Examining Instructional Efficiency among Flashcard Drill and Practice Methods with a Sample of First Grade Students

Dissertation

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By

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Abstract

A significant number of children in the United States have difficulty learning basic reading skills. The majority of children referred to school psychologists are referred for reading concerns. Unfortunately, the gap between good and poor readers widens over time as more advanced reading skills are built upon basic reading skills. Children with reading difficulties need to be identified early and receive proper reading interventions in order to catch up with their peers. Due to factors such as curricular demands and large class sizes, teachers have limited time to implement academic interventions in the classroom. Interventions that are both effective and efficient allow teachers to provide the greatest amount of instruction within the least amount of time. Further research is needed to identify instructional techniques that are not only effective but are efficient for helping children achieve desired academic outcomes.

The current study examined the instructional effectiveness and efficiency of two word reading interventions on the number of words read accurately and the learning rate of student participants. Specifically, an alternating treatments design was used to compare the effects of the traditional drill and practice technique (presenting only unknown words) and an incremental rehearsal technique (the interspersal of one unknown word between an increasing number of known words). This study extended previous research findings of the positive outcomes of the interventions by holding constant the amount of time allowed for each intervention as opposed to the number of
trials provided for each unknown word. Retention, maintenance, generalization, and social validity were also assessed.

Results indicated increased word reading for all five students who participated in the study. Specifically, traditional drill and practice was found to be most effective and efficient on measures of retention and maintenance. Incremental rehearsal was found to be most effective and efficient on a measure of word generalization. Slightly more students preferred the traditional drill and practice intervention. Social validity results indicated that both instructional techniques are a socially valid way to teach word reading skills to students who are behind their peers in reading.
Dedication

Dedicated to my parents, Ron and Holly Eveleigh, whose extravagant love and support allows me to reach my goals.
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CHAPTER 1: INTRODUCTION

This chapter includes a brief review of the literature related to the current study. Also included is a statement of the problem, the purpose of the study, research questions, and the significance of the study.

Background

Reading deficits are the most common academic concern experienced by students. Hence, reading is an important focus in intervention research (Grossen, 1997; Kulak, 1993). An estimated one in three children experience problems learning to read (Adams, 1990). In a recent evaluation of fourth-grade students’ reading achievement, the National Center for Education Statistics (NCES, 2008) reported that 34% of children in the U.S. read below the basic level. In Ohio, 27% of students read below the basic level (NCES, 2008). Many students fall behind in early literacy skills such as phonemic awareness, understanding of the alphabetic principle, and word recognition. Early acquisition of these skills establishes the trajectory of future reading ability. When students are not provided opportunities to develop these foundational skills, the long term effects can be devastating, as students who are behind early are unlikely to catch up (Francis & Stuebing, 1996). Stanovich (1986) named this phenomenon, “the Matthew Effect,” indicating that children who experience reading problems tend to fall further behind their peers over time. This has great implications, as early literacy skills are among the most
crucial skills learned in school. Acquiring basic reading skills is important because it predicts a student’s ability to derive meaning from text (Cunningham & Stanovich, 1998). Reading comprehension is the most important outcome of reading instruction. Good general language comprehension and word reading skills are critical for effective comprehension of written material (Torgesen, 1998). These skills are the foundation for learning across subjects such as math, spelling, and social studies (Chard, Simmons, & Kameenui, 1998). Slow readers may become frustrated with assignments that require large amounts of time and energy to complete (Binder, 1996; Skinner, 1998). However, children may be more likely to engage in academic activities if behavioral modification methods are used. For instance, an instructor may consider tactics such as reinforcing more often, using desirable reinforcers, and immediate reinforcement to increase the likelihood that students will engage in school work (Neef, Mace, & Shade, 1993; Neef, Mace, Shea, & Shade, 1992; Neef, Shade, & Miller, 1994).

Various methods are used to teach word recognition skills to children. These methods vary in their effectiveness and the amount of time required for implementing the technique. Given the time constraints allocated to instruction during the school day, it is critical for teachers to select the most efficient methods that will produce the most desirable outcomes for all children. This is especially true for children who learn at slower rates as they often become frustrated with assignments that require large amounts of time and energy to complete (Binder, 1996; Skinner, 1998). In recent years, researchers have explored the effectiveness and efficiency of techniques for instructing basic literacy skills for children with and without disabilities.
Word Recognition Instruction

Word recognition is a basic reading skill that underlies the comprehension of text. (Daneman, 1991; Stanovich, 1994). In order to develop reading fluency, readers must obtain both word identification strategies and sight word recognition strategies (McCormick, 1999). Students at the beginning stages of word learning must often read words by sight because they do not yet have the skills to read words using phonological decoding methods (Ehri, 1991). Research indicates that sight word reading can be successfully taught with systematic instruction (Browder & Snell, 2000; Slaton, Schuster, Collins, & Camine, 1994).

A successful reader is able to read words as a whole, and do so fluently. Moreover, practice with words is the key mechanism by which the Matthew Effect can be minimized (Stanovich, 1986). The quick identification of words allows children to read more efficiently and increases reading comprehension skills (Burns, Dean, & Foley, 2004). Good readers are able to read the text fluidly, whereas unskilled readers work laboriously to decode individual words. The process builds upon itself as children who are able to read more sentences gain better vocabulary and comprehension skills, leading to better general reading. Students with difficulty identifying words fluently have fewer opportunities to practice, hence, impeding vocabulary development and comprehension skills. A major goal of reading instruction should be to assist learners in increasing their individual sight word vocabulary as rapidly and as meaningfully as possible (Sinatra, 2003).
Darrell, Bloodgood, and Perney (2003) examined kindergarten predictors of later reading achievement in first and second grade. The predictors studied were alphabet recognition, word conceptualization, beginning and final consonant awareness, phoneme segmentation, word recognition, and contextual reading. The researchers found that alphabet recognition and word conceptualization at the beginning of kindergarten had the greatest effect on first grade reading ability. However, word recognition was a stronger predictor of first-grade reading ability at the end of kindergarten. Similarly, Morris, Bloodgood, and Perney (2003) examined which kindergarten reading skills were the greatest predictors of later reading achievement. The students’ pre-reading skills were assessed in the beginning, middle, and end of kindergarten. Reading achievement was assessed at the end of first and second grade. The authors found that at the end of kindergarten, word-recognition and spelling were the best predictors of first-grade reading achievement. These results were the same for second-grade reading achievement. Interestingly, the greatest predictor of end-of-second-grade reading achievement was end-of-first-grade reading achievement.

Levy, Abello, and Lysynchuk (1997) also examined the relationship between word-recognition speed and reading comprehension. Forty fourth-grade students were trained to recognize 72 targeted sight-words. Next, the students were asked to perform repeated readings of two stories. One story included the acquired sight words and the other did not. The results indicated that students had significantly greater fluency and comprehension with the story containing the targeted sight-words.
The Alphabetic Principle

Foorman, Francis, Fletcher, and Schatschneider (1998) studied whether first and second grade urban students who received instruction in the alphabetic principle would show more growth in one school year than students who received instruction using the whole language curriculum already occurring at the school they attended. The following three methods were implemented: direct instruction in letter-sound correspondences (DC), less direct instruction in systematic spelling patterns embedded in connected text (EC), and indirect, incidental instruction in the alphabetic code embedded in connected text as part of the district’s standard curriculum (IC). An analysis of the students’ improvement in word reading demonstrated that the children provided instruction with the DC method improved word reading skills at a faster rate than the other groups. The research indicated that students directly instructed in the alphabetic principle improved word reading skills at a significantly faster rate than children who were indirectly instructed through exposure to literature.

Directly teaching students word recognition skills is clearly important. However, the effectiveness and efficiency of instructional procedures should also be considered for practical application to educators who function under time constraints in a school day. Recent research has made strides toward identifying interventions that are both effective and efficient.

Effectiveness and Efficiency Research

Instructional effectiveness is the level of acquisition resulting from being taught with a certain instructional procedure (Cates, 2003). When students are taught words
using a traditional flashcard method, they increase the number of words they are able to read. Instructional efficiency refers to the amount of learning that occurs during the time it takes to implement instruction (MacQuarrie et al., 2002). When students are taught words using a traditional flashcard method, they increase the number or words they are able to read per minute of instruction. Enhancing the learning rates of students who fall behind their peers is the recommended way to remediate student skill deficits (Skinner, Fletcher, & Hennington, 1996). The results of one study indicated that in order to improve student learning, it is necessary to identify instructional methods that effectively increase student achievement in reading and that are also easy to implement (Fitzpatrick, McLaughlin, & Webber, 2004). While many interventions can enhance learning, not all interventions are equally efficient (Cates, Skinner, Watson, Meadows, Weaver, & Jackson, 2003). When students are unable to grasp basic concepts, they miss opportunities to practice skills and therefore limit their access to learning. This may, in turn, constrain their advancement in academic skills. Hence, it is important to identify interventions that are effective in remediating skill deficits quickly. This is particularly true regarding foundational skills upon which higher order skills are built.

Instructional efficiency and effectiveness are variables that have been examined across various academic subject areas, such as spelling (e.g., Cates et al., 2003), word reading (e.g., Nist & Joseph, 2008; Skinner, Belfiore, & Watson, 1995), and mathematics (e.g., Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997; Skinner, Ford, & Yunker, 1991). Despite some work in this area, a limited amount of research has been conducted to determine which academic interventions are most efficient.
Skinner, Belfiore, and Watson (1995) examined instructional efficiency and effectiveness by comparing two tape-recorded reading (slow-taped and fast-taped) interventions on students’ word learning. Students were asked to read along with a tape recorder. The slow taped-words condition involved words presented at five second intervals. The fast taped-words condition consisted of words being presented in rapid succession, one right after the other. Although the slow taped-words condition led to more words being learned by students, the learning rate of students was greater under the fast taped-word condition. That is, students learned more words per minute of instruction when words were presented rapidly.

Skinner and colleagues also examined the effects of using verbal and written response methods on instructional efficiency (Skinner, Ford, & Yunken, 1991; Skinner, Belfiore, Mace, Williams- Wilson, & Johns, 1997). The results indicated that when students were instructed to give verbal responses rather than written responses, the time it took to complete the intervention session was reduced without detrimental effects on student performance. In fact, enhancing response efficiency allowed for greater rates of responding and increased learning rates. In addition to the methods used by Skinner and colleagues, drill and practice methods are another way to elicit high rates of learning (Nist & Joseph, 2008).

Drill and Practice Methods

Various drill and practice techniques have been evaluated as a means to increase the overall instructional effectiveness when presenting academic content (MacQuarrie-Klender, Tucker, Burns, & Hartman, 2002). Burns (2004) suggested that drill tasks are an
important means of academic remediation for children who do not have the prerequisite skills needed to perform higher order tasks. Roberts and Shapiro (1996) recommended that practitioners turn to drill techniques for academic remediation because they allow for high repetition of new items. Standard drill and practice techniques consist of new material being presented over and over for the learner to practice until the response is automatic (Cooke & Guzaukas, 1993). This allows the student to have greater fluency with the new material. There are various drill and practice methods that practitioners can implement. Traditional drill and practice and interspersal procedures are two that have been used in the classroom setting and in research studies.

