational Risks: Reading Institute.

Permanent address (or email): 810 W St. John's Ave Unit 1261, Austin, TX, 78752;

minkimedu@utexas.edu

This dissertation was typed by Min Kyung Kim.