A recent study by Burns and colleagues (2009) examined the effects of two independent variables using fourth grade participants: (1) behavioral momentum and (2) an interspersal technique using word lists. In the behavioral momentum condition, easier first grade words were placed at the beginning of the word list followed by more difficult sixth grade words. In the interspersal condition, easier words were arranged throughout the word list. A third (control) list was developed lacking the easier words presented in the other conditions. The results demonstrated that students in the behavioral momentum group read significantly more words correctly per minute than students in the control condition. No statistically significant results were found between the interspersal and control conditions (Burns, Ardoin, Parker, Hodgson, & Klingbeil, 2009).

**Interspersal Methods**

The term interspersal refers to a method of drill and practice where the delivery of previously learned behavior is interspersed among trials of behavior that have not yet
been learned. The procedure has implications for student motivation. Techniques that increase the probability that a student chooses to engage in academic tasks can increase the rate of learning and decrease inappropriate behavior (Skinner, 2002). Such research provides support for the discrete task completion rate hypothesis (Skinner, 2002). This hypothesis is partially based upon a law proposed by Herrnstein (1961), stating that when presented a choice between two conditioned responses and all else is held constant, an organism will choose to engage in the response that results in the highest relative rate of reinforcement (Herrnstein, 1961). The following formula has been used to understand Herrnstein’s law:

\[ \frac{B_1}{B_2} = \frac{N_1}{N_2} \]

where \( B_1 \) and \( B_2 \) represent two independent behaviors and \( N_1 \) and \( N_2 \) represent the number of reinforcers provided to each of the two behaviors, respectively. Hence, instructional procedures such as incremental rehearsal that intersperse known items within an assignment can increase student preference for the assignment (Cates & Skinner, 2000; Skinner, Fletcher, Wildmon, & Belfiore, 1996; Wildmon, Skinner, & McDade, 1998), and increase the probability that students will choose to engage in assigned work (McCurdy, Skinner, Grantham, Watson, & Hindman, 2001). Early studies on interspersing techniques were conducted by Neef, Iwata, and Page (1977; 1980). The studies looked at the effects of the techniques on student achievement and retention of spelling words. Both studies included participants identified as mentally retarded. The results of the studies indicated that the students acquired and maintained more words in the interspersing condition than in the control condition, which consisted of solely unknown words.
Browder and Shear (1996) examined the effectiveness of interspersing known items with unknown items to teach sight words to three middle school students with moderate mental retardation and severe behavior disorders. The following dependent variables were studied: the number of unknown words read correctly on a sight word test, the percentage of error responses for unknown words, and the generalization of sight word reading to a newspaper’s report of the weather. Ten known and ten unknown words were presented to the students. The results indicated that interspersing known words positively influenced the rate of student learning.

In order to prevent and overcome academic skill deficits, Skinner, Belfiore, and Watson (1995) recommended that school personnel should determine which interventions are most efficient by measuring students’ learning rates under different instructional conditions. Cates et al. (2003) used flashcard instructional techniques to examine how instructional time and learning rate contributed to academic treatment decisions. The main dependent variables were instructional effectiveness and instructional efficiency. Students in this study were exposed to three spelling interventions: traditional drill and practice, interspersal training, and high-probability sequencing. During the traditional drill and practice sessions, students were presented with six unknown target words only. In the high-probability sequencing condition, experimenters presented the students with six unknown target words and eighteen known words. Three known words were presented before each target word. In the third condition, interspersal, the first word was a known word, and three other known words were added and interspersed following every third target “unknown” word.
Over the twelve consecutive days of experimental sessions, the students experienced two of the three conditions. Conditions were randomly selected and counterbalanced across school days to control for sequence effects. The experimenter followed a format similar to a traditional spelling test. The word was read aloud, used in a sentence, and then read aloud again. The experimenter observed the student write the word on paper. All correct responses were followed with verbal praise. Incorrect responses were followed by an overcorrection procedure in which the experimenter presented an index card with the word spelled correctly and instructed the student to write the word correctly three times.

Instructional effectiveness was defined as the cumulative number of target words learned across conditions. Instructional efficiency was measured by learning rate, defined as the number of words learned per minute of instruction. Student performance was measured and graphed via (a) cumulative learning, which does not consider the amount of instructional time, and (b) student learning rate, which does consider the amount of instructional time. The results of the study indicated that each student learned approximately the same number of words in each of the conditions. However, when learning rate was considered, the researchers found that the students learned more words under the traditional drill and practice condition. Similar results were found during the maintenance phase (Cates et al., 2003).

Several studies have compared the efficiency and effectiveness of instruction and found that all methods led to gains in word reading performance; however, the most time efficient method was the traditional drill procedure. Joseph and Nist (2006) extended the
research of Cates et al. (2003) with similar findings. The authors examined instructional effectiveness and efficiency using the following three flashcard procedures: a high probability sequence flashcard drill, an interspersal flashcard drill, and a traditional flashcard drill. The traditional flashcard drill was the most efficient instructional method compared to the other conditions that included ratios of known to unknown words. Schmidgall and Joseph (2007) compared the effectiveness and efficiency of whole word methods to a phonic analysis method (word boxes) on the word reading skills of six first grade students. Joseph and Schisler (2007) compared the instructional effectiveness and efficiency of phonic analysis, incremental rehearsal, and traditional drill and practice word reading techniques during repeated reading lessons. These studies, again, revealed that traditional drill and practice was most efficient.

Incremental rehearsal is an interspersal procedure used to facilitate word reading instruction. The IR procedure consists of known words being inserted between each presentation of an unknown word with increasingly more known words being presented (Burns et al., 2010). Roberts and Shapiro (1996) examined the effect of different instructional ratios of known to unknown vocabulary words on students’ reading progress. The results indicated that procedures consisting of a high percentage of known words may initially lead to a lower number of new words learned, but may have correlated with better word retention. The IR model is one such model including a high number of known words. IR has a long history and is based on Betts's (1946) classic work as interpreted by Gickling and Havertape (1981). Incremental rehearsal is conceptually desirable because it uses a high repetition of words. After the initial
instruction, words are rehearsed several times in order to reach mastery. Once the word is mastered, a second word is introduced and the previous unknown word is treated as the first known word. This allows for overlearning, high retention rates, and errorless learning. The IR method also provides a gradual introduction of unknown items, results in a high rate of success due to the high number of known material, and offers enough spacing to move unknown words from short-term to long-term memory (MacQuerrie, et al., 2002).

MacQuarrie et al. (2002) compared incremental rehearsal to a traditional drill approach and drill sandwich procedure for vocabulary learning. Participants were taught words from the Esperanto International Language. Words were presented individually on flashcards. The child was asked to pronounce the word and recall the English translation. The results of the study indicated that the incremental rehearsal condition produced better retention than the drill sandwich or the traditional flashcard approach. Results also indicated that incremental rehearsal could be a useful way for students to rehearse rote learning material in an individual drill setting (MacQuarrie et al., 2002). Burns, Dean, and Foley (2004) also used an incremental rehearsal procedure to teach key unknown words to students with learning disabilities. The strategy resulted in improved reading fluency and reading comprehension skills.

Nist and Joseph (2008) compared the effectiveness and efficiency of the following three flashcard drill instructional methods: incremental rehearsal, a more challenging interspersal method, and a traditional drill and practice flashcard method. The incremental rehearsal condition included the repeated interspersing of one unknown
word throughout nine known words. The other interspersal procedure consisted of a more challenging ratio of known to unknown words in which students were presented one known word prior to every third unknown word at a ratio of 67% unknown to 33% known. During the traditional drill and practice condition, the examiner presented only unknown words. Instructional effectiveness was defined as the cumulative number of words read accurately on next-day retention probes. Instructional efficiency was the cumulative rate of words retained per minute of instructional time.

The researchers used a counterbalanced alternating treatments design to control for sequence effects. Results indicated that incremental rehearsal was the most effective method. Students maintained and generalized more words taught in this condition. In contrast, traditional drill and practice was the most efficient method for improving reading performance. Students learned the greatest number of words per minute of instruction. A social validity assessment was administered to teachers and students in this study. The researchers concluded that the long duration of the incremental rehearsal method, given the presentation of higher ratios of known to unknown words, made the intervention seem more intensive and less desirable to students and teachers (Nist and Joseph, 2008). Thus, Nist and Joseph (2008) found that both teachers and students preferred the traditional flashcard method due to the efficiency of the technique.

In previous studies examining the effectiveness and efficiency of flashcard drill methods, instructional time across methods was allowed to vary while the researchers controlled for the number of trials to practice reading words. For instance, in Nist and Joseph’s (2008) study, the number of trials given to practice reading words was nine
across all instructional conditions (incremental rehearsal, traditional drill and practice, and the more challenging interspersal procedure) while the time it took to implement each instructional method varied considerably. In a commentary on the Nist and Joseph (2008) study, Skinner (2008) made suggestions with regard to future research on examining instructional effectiveness and instructional efficiency variables. Due to the instability of learning rates within students, Skinner surmised that holding time constant across each instructional condition and allowing trials to vary may be a more precise measure of learning rates. This procedure differs from much of the research on examining effectiveness and efficiency variables as most studies consist of varying time rather than learning trials. Skinner contends that by holding time constant researchers may be able to better determine which method yields the most learning within an allocated period of time. Moreover, teachers are typically allocated a certain time frame to teach specific academic skills. Therefore, it is important for researchers to conduct studies where time is held constant. This may allow them to recommend the methods that are likely to produce the most achievement given the time constraints faced by educators.

Incremental rehearsal may have limitations when applied to reading assignments consisting of multiple-paragraph passages. In contrast to previous studies on the technique, the results of a study on the use of IR with whole paragraph reading showed that student preference was not altered by the introduction of easier material (Martin, Skinner, & Neddenriep, 2001). Hence, the procedure may be more preferable when it increases discrete task-completion rates as opposed to whole paragraphs. However, incremental rehearsal is generally desirable because it includes words that are already
known by the student. The procedure is generally easier for students to complete and provides more opportunities for success, subsequently increasing motivation for the task.

**Social Acceptability**

Social validity, including teacher acceptability, has become increasingly important as schools are held accountable to student performance outcomes. More research is necessary to identify interventions that can be implemented effectively within a short amount of time. (i.e., efficiently). Several studies have collected social validity data. Results of earlier studies such as Neef et al. (1980) and Dunlap (1984) found that students preferred interspersal procedures over other types of instruction because of their inclusion of known content. Social validity data collected by Schmidgall and Joseph (2007) indicated that four out of the six first graders preferred the word boxes, one preferred a traditional drill and practice method, and one preferred the interspersal procedure. The researchers hypothesized that preference for the word boxes may have resulted from the students’ opportunity to manipulate appealing materials such as plastic letters and dry erase boards. Additionally, the researchers found that the students preferred the intervention under which they performed the best. Nist and Joseph (2008) also collected social validity data for reading intervention. All children chose the traditional drill and practice method. On a follow-up interview, students indicated that they felt that all three instructional methods helped them learn new words but would choose the traditional drill because it took the shortest amount of time to complete. Classroom teachers participating in this study felt that four of the six students increased their word reading skills and that all of the instructional approaches appeared valid for
teaching words to students with word recognition difficulties. They reported that the
traditional drill and practice method would be the most efficient for most students, but the
other approaches may be considered for students with special needs. Overall, more
research is needed to identify instructional procedures that are effective and efficient, as
well as socially viable.

Purpose of the Study

Traditional drill and practice was the most efficient method in the aforementioned
studies comparing traditional drill and practice methods to various types of interspersal
methods (i.e., Cates et al., 2003; Joseph & Nist, 2006; Schmidgal & Joseph, 2007; Nist &
Joseph, 2008). Once again, it should be noted that in the aforementioned studies, the
opportunities to read new words was held constant across different types of instructional
conditions and time to implement instructional method varied. According to Skinner
(2008), a better comparison between drill and practice methods may be to hold time
constant and permit learning trials (opportunities to respond) to vary. Determining
which method is more efficient by holding time constant may be more reflective of the
natural classroom environment as only a certain amount of time can be allocated to
reading instruction in most schools. Therefore, the current study extends prior research by
comparing traditional and interspersal drill and practice methods when the amount of
implementation time is held constant across instructional conditions.

The primary purpose of this study was to examine the instructional effectiveness
and instructional efficiency of two word reading interventions on students’ cumulative
number of words read accurately and cumulative learning rate. Specifically, the study
examined which of the two instructional conditions (traditional drill and practice or incremental rehearsal) was most effective given a specified amount of time. This was an important departure from similar investigations because it allowed the researcher to look at the effectiveness of an intervention in light of the amount of time spent providing instruction. This may reduce the number of unnecessary learning trails and help to pinpoint the most effective and efficient implementation of the techniques provided.

Maintenance and generalization of words that were taught under each instructional condition were also examined. Social validity data was gathered from the participants and their teachers to determine the acceptability of the methods.

Traditionally, intervention comparison studies have held the number of opportunities to respond constant, allowing instructional time to vary. Teachers have limited time to implement interventions, and some social validity data suggested that teachers and students preferred less time intensive interventions (Nist & Joseph, 2008).

Thus, the current study aimed to examine the same instructional variables that Nist and Joseph (2008) studied through a different methodological lens.

*Research Questions*

The following research questions guided this study:

1. Which method, incremental rehearsal or traditional drill and practice flashcard method helps children read the most words correctly?

2. Which method, incremental rehearsal or traditional drill and practice helps children read the most words correctly per minute of instructional time?
3. Which method, incremental rehearsal or traditional drill and practice, helps children maintain reading words accurately?

4. Which method, incremental rehearsal or traditional drill and practice, helps children maintain reading words accurately per minute?

5. Which method, incremental rehearsal or traditional drill and practice, results in the most generalization to accurate word reading in sentences (pre-post sentences)?

6. Which method, incremental rehearsal or traditional drill and practice, results in the most generalization to accurate word reading in sentences per minute of instruction (generalization rate)?

7. Which method, incremental rehearsal or traditional drill and practice, is viewed as most useful by first grade teachers and students?
CHAPTER 2: REVIEW OF LITERATURE

This chapter consists of a review of the related literature. Specifically, word identification and word recognition development are discussed with regard to the importance of these components to the reading process. Methods for teaching word identification and recognition are described, including a discussion of traditional drill and practice, interspersal, and incremental rehearsal procedures. These teaching methods are discussed within the context of their instructional effectiveness and instructional efficiency.

In a recent evaluation of the reading achievement of fourth grade students, the National Center for Education Statistics (NCES, 2008) reported that 34% of children read below the basic level. In Ohio, 27% of students read below the basic level (NCES, 2008). Unfortunately, children who fall behind in reading are likely to continue to have reading problems throughout their school career and into adulthood (Baydar, Brooks-Gunn & Furstenberg, 1993). The gap between poor readers and successful readers increases over time and more than five million adolescents in the United States are unable to adequately read or comprehend the textbooks, teaching materials, or assignments used in their core academic classes (Perie, Grigg, & Donahue, 2005). Perie et al. (2005) found that 26% of middle and high school students struggle to complete basic literacy tasks such as following written instructions, entering personal information on a form, and locating the
time of an event on a posted schedule. For many of these students, difficulty with reading may result from limited opportunities to engage in reading coupled with limited reinforcement for engaging in reading activities (Duffy & Allington, 2003). This, in turn, delays the development of automaticity with word-recognition. Thus, reading for meaning is hindered, unrewarding reading experiences multiply, and practice is avoided or merely tolerated (Stanovich, 2008/2009). Given that a majority of academic difficulties in school are reading related (Lerner, 2003), school psychologists should be knowledgeable about effective reading interventions.

The current political and professional climate supports investigations that pinpoint best practices in academic instruction. As the field of school psychology shifts toward a “response to intervention” model, it is imperative that professionals in the field become aware of the most effective and efficient academic interventions. In addition, a cornerstone of the No Child Left Behind (NCLB, 2001) Act, is to support states in making every child a proficient reader by the end of the third grade. The legislation requires the use of evidence-based practices that explicitly and systematically provide instruction on the big ideas of beginning reading (i.e., phonemic awareness, phonics, fluency, vocabulary, and comprehension).

Despite instruction in core reading programs that embrace evidence-based practices, some children fail to acquire basic skills and are at risk for reading failure (Foorman & Torgesen 2001). In addition to receiving instruction in their core reading program, these children require supplemental instruction providing opportunity to
practice underdeveloped skills (Simmons & Kame‘enui, Stoolmiller, Coyne, & Harn, 2003).

Stages of Reading Development

Learning to read begins before a student enters formal schooling and continues to develop over time. Jeanne Chall’s (1983) landmark model of reading development consists of six developmental stages. Chall’s stage 0 is the pre-reading stage. This stage spans birth through age 6. At this stage students become familiar with print, develop oral language, and gain phonological awareness. Children in stage 0 generally pretend to read storybooks, recite favorite stories, and begin to use appropriate prosodic features (Sulzby, 1985). Another activity characteristic of this stage is “reading” common signs or logos (Idrisano & Chall, 1995).

Stages 1 and 2 of Chall’s model are considered the “learning to read” stages and consist of skills acquired during the first, second, and third grades. Stage 1, labeled the initial reading stage, is typically reached in the first grade but may continue into second grade. During this stage, children learn the alphabetic principle, phonological awareness, and word decoding skills. In stage 2, the confirmation and fluency stage, children develop reading fluency. Following stage 2, the model conceptually shifts from “learning to read” to “reading to learn,” and comprehension becomes the most critical aspect of reading. Stage 3, spans grades four through eight, a time where students are confronted with increasingly unfamiliar and more complicated vocabulary and reading material (Indrisano & Chall, 1995). Comprehension becomes paramount as students are expected to extract the necessary information for learning from their reading. Stages 4 and 5 occur during
high school and college, respectively, and the process of reading requires comprehension and critical thinking skills to construct a deeper understanding of text. As such models demonstrate, reading is complex and involves many different skills. This includes word recognition, word study, reading fluency, and conceptual understanding (Gravois & Gickling, 2002).

Word Identification

Word identification skills are strategies a reader uses when he or she does not recognize a word automatically. A correlation has been found between word identification and reading performance (McCormick, 1999). Successful reading acquisition requires students to develop efficient strategies for identifying unfamiliar words in text. In turn, these word identification strategies are important in the development of rapid word recognition ability (Tunmer & Chapman, 2002). Increased automaticity in word recognition results in a greater amount of free cognitive resources that can be allocated to comprehension and text integration processes (Perfetti, 1985). Specifically, the student’s resources are not diverted from comprehension by focusing on word decoding.

Teaching competent use of word identification strategies is important because it allows students to read unfamiliar words independently without the assistance of a teacher (McCormick, 1999). Once a student uses these strategies, major advances are made in the number of words they can read (Juel, 1991). As a result, the development of word identification strategies facilitates comprehension because students are simply able to read more words with greater fluency (Daneman, 1991).
Two general strategies that beginning readers use to identify unfamiliar words in text are text-based strategies and word-based strategies (Tunmer & Chapman, 2002). Tunmer and Chapman (2002) stated that text-based strategies may include picture cues, semantic cues (e.g., “The ball ate the sandwich” is outside of the semantic constraints of the sentence), syntactic cues (e.g., “The boy slept the door” is outside of the grammatical constraints of the sentence), preceding passage content, and prior knowledge activated by the text. The authors describe word-based strategies as making correspondences between letters or digraphs and single phonemes, correspondences between groups of graphemes (e.g., *tion*) and groups of phonemes (e.g., /shun/), orthographic analogies (i.e., reading an unknown word like *claw* by analogy to a known word like *saw*), and polyphonic letter patterns (e.g., *ear* as in *bear* and *hear*, *own* as in *clown* and *flown*, where children generate alternative pronunciations of the word until one is produced that matches a word in their listening vocabulary).

Tunmer and Chapman (2002) conducted a study of the word identification strategies used by beginning readers. The strategies for identifying unfamiliar words in text were examined in relation to reading achievement, reading-related skills, and academic self-perceptions. The results suggested that students reporting the use of word-based strategies showed superior reading and reading-related performance, reported more positive self-efficacy in reading, and demonstrated more positive academic self-concepts than children who reported using text-based strategies.

Hammill, Mather, Allen, and Roberts (2002) investigated the extent that semantic, grammatical, phonological, and rapid naming abilities were able to predict word
identification. Participants were 200 students in first through sixth grade. Multiple regression analyses showed that among younger children in the early stages of learning to read and children whose word identification skills were below average, the phonology and rapid naming composites accounted for the most variance in predicting word identification skills. Among older children and children who were proficient in word identification, the semantics composite accounted for the most variance. The authors also evaluated the practical value of using the composites to predict poor word identification skills in children. In order to be considered useful for practical purposes, all predictive outcome values had to be .75 or greater. Surprisingly, none of the composites studied met this criterion. The authors questioned the accuracy and utility of using any of the abilities studied to predict which students were at risk for or had poor word identification skills (Hammill et al., 2002).

Ehri (1991) identified five methods of reading words: 1) by sight, 2) by phonological recoding, 3) by analogizing, 4) by orthographic generalizations, and 5) by contextual guessing. Sight word reading occurs when a reader sees a familiar word and the visually encoded string of letters activates the word’s pronunciation, meaning, and spelling (Ehri, 1991, 1995b). A word may be considered recognized by sight when the word is read as a whole unit within one second of seeing it (Ehri, 1992, 1995a; Torgesen, Waters, Cohen & Torgesen, 1988). Students at the beginning stages of word learning often read words by sight because they lack the skills for reading words through phonological recoding systems (Browder & Snell, 2000; Slaton, Schuster, Collins & Camine, 1994)
In contrast, phonological recoding involves transforming printed letters into sounds and then combining the sounds to pronounce the word (Ehri 1991, 1994, 1995b). Students can use the decoding procedure to sound out and recognize novel words. Phonological recoding can be slow and laborious compared to sight word reading, as it requires the student to identify grapheme-phoneme correspondences and blend them to recognize the word. The development of word identification skills is essential in order for students to become successful, fluent readers. This is particularly true because skill in word identification accelerates reading acquisition (Stanovich, 1991). In addition to accelerating reading acquisition, efficient word identification strategies are also necessary for the development of rapid word recognition ability (Tunmer & Chapman, 2002).

Research indicates that phonological awareness is one of the greatest predictors of reading achievement (Adams, 1990; Whitehurst & Lonigan, 1998). Phonological awareness is the ability to discriminate and manipulate the sound structure of language (Ehri, Nunes, Stahl, & Willows, 2001). Teaching children phonological awareness skills may begin prior to formal reading instruction in order to maximize later reading performance (Snider, 1997, Stanovich, 2000). The National Reading Panel analyzed the effect sizes of studies on phonemic awareness instruction. The analysis revealed that the impact was large and statistically significant. Phonemic awareness also resulted in a moderate, statistically significant impact on reading and spelling (Ehri, Nunes, Stahl, & Willows, 2001). Despite the effectiveness of this method, reading instruction cannot be seen from a “one size fits all” perspective, which has implications for school
psychologists working under the response to intervention model. Educators may need to employ multiple approaches before considering a student “unresponsive” to instruction.

**Word Recognition**

In order to develop reading fluency, readers must obtain both word identification strategies and sight word recognition strategies (McCormick, 1999). Stanovich (1991) refers to word recognition as linking the printed representation of a word with its meaning. It is the process of seeing a word and accessing its meaning. Word recognition involves the ability to identify a word automatically (Ashby, Rayner, & Clifton, 2005). Word recognition is a foundational skill that young children must possess to develop higher order skills such as vocabulary and comprehension to experience pleasure while reading (Stanovich, 1991). With practice, children build automaticity in their ability to recognize words when reading text (Adams 2001). Ongoing development of word recognition also serves as a critical basis for skillful writing (Carnine et al., 2004; National Reading Panel, 2000). Students who fail to develop strategies for word recognition are at serious risk of academic failure because of the negative effects on other reading skills, such as fluency and comprehension (Coleman-Martin et al., 2005; Stahl & Yaden, 2004).

Several effective approaches to teaching word recognition among children with learning challenges have been identified. For example, Schoen and Ogden (1995) had positive results using a constant time-delay procedure and learning through observation with students with moderate mental retardation and students considered at-risk learners. The constant time-delay procedure introduces and subsequently fades prompts for the
purpose of maximizing correct responses and minimizing student errors (Snell & Gast, 1981). Shuffled piles of words contained five repetitions of the two target words for each student. The first session of each of four instructional sets was characterized by 10 trials of 0-second time-delayed prompt followed by 20 trials of 3-second time-delayed prompts. Subsequent sessions within each set remained consistent at the 3-second delay condition. Mosley, Flynt, and Morton (1997) implemented community- or recreation-based methods using naturally occurring examples (e.g., street signs, grocery stores, etc.). Both methods led to increased recognition of words. The participants, age 13 to 17 with moderate mental retardation, learned more words at a faster rate using a direct instructional approach than with a community-based method, but preferred the latter approach.

Students in the beginning stages of word acquisition may read words by sight because they lack skills for reading words through phonological recoding systems or sophisticated word identification strategies (Ehri, 1991). Sight word reading, sometimes referred to as whole word reading, can be successfully taught with systematic instruction (Browder & Snell, 2000; Slaton, Schuster, Collins, & Camine, 1994). Some have suggested that reading words by sight is the most cognitively resourceful way to read words in text. Ehri (2005) explains that because words are always spelled the same way, they are more reliable units for readers’ eyes to process. In contrast, grapheme–phoneme correspondences may vary. The author argues that the same phoneme may be spelled more than one way, and the same letter may stand for more than one phoneme. Additionally, written words activate meanings, whereas single graphemes do not. Hence,
whole words are the basic units that readers’ eyes pick up and process to construct meaning out of print.

Rinaldi, Sells, and McLaughlin (1997) conducted a study on the effectiveness of the “reading racetrack” practice procedure and precision teaching techniques to increase elementary students’ fluency in reading isolated Dolch Sight words. Fifteen third and fourth grade students receiving either special education services in a resource room, services for learning difficulties, or general education participated in the study. The words read on the racetracks were taken from the lists of Dolch Sight Words (sets 1-4) that were often used in the school district. The first racetrack procedure contained seven target words that were repeated in random order. Every fifth racetrack presented was a review that contained the accumulation of the different words introduced in the four previous racetracks. The dependent variables were the number of words read correctly from the reading racetrack during a one-minute timing, and the frequency of errors during the same one-minute timed reading (Rinaldi, Sells, & McLaughlin, 1997).

During baseline, the participants read a list of Dolch Sight Words orally for one minute with no instruction provided. During the treatment condition, the reading racetracks were used in place of the Dolch Sight Word lists. The participants read the words on the racetrack for one minute. The participants then counted the number of words that were read. The instructor tallied the number of errors and provided feedback to the participant. Participants remained on a given racetrack until they reached the criterion of 90 words read correctly per minute with zero errors. Rinaldi et al. (1997) found an increase in the number of words read correctly by each participant during the
treatment condition. Additionally, the students demonstrated few errors during the reading racetrack condition.

Valleley, Evans, and Allen (2002), trained a parent to implement a sight word flash card drill and an overcorrection reading procedure for her seven year old son. The two dependent variables in the study were sight word knowledge, measured using the Dolch Basic Sight Word List at the pre-primer level, and reading fluency, defined as words read correctly per minute during brief reading assessments. At baseline, the participant correctly identified 22 out of the expected 86 pre-primer Dolch Sight Words. The participant also read a beginning first grade passage at a rate of eight words per minute. A typical second grade student would be expected to read at least 40 words per minute (Fuchs & Deno, 1982). Following the baseline assessment, the parent implemented a sight word flashcard procedure that involved modeling, corrective feedback, and the addition of new words. Fourteen words were presented to the student each day, six were unknown and eight words were considered known. The parent modeled the correct pronunciation of any words that were read incorrectly. Incorrect words were reviewed until the student read them correctly. Words read correctly on three consecutive days were replaced with new unknown words. The student was provided an overcorrection procedure following the sight word drill. If the student made an error or hesitated to respond within five seconds, the parent would read the word out loud to the student, and the student subsequently repeated the word three times. The student was then asked to reread the sentence from the beginning and continue reading the passage. The results indicated improvement in the student’s sight word knowledge. At a three-month
follow-up, the student maintained gains in sight word knowledge and reading fluency (Valleley, Evans, & Allen, 2002).

Word reading by analogy to a known sight word is another approach that is used to identify words (Hansen & Bowey, 1994; Goswami, 1990). In this approach, the reader recognizes the similarity of spelling patterns between the unfamiliar word and known word; accesses the known sight word from lexical memory; and infers the pronunciation of the unfamiliar word from that of the familiar word (Bruck & Treiman, 1992, Ehri, 1991, 1994, 1995b; Goswami & Mead, 1992). For instance, if the word is “bat,” the student may retrieve the word “cat” from memory and substitute the “c” for the “b” to identify the target word (Bruck & Treiman, 1992).

Orthographic generalization is a method of word identification by which groups of letters are processed as opposed to individual letters that results from experience reading words with common letter patterns (e.g., bake, cake, take, snake; Ehri, 1994). An unfamiliar word may activate memory of a group of words that share orthographic features of the unfamiliar word.

Contextual guessing allows readers to identify words using context clues (Ehri, 1994; Greenberg et al., 1997). The reader may use pictures or words that appear along with the target word to aid in the identification of the unknown word. For example, if there is a pizza on the page and the sentence says, “Baloo Bear likes to eat pizza,” the student who does not know the word pizza could infer the unknown word from the picture and other words in the sentence.
A review of the literature on word identification and word recognition highlights the various ways reading skills develop. The following is a discussion of several instructional approaches to enhance word reading performance.

*Traditional Drill and Practice*

In a review of research, Cates (2005) discussed the classic work of Haring and Eaton (1978), who defined drill and practice procedures as two independent procedures with different functions. According to the authors, the term “drill” refers to procedures that allow for repetition of responses to be learned. In contrast, “practice” refers to procedures focused on combining a number of learned responses to solve problems (Haring & Eaton, 1978). Drill and practice consists of new material being presented repeatedly for the learner to practice until the correct response becomes automatic (Cooke & Guzaukas, 1993). For example, a student may be shown target words on flashcards, repeat the words after the instructor, and then, once shuffled, practice reading the words as they are presented. Research has underlined the importance of developing fluency with basic academic skills as a foundation for building more complex skills, such as, reading comprehension, composition writing, and solving complex math problems (Cooke & Guzaukas, 1993). Traditional drill and practice approaches have been used to teach word recognition and have also resulted in increased comprehension (Tan & Nicholson, 1997). In a study by Tan and Nicholson (1997), 42 below-average readers age 7 to 10 learned words using flashcards. They read passages aloud containing target words and performed better on tests of comprehension than students in the control condition who solely discussed the words and read them once. In another study involving traditional drill and
practice, Cates and colleagues (2003) compared three spelling interventions: traditional drill with all unknown words; interspersal training with three known words included between two sets of three unknown words; and high-probability sequencing with each of the six unknown words was followed by three known words. Cates et al. (2003) found the traditional drill and practice method to be more efficient than other techniques for five second-grade students with difficulties in spelling. Nist and Joseph (2008) also found that traditional drill and practice was more efficient, resulting in more words acquired per instructional minute.

While traditional drill and practice has established benefits with regard to efficiency, some research has indicated that interspersal methods may rival TDP when considering maintenance data. Burns and Sterling-Turner (2010) compared efficiency metrics looking at initial learning and maintenance with 25 fourth-grade students. Participants were taught the English pronunciation and translation of 12 words from the Esperanto international language using TDP, with all unknown words, and incremental rehearsal (IR), interspersing one known word with eight unknown words. Results indicated that IR led to significantly more words being retained while TDP was significantly more efficient for initial learning. However, the two conditions were equally efficient when maintenance data were considered. The authors stated that it was difficult to judge which intervention was more efficient because the IR condition took 2.5 times longer to implement but was almost 3 times as effective. Hence, studies comparing TDP with interspersal techniques to gain information regarding which method of instruction is effective for certain settings or type of student is important. The following is a discussion
of the literature surrounding interspersal techniques with specific focus on research examining incremental rehearsal.

**Interspersing Procedures**

Research has demonstrated the benefit of interspersing known items with unknown items to increase student preference and on-task behavior across various subjects (Burns, Dean & Foley, 2004; Cates & Skinner, 2000; McCurdy, Skinner, Grantham, Watson & Hindman, 2001). Neef, Iwata, and Page (1977) were among the first to study the effects of interspersing known and unknown items during instructional drills of information. Six students diagnosed with mental impairment were taught a list of 50% known and 50% unknown spelling and sight words. In a control condition, students were presented with only unknown words. The results indicated that students with low cognitive ability acquired and retained more unknown words during the interspersing condition than in the control condition where all words presented were unknown.

Neef, Iwata, and Page (1980) investigated the effect of interspersing new items with review items during spelling instruction. The participants were three adult males with developmental disabilities. Two of the participants were identified as trainable mentally retarded and one diagnosed as profoundly deaf. Correct responses were reinforced with verbal praise and incorrect responses were corrected by the examiner. During baseline, the student was asked to write the words correctly 3 times. Following baseline, student received social reinforcement for behaviors such as paying attention, writing neatly, and trying hard. The 10 words from the pretest were presented in an alternating fashion with the 10 test words. The results indicated that interspersing review
items among new items increased the acquisition and maintenance of the new spelling words when compared to a control condition introducing only new words. Additionally, the students consistently preferred instruction using the interspersing condition.

Drill ratios. An important aspect of effective instruction is providing students with an appropriate level of challenge, also called the instructional level (Burns, 2004). For drill and practice interventions, establishing the optimal ratio of known to unknown words presented to a learner ensures the best rate of acquisition. Much discussion has occurred in search of the optimal ratio of known to unknown items for drill tasks, but varying results have emerged (Burns, 2004). Different ratios for drill tasks have been suggested to be effective, including 70% to 85% known and 15% to 30% unknown (Gickling & Thompson, 1985), 30% unknown to 70% known (Coulter & Coulter, 1989), 50% unknown to 50% known (Neef, Iwata, & Page, 1980), and more challenging ratios of less than 50% known (Robinson & Skinner, 2002). Tucker (1989) presented the incremental rehearsal model, in which an unknown item is interspersed among an incrementally increased number of known items to teach a drill task. This model could be applied to any drill ratio, but Tucker’s example used 10% unknown to 90% known, which continues to be a common ratio for the model.

Results have consistently found that the more challenging ratios (i.e., those with 40% or more unknown words) lead to a larger number of words mastered (Szadokierski & Burns, 2008). Less challenging ratios such as 30% unknown to 70% known require more time to reach mastery than ratios consisting of a larger percentage of unknown words, but lead to better retention. However, the authors caution that when unknown
words are introduced at the commonly practiced ratio of one unknown to nine known, students may be kept at a slower pace of learning than necessary (Cooke & Reichard, 1996). MacQuarrie (2002) suggests that interspersing known and unknown items is superior to presenting all unknown material; however, research results are inconsistent. Burns (2004) conducted a meta-analysis of the following drill ratios: <50% known, 50% to 69% known, 70% to 85% known, and 90% known. Results indicated that presenting a greater number of known words was more conducive to learning than a more challenging ratio including fewer known words. The 90% known group had the highest median effect size coefficient and the second highest (behind the 70% to 85% group) mean effect size. The most challenging (<50% known) ratio produced a small to moderate effect.

Cooke, Guzaukas, Pressley, and Kerr (1993) conducted research on instructional ratios and learning rates by looking at the differential effects between a 30% unknown words to 70% known words drill ratio, and a traditional 100% unknown words procedure. The authors examined the relative effects of the two conditions on acquisition of spelling words with four adolescents with emotional/behavioral disorders. The order in which the words were presented was based on suggestions made by Coulter and Coulter (1989). Data were collected for (a) the percentage of words spelled correctly on single daily probes, (b) number of words learned per session minute, (c) percentage correct on a maintenance probe every fifth session and (d) participant preference for conditions. Results indicated that accuracy levels were similar between the two conditions across daily probes. In addition, the 100% condition allowed for more words to be learned per minute across all students. The mean percentage of words correct on maintenance probes
ranged from 3.4% to 10% higher in the 30% new/70% review condition compared to the 
100% new words condition (traditional drill and practice). This indicates slightly greater 
maintenance for three of the four students when the instructional load was reduced. 
However, this difference was offset by the more dramatic difference in efficiency. In the 
100% unknown words condition, the students learned more than twice as many words 
than when a ceiling of 30% new words was imposed. The authors concluded that 
restricting the instructional load to only 30% new items may have unnecessarily restricted 
the amount of learning students experienced.

*Incremental rehearsal.* Incremental rehearsal (IR) is an interspersing procedure 
involving multiple presentations of the same unknown word. The number of known 
words presented between presentations of the unknown word systematically increases. 
Unknown items are gradually introduced one at a time using an established drill ratio. 
Students experience high rates of success due to a great amount of known material. The 
procedure also supports the movement of unknown words from short term memory to 
long term memory due to spacing between known and unknown items (MacQuarrie, 
Tucker, Burns, & Hartman, 2002). The incremental rehearsal approach was based on 
research supported practices such as errorless learning, spaced repetition, the introduction 
of small subsets of material, teaching to automaticity, and increased opportunities to 
respond (Burns, Dean, & Foley, 2004).

Findings of previous research support the efficacy of IR for facilitating the 
acquisition and retention of academic skills. MacQuarrie et al. (2002) found that the 
incremental rehearsal procedure resulted in significantly more words retained compared
to traditional drill and practice and drill sandwich techniques with elementary and middle school students. Participants were taught words from the Esperanto International Language. A traditional drill (TDP) approach was used as the control condition. Each card was presented individually and the students were asked to state the pronunciation and English translation. A plus sign was placed on the back of the card when the student correctly stated both pronunciation and translation. The students were not told that the word was correct, and responses were not reinforced. However, the pronunciation and translation were provided if students stated the incorrect pronunciation and/or translation. Once a word had three plus signs on the back of the card it was removed from the set.

Drill sandwich (DS) was the second condition and involved presenting the nine unknown words to the students in sets of three. The first three unknown words were taught along with six words that the child already knew in the following sequence: first known, second known, third known, first unknown (Esperanto), fourth known, fifth known, second unknown (Esperanto), sixth known, and third unknown (Esperanto). In the IR condition, the unknown words were introduced and rehearsed one at a time with an increasing number of known words interspersed between the unknown words. Results showed large effect size coefficients comparing IR to DS and all but one exceeded .80 when comparing IR to TDP. The mean number of words correctly retained from Day 1 to Day 30 using the IR model decreased by 9.2% fewer words. DS and TDP resulted in a 32.8% and 35.2% decrease in the number of words retained at Day 1 and Day 30.

Burns and Boice (2009) replicated the MacQuarrie et al. (2002) study. The Esperanto International Language was taught to seventh and eighth grade students.
receiving special education services and diagnosed with a learning disability or mental retardation. The IQ scores of the participants ranged from 61 to 85. Participants were exposed to the three treatment conditions used in MacQuarrie et al. (2002). The findings were consistent with the previous study as the IR condition resulted in students retaining two to three times more words than the traditional and interspersal conditions. Students in this study did not retain as many words overall for each condition, which may be accounted for by the disability diagnoses, but the correlation coefficients approximated the results obtained in MacQuarrie et al. (2002) study.

Using IR as a preteaching strategy has been shown to increase skills such as reading fluency and reading comprehension (Burns, 2002; Burns, Dean, & Foley, 2004). Burns, Dean, and Foley (2004) used incremental rehearsal to improve reading fluency and reading comprehension skills with 20 third- and fourth-grade students diagnosed with specific learning disability in the areas of basic reading or reading comprehension. The students were presented with the key words and were also presented 20 known words from a second grade word list. From that list, nine known words that the student could correctly orally read within two seconds of presentation were identified. Words that were not correctly identified were considered unknown and were taught to the child.

In the control condition, students read a passage and answered comprehension questions without prior intervention. The treatment condition consisted of using the IR approach to teach key words derived from a reading passage that the students were asked to read. Students were then asked to respond to comprehension questions. The unknown words were presented in the same order as they appeared in the passage and the order
remained the same for each student in a particular grade. An error was identified if the student was unable to correctly read the word or could not read the word within two seconds of presentation. Results indicated a statistically significant increase in reading fluency at an average of 8.0 words per minute resulting from the IR procedure. The mean number of reading comprehension questions answered correctly was also statistically significant, increasing by 2.4 questions.

Burns et al. discussed several limitations of their investigation. First, males were overrepresented in their sample size (85% male). Secondly, the sample size was small, limiting the extent that the results could be generalized. Finally, the students in the study were identified with specific learning disabilities by school personnel using a particular state’s criteria and the discrepancy model which may make it difficult to generalize the findings across states as eligibility criteria may vary across states.

Incremental rehearsal is an effective instructional method not only for reading but for other academic areas such as math. Burns (2005) used IR to teach single-digit multiplication facts to three elementary school students identified as having a learning disability in math calculation. Students’ progress was monitored with weekly curriculum-based measurement fluency probes. The students were asked to complete 35 randomly selected single-digit multiplication facts in two minutes. The number of digits correct was counted and converted to a rate by dividing the number correct by two, for the two minutes that students were working on the multiplication facts, resulting in the number of facts correct per minute.
Each classroom was assigned a university student researcher who taught the unknown facts to the students in the experimental condition in a one-on-one manner. In order to determine whether the multiplication facts were known or unknown, the facts were written on index cards, shuffled, and presented to the participant one at a time. Correct answers given within two seconds were counted as known, and incorrect answers were counted as unknown. Multiplication facts were taught using IR. The first unknown fact was presented to the student, and the experimenter verbally gave the correct answer. The student was asked to restate the fact and provide the correct answer. Next, a known fact was provided, followed by the unknown fact, until the sequence was repeated nine times. After completing the sequence, the first unknown fact was treated as the first known and the previous ninth known fact was removed. A new unknown fact was then introduced. The number of cards always remained 10, and the ratio of unknown to known items was 10% unknown to 90% known. Incremental rehearsal was found to be an effective intervention for increasing the fluency of completing single-digit multiplication facts among the third-grade children who participated in the study (Burns, 2005).

Fluency

Fluency underlies reading proficiency for readers of all skill levels. Fluency has been defined as behavior that is performed with a high degree of accuracy and speed (Binder, 1996; Johnson & Layng, 1992). Research consistently demonstrates that the development of automaticity in basic skills can result in higher performance on subsequently more complex tasks (Dehaene & Akhavein, 1995; Jones & Christensen, 1999; Logan & Klapp, 1991; Ormrod & Lounge, 1990). Reading fluency, specifically, is
defined as the ability to read single words quickly and accurately both in and out of context (Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Fuchs, Fuchs, Hosp, & Jenkins, 2001). However, researchers have suggested that both components of fluency, automaticity and prosody, should be considered in measures of reading fluency and in instructional methodologies for improving reading fluency (Rasinski, Rikli, & Johnston, 2009). Kuhn and Stahl (2003) encouraged children to use fluency techniques in classrooms more often due to the positive benefits that accrued for overall reading. Kubina (2005) recommended reading fluency tasks for students with and without disabilities in an inclusive classroom.

Research indicates that a significant correlation exists between sight word reading and text reading fluency. When word recognition is automatic and reading is fluent, attention and processing resources can be devoted to reading comprehension instead of decoding each word. Thus, automatic word recognition is linked to fluent reading and comprehension (Carnine, Silbert, Kame'enui, & Tarver, 2004). Torgesen, Wagner, and Rashotte (1998) found that both sight word efficiency and phonemic decoding efficiency subtests of a test of word reading efficiency had a 0.80 correlation with the rate and accuracy scores of the Gray Oral Reading Test. Analyses have also shown that the additional contribution of other variables over and above sight word and non-word reading efficiency is very small (Torgesen, Rashotte, & Alexander, 2001). Due to these correlations, some have argued that reading words and reading text share many of the same underlying skills and represent the same latent construct (Fletcher, Lyon, Fuchs, & Barnes, 2006). Hence, for children to increase automaticity in reading skills, words may
first need to be taught and practiced in isolation (Carnine, Silbert, Kame'enui, & Tarver, 2004).

The development of reading fluency is considered a critical component of general reading ability due to its high association with the improvement of reading comprehension (Chard, Vaughn, & Tyler, 2002; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Fuchs & Maxwell, 1988). Research indicates interventions that increased reading rate also increased reading comprehension (Cates, Thomason, Havey, & McCormick, 2006). Hence, fluent sight word reading established through remedial reading instruction is important for comprehension and, subsequently, quick and effortless word recognition is imperative for fluency. Therefore, success at improving word recognition could improve fluency, which would likely improve comprehension (Burns, 2002).

Opportunity to Respond

Opportunity to respond (OTR) refers to the interaction between a student response to instructional stimuli and feedback received from the teacher (Greenwood et al., 1984). Research has shown that fluency and maintenance are enhanced when students engage in high rates of active accurate academic responding (Skinner, Belfiore, Mace, Williams, & Johns, 1997). Each presentation of academic stimuli is presumed to strengthen the relationship between the stimulus and the response. As a result, accurate responses should be reinforced and incorrect responses corrected. During word drill, the efficacy of OTR is maximized when the instructor follows a sequence of presenting a word to the student, having the student provide a response, and giving feedback about accuracy (Belfiore & Skinner, 1995). Increasing the number of OTR can increase learning (Greenwood et al.,
1984; Belfiore et al., 1995), accuracy (Albers & Greer, 1991), and fluency (Skinner, Turco, Beatty, & Rasavage, 1989). Findings indicate that students with average intelligence require fewer presentations of a particular word than students with mild disabilities before demonstrating automatic word recognition. Additionally, research indicates that the number of opportunities to respond is of greater importance than the drill ratio for instructional interventions using flashcard drill and practice (Burns, 2007b; Szadokierski & Burns, 2008).

Skinner, Ford, and Yunker (1991) examined the effects of an increased number of opportunities to respond on two students with Emotional/Behavioral disabilities by using a verbal cover, copy, and compare intervention (VCCC); a written cover, copy, and compare (WCCC); and no treatment. Students were trained in the WCCC intervention to look at the math problem, cover the problem and answer, write the problem and answer, uncover the problem and answer, and evaluate what was written. The VCCC intervention required the students to verbally state the problem and answer. Data showed that the VCCC intervention led to approximately 2.5 times as many opportunities to respond as the WCCC intervention during the same amount of time. The mean percentage of problems correct was 74 for the VCCC intervention and 68 for the WCCC intervention and no treatment combined. The VCCC intervention also resulted in 28 digits correct per minute, 20 digits correct per minute for the WCCC intervention and no treatment condition combined (Skinner et al., 1991).

Skinner, Smith, and McClean (1994) increased the number of opportunities to respond by increasing the presentation rate, in addition to requiring increased responses
from participants during two intervention conditions. An alternating treatment design was used to evaluate the effect of two interventions, 1-second and 5-second presentation rates on the number of reading words mastered by three elementary students. Students were given three opportunities to respond per target word during each of the interventions, compared to one opportunity to respond per target reading word during the no-treatment condition. The results indicated that both interventions led to increased mastery of words across all students. The presentation rates of 1 and 5 seconds did not differ. Across students, the 5 second presentation rate took an average of 103 seconds longer per session than the 1 second presentation rate and may have characterized a somewhat more efficient use of instructional time (Skinner et al., 1994).

**Instructional Effectiveness and Efficiency**

Instructional effectiveness refers to the level of acquisition of new material resulting from being taught with a certain instructional method. In contrast, instructional efficiency is the level of acquisition attained per minute of total instructional time, or the rate of acquisition (Cates, 2003). In many intervention studies, the amount of learning often serves as the primary dependent variable. MacQuarrie et al. (2002) stated that efficiency, the length of time needed to implement the intervention, should be included as well. When selecting an intervention, practitioners should consider instructional efficiency, which is best determined by dividing the total amount of learned information by the time required to learn it (Skinner, Belfiore, & Watson, 1995). Until recent studies, instructional efficiency has been overlooked in intervention research. Skinner (2008) suggested that most learning research should include measures of learning rates as
opposed to just studying learning levels. Instructional efficiency should be a priority when designing instructional strategies and evaluating outcomes. Assessing learning rates requires measuring the change in behavior while also taking into account the time required for the learning experience (Skinner, 2008).

Skinner, Belfiore, and Watson (1995) examined instructional efficiency and effectiveness by comparing two tape-recorded reading interventions on the word learning of students described as having mild disabilities. Students were asked to read along with a tape recorder. A slow taped-words condition involved words presented at five second intervals. A fast taped-words condition consisted of words being presented in rapid succession, one right after the other. Although the slow taped-words condition led to more words being learned by students, the learning rate of students was greater under the fast taped-word condition. That is, students learned more words per minute of instruction when words were presented rapidly.

Experiments comparing interspersal techniques to the traditional drill and practice flashcard method have resulted in varying findings. Neef et al. (1977; 1980) found that interspersing easy, known, or mastered items enhanced both the effectiveness and efficiency of remedial intervention. In contrast, Cooke and Gazaukas (1993) found that the most rapid learning rates occurred during the condition that consisted of 100% unknown words (described above). Additional reading remediation studies found that the most rapid learning rates occurred during the traditional drill and practice condition (Cates, Skinner, Watson, Meadows, Weaver, & Jackson, 2003; Nist & Joseph, 2008). Specifically, incremental rehearsal procedure required approximately 15 to 20 minutes to
complete (Burns, 2007; Joseph & Schisler, 2007; Mac- Quarrie, Tucker, Burns, & Hartman, 2002), which Beck, Burns, and Lau (2009) describe as a relatively long period of time for implementing a one-on-one intervention. However, the incremental rehearsal approach led to better maintenance and generalization than approaches that took less time to implement, such as traditional drill and practice and drill sandwich (MacQuarrie et al., 2002; Burns, 2007; Nist & Joseph, 2008). Inconsistency appears to exist both across and within studies; however, the majority of findings suggested that learning rates were highest when more new material was presented than review material (Cooke et al., 1993; Cooke & Reichard, 1996; Roberts & Shapiro, 1996; Roberts et al., 1991). The removal of unknown items and addition of known items may increase learning retention. In contrast, the removal of unknown items may reduce opportunities to learn new material and subsequently reduce the efficiency of academic intervention (Cates, 2003).

Most students referred to school psychologists for intervention and assessment are, in fact learning, but their rate of learning is unacceptable. (Skinner, Fletcher, & Henington, 1996). Learning rates are often measured by the amount of increased accuracy over time. Learning rates can be improved by increasing the quality and/or quantity of learning trials in a set period of time (Skinner et al., 1996). Quality refers to the amount of learning during trials. Learning trials that are qualitatively stronger require fewer trials to meet a standard. The quantity of learning trials can also enhance learning. This can be done by increasing the time allowed for participation in learning trials (Skinner et al., 1996).
Due to the recent emphasis on state performance-based testing, teachers are forced to cover a vast amount of information in a minimal amount of time (Braden, 2002). Hence, it is important to consider the amount of instructional time necessary in implementing remedial and instructional interventions. Research has focused on finding effective interventions that take into consideration both the instructional time and learning rate that is likely to result. In other words, researchers are seeking interventions that provide the greatest amount of learning in the least amount of time due to the time constraints for delivering instruction during the school day.

Cates, Skinner, Watson, Meadows, Adam, and Jac (2003) examined the effectiveness and efficiency of three spelling interventions on the spelling performance of five second grade students in a general education setting. The researchers considered the extent to which instructional time and student learning rate affected academic treatment decisions. The following instructional methods were used in the investigation: an interspersal procedure, traditional drill and practice, and a high-p sequencing procedure. An alternating treatments design was used and student performance was measured and graphed. The researchers measured and developed cumulative learning graphs, without consideration for instructional time, and also graphed the students’ rate of learning, taking instructional time into account. The measurement procedures were compared based on the ability to detect differential effects of interventions on spelling mastery. Results indicated that student learning rate better facilitated data-based decision making. Additionally, participants learned a significantly greater number of words under the
traditional drill and practice condition than other conditions when the amount of instructional time was considered.

Joseph and Nist (2006) extended the Cates et al. (2003) study through an investigation of the instructional effectiveness and efficiency of three whole-word reading techniques on word mastery. The authors measured the cumulative number of words read accurately and cumulative learning rates of two fifth-grade students and one sixth-grade student with reading difficulties. An alternating treatments design was used to compare the effects of high-p sequencing technique, an interspersing procedure, and traditional drill and practice method on word reading mastery. In the high-p sequencing method, three known words were presented prior to the presentation of each known word. In the interspersal training method, three known words were interspersed following the presentation of every third unknown word, and the traditional drill and practice condition involved the presentation of the six unknown words. Each of the three participants was presented with all three treatment conditions. Prior to treatment, students were given a pretest in order to develop a bank of known and unknown words. A total of 100 words were taken from informal reading materials used in the students’ classrooms. Each student was presented with 3-inch by 5-inch index cards with words printed on them. The students were given three seconds to read the words. No feedback or error correction was provided for incorrect responses, and verbal praise (e.g., “That’s correct”) was provided for all students’ correct responses. Words read correctly were used as known words in the high-p sequencing and interspersal training conditions, and words read incorrectly were
randomly selected and taught in one of the three conditions. Six unknown words were taught per condition.

Modeling was provided during each treatment condition. The experimenter read the unknown word the first time it appeared in each condition. Verbal praise was provided for correct responses, and corrective feedback was provided for responses that were incorrect. After all words in each instructional condition were presented once, the index cards were shuffled and a second trial with corrective feedback only was provided. Unknown words were considered mastered when the student correctly read the word on both trials within three seconds. Results indicated variability when analyzing cumulative learning across conditions. However, higher cumulative learning rates were evident under the traditional drill and practice condition in which all words presented were unknown; these findings were consistent with the Cates et al. (2003) study.

Schmidgall and Joseph (2007) further investigated instructional effectiveness and efficiency by examining the cumulative number of words read accurately and cumulative learning rate resulting from three word-reading interventions with six first grade students. An alternating treatments design was used to compare the effects of an interspersal procedure, in which one known word was presented prior to every third unknown word; the phonic analysis method of word boxes, in which only unknown words were presented, and traditional drill and practice procedure consisting of only unknown words. The inclusion of the phonic analysis method as well as the measure of generalization was extended in this study. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) was used to identify six participants performing below grade-level in word identification.
The cumulative number of words read accurately and the cumulative rate of reading words accurately across each instructional condition was studied. Cumulative words read accurately were measured by recording the number of correct words read on three trials under each instructional condition and summing the total correct across instructional sessions. Cumulative rate of reading words was measured by summing the number of words read correctly per minute of instructional time under each instructional condition. Maintenance of words learned under the instructional conditions was assessed following the 10th and 20th sessions. Participants were presented with the words mastered during the daily sessions under each instructional condition. Generalization was assessed by asking the students to read maintained words in sentences. The experimenter randomly selected 54 words that were read correctly on maintenance assessments and created sentences containing each of the words. Maintained words were considered generalized and recorded as correct when they were read accurately as a whole.

Results indicated that all instructional procedures lead to positive effects for enhancing word reading. The word boxes approach was the most effective, and the traditional drill and practice approach was the most efficient in terms of increasing word reading performance. Neither of the instructional approaches was statistically more effective regarding the participants’ ability to maintain and generalize words mastered during the three treatment conditions. A social validity measure indicated that students preferred the word boxes approach over the traditional drill and practice and interspersal training procedures.
Joseph and Schisler (2007) compared the instructional effectiveness and efficiency of phonic analysis, incremental rehearsal, and traditional drill and practice word reading techniques during repeated reading lessons. Sixty students in the first through third grade having difficulty with oral reading fluency were randomly selected to participate in one of the three word reading techniques paired with the repeated reading lessons. In the repeated readings with phonic analysis condition, each student was given one minute to orally read a passage on his or her instructional level. The instructor recorded the number of words read correctly in one minute and printed the words read incorrectly on index cards. Words read incorrectly were taught through a phonic analysis procedure called word boxes. The word boxes technique consisted of a dry erase board divided into sections to form connected boxes according to the number of sounds heard in a word. A word printed on an index card was initially pronounced by the instructor and placed above the rectangle. Plastic letters were placed below the divided sections of the rectangle and were used to instruct the student to make one-to-one letter-sound correspondences. The instructor modeled articulating the sounds while sliding the plastic letters into the boxes. The student was then asked to slide the letters into the respective divided sections as he or she articulated the sounds of the word printed on the index card. The student was then asked to blend the sounds and say the word as a whole. If the student read the word incorrectly, the instructor provided the correct pronunciation of the word.

In the repeated readings with incremental rehearsal condition, each student was given one minute to orally read a passage on his or her instructional level. Certain
correctly read words were printed on index cards and used as “known” words. Words read incorrectly were taught in the incremental rehearsal procedure. Flashcards were then presented to the student using a ratio of 1 unknown to 6 known words. The experimenter then presented an unknown word, modeled the correct pronunciation, and then presented the first known word. The first unknown word was presented again, followed by the first known word, the second known word and the third known word, etc., until all unknown words were interspersed with the known words. In the repeated readings with drill and practice condition, each student was given one minute to orally read a passage on his or her instructional level. The instructor recorded the number of words read correctly and incorrectly and printed the incorrectly read words on index cards. Words read incorrectly were then taught through a traditional whole word drill and practice technique.

Instructional effectiveness was measured by the groups’ mean cumulative oral reading passage fluency performance. Instructional efficiency was measured by the groups’ mean cumulative oral reading passage fluency performance per minute of total instructional time. Results indicated no significant differences between treatment groups. Instructional efficiency results were consistent with previous studies. The traditional drill and practice and repeated reading condition was found to be most efficient when compared to the other two instructional conditions.

Nist and Joseph’s (2008) study of effectiveness and efficiency compared an incremental rehearsal procedure, a more challenging interspersal procedure, and traditional drill and practice using flashcards. Six first-grade students participated in the study. Instructional effectiveness was measured by the cumulative number of words read
accurately on next-day retention probes. Instructional efficiency was measured by the cumulative rate of words retained per minute of instructional time. Results indicated that students as a group learned to read more words under the incremental rehearsal condition. Efficiency data was consistent with previous investigations, as the traditional drill and practice method was found to be the most efficient method in the number of words learned in relation to total instructional time.

Burns and Sterling-Turner (2010) compared two different efficiency measures by examining the extent to which how efficiency was defined affected how it was judged. The authors examined (a) the effectiveness of TDP and IR (b) the efficiency of the instructional approaches based on the number of words learned, and (c) the efficiency of the approaches based on the number of words retained after a delay of 1 week and (d) the extent that the method for computing efficiency affected which intervention was deemed more efficient. Twenty-five fourth grade students were taught sight words from the Esperanto International Language to ensure no rehearsal effects or prior rehearsal were not confounding variables. Six words were taught in each condition. In the TDP condition all six unknown words were presented one at a time. In the IR condition eight known words were selected and known words were incrementally added between the presentations of the unknown word (unknown, known, unknown, known, known, unknown, known, known, known, up to the eighth presentation of the unknown word followed by eight known words). Efficiency was computed by converting the time required to complete the intervention session to a decimal and dividing six (the number of words taught) by the number of minutes required to complete the intervention. Efficiency
within the maintenance metric was computed by dividing the number of words retained by the number of instructional minutes required to complete the intervention session. Paired-samples t tests using number of words retained, number of words learned per minute, and the number of words retained per minute were used to address the research questions. A chi-square analysis was used to compare the number of students for whom each intervention was most efficient. One week after instruction, the students recalled more words taught with the IR procedure. However, students required and average of 3.52 minutes to complete the TDP condition and 8.90 minutes to complete the IR condition. When efficiency was computed for the number of words retained one week later, .43 words per instructional minute were retained from the TDP condition, and .46 words per instructional minute were retained for the IR condition. The difference was not significant but the effect size was moderate (d=.50). TDP was more efficient for all 25 children when examining initial acquisition of the material, but was more efficient for only 36% of the children when retention was considered. Conversely, IR was less efficient for all students during initial acquisition but more efficient for 64% of the students when considering retention (a significant effect). The authors concluded that the metric used to determine efficiency influenced the resulting judgment.

Summary

In conclusion, the research indicates that reading development is a complicated process that can be facilitated through various instructional methods. While some students gain reading skills naturally from the environment, other students are referred to educational professionals for remediation. Various studies have examined the use of
flashcard interventions for teaching students words recognition and facilitating reading comprehension. Both traditional drill and practice and interspersal methods have demonstrated positive effects for teaching reading to students at various grade levels. Recently, research has shifted toward identifying not only the most effective method of intervention, but also determining which methods are the most efficient. This is important given the demands of teachers and the importance of foundational reading skills for building more complex skills such as reading comprehension. The purpose of the following study is to determine the effectiveness and efficiency of two different word reading interventions, TDP and IR, when controlling for the amount of time used to implement the interventions as opposed to teaching a certain number of target words.
CHAPTER 3: METHODOLOGY

This chapter describes the methods of the study including the participants, participant selection, setting, experimenter, materials, definition and measurement of the dependent variables and independent variables, and experimental design. Additionally, interscorer agreement, treatment integrity, and social validity are discussed.

Participants

The participants in the study were five first grade students from a suburban elementary school in Central Ohio. All participants were given pseudonyms to ensure confidentiality. They are referred to as Julie, Alex, Jack, Nolan, and Ronald. Julie was a 7-year, 2 month old Caucasian female; Alex was a 6-year, 11 month old Caucasian male; Nolan was a 7-year, 3 month old Caucasian male; Ronald was a 6-year, 11 month old Caucasian male; and Jack was a 7-year, 9 month old Caucasian male. The mean age of the participants was approximately 7-years, 2 months and the age range is 6 years, 11 months to 7 years, 9 months. Additionally, two of the five students (Julie and Nolan) qualified for the National School Lunch Program.

The participants’ school district included one elementary school, one intermediate school, one middle school, one high school, and one alternative school. Total enrollment in the district was approximately 3,054 students. The socioeconomic status of families in this district generally ranged from low to middle class. Forty-four percent of students
were considered economically disadvantaged. In 2007, 40.3% of students in the school district qualified for the National School Lunch Program. Approximately 11% of the population was identified as having educational disabilities, 7.8% were gifted, and 0.9% exhibited limited English proficiency. Reported student racial background for the school district was as follows: African-American – 11%, Asian/Pacific Islander – 1%, Hispanic – 2%, Multiracial – 5%, and Caucasian – 80%.

Participant Selection

Students were recruited by first obtaining approval to conduct the study from school administrators and the university’s Institutional Review Board. Students with reading difficulties were selected through teacher referral. Parent, student, and teacher consent or assent was obtained by the experimenter. First grade teachers received a letter describing the details of the study and their role in the research if they chose to participate. Those who returned a signed consent form to the lock box in the main office were asked to refer a total of ten students (between all of the participating teachers) having difficulty reading first grade sight words. Parents of the ten referred students received a letter describing the nature of the study, issues of confidentiality, and how results would be reported (see Appendix A). A consent form (see Appendix B) for permitting their child to participate in the study was sent to the parents. Only those students for which consent to participate was granted had a chance to participate in this study. Parents and students returned the parent consent forms to the lock box located in the main office of the elementary school. Parents placed the consent form in an envelope provided by the researchers. Parents returned the envelope in person or had their student
submit it to the lock box. Students were assisted by office personnel when submitting the envelope into the lock box if necessary. Students were permitted to submit their assent forms to the researchers directly or to the lock box in the main office.

The Letter-Word Identification subtest of the Woodcock-Johnson III Tests of Achievement (WJ-III) (Woodcock, McGrew, & Mather, 2001) was utilized to measure the students’ ability to identify letters and read words. Children who earned a standard score of 90 (25th percentile) or below were included in the study. If five children were not identified, the researcher would have continued searching via teacher referral and screening using the WJ-III.

The WJ-III is a nationally normed, individually administered multiple subject comprehensive test consisting of 12 subtests that assess listening, speaking, reading, writing, and mathematic skills. Scores derived from this assessment are based on a mean of 100 and a standard deviation of 15. The WJ-III can be used to assess various facets of reading performance through the administration of subtests such as Letter-Word Identification, Reading Fluency, and Passage Comprehension. For the purpose of screening for participation in this study, only the letter-word identification subtest was used. This subtest measures reading decoding skills and the child’s ability to identify printed letters and words. The WJ-III ACH has high validity and reliability. With regard to validity, internal correlations of the entire battery are consistent with relations between areas of achievement and between areas of achievement and ability clusters. With regard to concurrent validity, the WJ-III ACH total achievement cluster correlated strongly with the Wechsler Individual Achievement Test- 3rd Edition (WIAT-III) and the Kaufman Test
of Educational Achievement- 2nd Edition (KTEA-II). The coefficients were .65 and .79 respectively. The Basic Reading Skills of the WJ-III ACH has a .82 correlation coefficient with the WIAT-III as well as the KTEA-II (.79). The median cluster reliabilities are .80 or higher, many are .90 or higher. The median reliability of the letter-word identification subtest across age is .94. The reliability of the Letter-Word Identification subtest is .98 for 6 year olds and .97 for 7 year olds. The one year test-retest correlations for students age 4 to 7 at first testing is .92.

Students whose standard scores were at or below the 25th percentile (standard score of 90 or below) met the criteria for participation in this study. Students meeting the criteria were provided with a detailed, age appropriate description of the research study and were allowed the opportunity to assent or decline to participate. Only five of the referred students met the criteria to participate in the study. The following are the standard scores earned by each student on the Letter-Word Identification subtest of the WJ-III: Alex earned a standard score of 87 (19th percentile), Julie earned a standard score of 85 (16th percentile), Nolan earned a standard score of 81 (10th percentile), Ronald earned a standard score of 83 (13th percentile), and Jack earned a standard score of 89 (23rd percentile). All of the participants’ scores were classified as Low Average.

Teachers were asked to sign a consent form to participate. The examiner explained the purpose of the research, the instruction that students would be provided, and the role of the teacher in the study in the form of a letter presented to each teacher. Teachers were informed that their participation in the study involved referring students from their class who were delayed in reading; planning and allowing for students to leave
their classroom at an agreed upon time; and completing a brief social validity survey at the conclusion of the study. They were informed that they would not participate in the actual implementation of the interventions. The experimenter explained that all information provided is confidential and their names would not be used in any aspect of the research. The teachers who participated in the study signed a consent form and placed it in a lock box located in the main office of the elementary school.

Setting

The instructional interventions were conducted in a vacant classroom at the participants’ elementary school. The intervention took place at a half-circular table that comfortably seated the experimenter and the participant. Lighting in the room was adequate for the implementation of the instructional approaches. The room provided a quiet working environment free from external distractions.

Experimenter

The experimenter was a doctoral candidate in the School Psychology program at The Ohio State University. The researcher possessed sufficient training in the administration of the dependent measures and the experimental intervention conditions of this study through training provided by her academic advisor and other faculty members as well as through previous experience and coursework. The experimenter was responsible for obtaining consent from parents and teachers, and assent from students. Additionally, the experimenter administered, scored, and interpreted the results of all assessments during the screening, treatment, and maintenance phases of the study, including all intervention activities.
Independent Observers

Masters and doctoral level school psychology students from Ohio State University conducted interobserver agreement procedures for approximately 20% of the sessions. Each independent observer received comprehensive training by the experimenter before participating. The training included an explanation of the purpose of the study, intervention conditions, procedures, and dependent variables. Additionally, the observers practiced scoring before observing the session. Following an observed session, each item was compared to determine whether the experimenter and observer agreed on the student’s response. An agreement was defined as both the observer and experimenter correctly scoring a response.

Materials

Materials used in the study consisted of paper, pens, recording forms, a digital kitchen timer, pre- and post-assessment measures, and 4-inch by 6-inch index cards with words printed on them. The words were printed onto white index cards in black size 80 Arial font. The words were printed on cards without lines to help avoid distraction or visual fatigue.

Preassessment

To distinguish which words the participants could read (known) from those they could not read (unknown), the experimenter pre-assessed students who returned signed parental consent forms. The pre-assessment consisted of 381 randomly selected words from a list of first-grade and kindergarten words. Words were used from various sources including the Dolch Sight Vocabulary List, Houghton Mifflin High Frequency Words
Enchanted Learning’s Vocabulary Words for First Grade Readers (http://www.enchantedlearning.com/Vocabulary/VocabWords1.shtml), and the US Department of Education web site (http://www2.ed.gov/pubs/CompactforReading/table1.html). All words were printed on flashcards and presented twice in random order to each student individually. No corrective feedback was provided for correct and incorrect responses. Words read correctly within three seconds on both trials were considered “known” and many used in the incremental rehearsal experimental condition. Words not read correctly within three seconds on both trials were considered “unknown” and randomly selected to be taught in one of the two experimental conditions. Words read correctly during the first trial and read incorrectly during the second trial or vice versa were not included in the study.

Additionally, each student read 30 words in sentences before receiving either instructional method and again after all instruction was provided. Specifically, the experimenter created sentences that included 30 of each participant’s unknown words. Each sentence contained one targeted unknown word. The student was asked to read the sentences aloud. If a student read a targeted unknown word correctly in the context of a sentence, that word was not taught during experimental conditions of the study. This probe containing sentences with targeted unknown words served as the baseline for a measure of generalization that was administered after the intervention and maintenance phases. Thus, having the students read the words in the context of a sentence during the pre-assessment phase assisted the experimenter in determining which words students
could and could not read in the context of sentences prior to and following the implementation of instructional methods. This was done to minimize the possible influence of extraneous factors on the students’ performance on the generalization measure.

**Definition and Measurement of the Dependent Variables**

The two primary dependent variables were instructional effectiveness and instructional efficiency. Instructional effectiveness refers to the acquisition of skills as a function of the instruction. For this study, instructional effectiveness was measured as the number of words read correctly during intervention sessions. It was necessary for the student to read a word accurately on four consecutive trials during either of the two treatment phases in order for the word to be considered mastered. Responses were considered incorrect if a student read only part of the word or if the word was not read within three seconds from the time it was presented. Responses were considered correct if the whole word was read correctly within three seconds. For example, the word ‘sat’ read as a whole word within three seconds was counted correct. An example of an incorrect response would be reading the word ‘sat’ as /s/ or /sa/. The experimenter recorded whether responses were correct or incorrect during each session.

Next-day probes were administered to determine whether the student was able to read the words presented during the intervention conditions. Next-day probes included only the words that were mastered on the previous day during each lesson under each experimental condition. The flashcards containing the mastered “unknown” words that were taught under both conditions were shuffled and presented one by one to a student.
Students were asked to read the words. Words were counted correct when the whole word was read correctly within three seconds. Words were recorded as incorrect if they were only partially read, mispronounced, or if the student took longer than three seconds to respond.

Instructional efficiency refers to the rate of learning, defined as the number of words mastered per minute of instruction. For each condition, learning rate was calculated by dividing the number of words read correctly by 10 minutes. Cumulative learning rates across sessions for each condition were also calculated and compared to the instructional effectiveness data. For instance, if a student read one word correctly per minute during the first session of a flashcard drill method and read three words correctly per minute during the second session of a flashcard drill method, then the cumulative rate would be four words over two sessions (20 minutes). The average rate of words read correctly by each student over the course of the study was calculated by taking the average of the daily number of words acquired or read on next-day probes.

**Maintenance**

To determine whether words read accurately during the instructional conditions were maintained over time, a maintenance probe was administered by the examiner. The maintenance measure occurred at the end of the study following the intervention (instruction) phase. Flashcards containing words mastered during the intervention conditions were presented in random order and the student was asked to read each one. The experimenter recorded whether or not the student was able to read the word. No corrective feedback was provided during the end-of-study maintenance phase. Words
were considered maintained when the student correctly read the word within three seconds from the time a flashcard was presented. Maintenance rates were assessed by calculating the number of words maintained, and dividing that sum by the cumulative amount of instructional time (10 minutes per session) spent in each instructional condition.

Generalization

A measure of generalization was administered by the researcher to determine whether the students were able to generalize words read correctly on the maintenance probes to other contexts. The participants were given a probe consisting of sentences identical to the probe administered in the pre-assessment phase of this study. Students were asked to read the sentences containing the mastered “unknown” words that were targeted for instruction under treatment conditions. The sentences were printed in black and white and consisted of four to six basic words including the unknown word. Maintained words were considered generalized when the student orally read the word within three seconds of encountering it within the text. Generalization was calculated by dividing the number of correct responses by the total number of possible responses and multiplying that sum by 100. To determine generalization rate, the number of words read correctly was divided by the cumulative amount of instructional time.

Interobserver Agreement

Interobserver agreement (IOA) was calculated using several methods to ensure an accurate representation of agreement. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements, and multiplying by 100 to
yield a percentage. This method of IOA has a tendency to overestimate the amount of agreement between two observers. Consequently, occurrence and nonoccurrence IOA were calculated. The occurrence agreement formula is as follows: \( \frac{A \text{ occ}}{A \text{ occ} + D \text{ occ}} \times 100 \). Agreement was scored each time both observers recorded that the word was read correctly. Disagreement was scored each time only one of the observers recorded that the word was read correctly. The nonoccurrence agreement formula is as follows: \( \frac{A \text{ nonocc}}{A \text{ nonocc} + D \text{ nonocc}} \times 100 \). Agreement was scored for each time both observers recorded that the word was read incorrectly. Disagreement was scored for each time in which only one of the observers recorded that the word was read incorrectly. Observers recorded their observations on a copy of the session protocol identical to that used by the examiner.

**Independent Variables**

Ten minutes were allocated to each session. The experimenter set the digital kitchen timer to 10 minutes during each session under each instructional condition. Timing began when the first flashcard was presented. The timer would count down to zero, and made a beeping sound after 10 minutes, zero seconds elapsed. At this point, all instructional activity ceased. During the traditional drill and practice condition, words were considered mastered when read correctly four times consecutively. During the incremental rehearsal condition, words were considered mastered when four consecutive trials of words were read correctly. For both intervention conditions, the type of verbal praise was standardized. Only certain types of verbal praise were provided by the examiner following a correct response such as, “nice work,” “good job,” or “excellent”
(see Appendix C for all types of verbal praise used). This was done in an effort to keep the amount of instructional time consistent for each of the students during each instructional condition. For instance, if the examiner unknowingly provided long winded feedback during one condition and short responses during another, the amount of instructional time actually provided during the conditions may vary. The following paragraphs provide detailed description of the instructional conditions that were implemented in this study.

Traditional drill and practice. In the traditional drill and practice (TDP) condition, six unknown words were initially presented to the students on index cards throughout the 10-minute duration of the session. The experimenter presented a word printed on an index card and then said the word. The words were presented to the student one at a time. The student was given three seconds to read the word. The examiner then presented each of the words again, one at a time, and allowed three seconds for the child to read each word. Correct responses were followed by verbal praise (e.g. “good job” or “great work”). Corrective feedback was provided for incorrect responses or words that are not read within three seconds. Corrective feedback was comprised of the examiner providing the correct pronunciation of the word (i.e., reading the word as a whole word). A word was considered mastered after the student read it correctly four times in a row. When a word was mastered, it was randomly replaced with another targeted unknown word. Words read incorrectly continued to be taught during this instructional condition and students continued to receive corrective feedback until mastery criteria were met (see Appendix C for script).
**Incremental Rehearsal.** Incremental rehearsal is a flashcard drill method that consists of presenting a ratio of known to unknown words. Words were printed on index cards. The first unknown word was presented to the student. The examiner said the word to the child and then the child was given three seconds to read the word. The first known word was then presented for the child to read. Next, the first unknown word was presented again. This was followed by presentation of the first known word, and then a second known word for the child to read. Again, the first unknown word was presented, and the pattern continued until the child mastered the word. After the unknown word was mastered, it became the first known word and the last known word was removed. Thus, the mastered unknown word was then treated as a known word. Verbal praise was provided for correct responses (e.g. “good job” or “great work”). Corrective feedback was given to the child any time a word was read incorrectly or if the child did not respond within three seconds. Corrective feedback consisted of the examiner providing the correct pronunciation of the word (i.e., reading the word as a whole word). Words were considered mastered when the student correctly read the target word four times consecutively. The newly learned targeted words were then used as known words in the instructional condition. Words not read correctly continued to be presented in this instructional condition (see Appendix D for script).

Specifically, during the IR condition, the target word was presented incrementally until it was read correctly four consecutive times. The word continued to be administered using the IR procedure until it was read correctly four times consecutively. Once it was mastered, the procedure began again with a new word.
Experimental Design

This study employed a single subject, alternating treatments research design. An alternating treatments design was used to compare the effects of the treatment conditions on student learning and learning rate. This design is effective for comparing two instructional conditions over a brief period of time (Cooper, Heron, & Heward, 2007). Single subject designs allow the researcher to detect changes in behavior over time. The behavior is graphed and visually inspected to determine whether a change in behavior relates to changes in treatment conditions. The student’s performance is compared with his or her own previous performance. Repeated measurement is a distinguishing feature of single-subject research and allows for the detection of performance patterns over time.

Alternating treatments designs are useful for comparing the effects of two or more instructional approaches on student performance in reading. The independent variables are rapidly alternated in a counterbalanced order. The design is beneficial in education research because it is time efficient, guards against sequence effects, and does not require the removal of instruction. Multiple treatment interference is the main limitation of this design, referring to the effect of one treatment influencing the effects of another treatment in the same study. Counterbalancing the treatments minimizes the effects of this confounding variable.

Procedures

The students were exposed to both experimental conditions during each session. Conditions were randomly selected and counterbalanced across sessions to control for sequence effects. The experimenter used a digital kitchen timer to ensure that each
intervention continued for exactly 10 minutes. Timing began as soon as the first word in the condition was presented. The intervention ceased when the timer sounded indicating the end of ten minutes. The experimenter documented on a record form whether or not the target word was read correctly each time it was presented during each intervention (see Appendix E).

The intervention phase of the study began on a Monday. Each Monday throughout the duration of the study, the students received both instructional conditions. Tuesday through Thursday, the sessions began with a next-day probe of the words mastered the previous day in both intervention conditions. The students then received each of the instructional conditions. No new instruction took place on Fridays because next-day probes were impossible due to the weekend. Only retention data were collected on Friday. Teacher and student participants were asked to complete social validity surveys after all intervention tasks were completed.

*Treatment Integrity*

Procedural integrity data were collected by Master’s and Doctoral level school psychology students. Using procedural integrity checklists developed for each condition (see Appendixes F and G), 20% of sessions randomly selected under each instructional condition were observed. The observer circled “yes” if the instructor implemented the procedural step correctly and “no” if the instructor did not implement the procedure as indicated on the checklist. For example, the observer would rate items, such as whether the examiner read the target word aloud, presented the cards in the correct order, and recorded the response of the student.
Social Validity

Interviews, questionnaires, and rating scales are frequently used to assess the social validity of interventions from the perspective of participants, parents, teachers, and other staff members. The current study included student rating scales (see Appendix H) and teacher questionnaires (see Appendix I) to assess the social acceptability of each instructional method. For example, the students were asked questions, such as which intervention they preferred and whether they thought the activities helped them read better. Examples of teacher items included which instructional method seemed most effective and which method she would consider using in the classroom. The teacher of the students participating in the study was provided with a thorough written description of each intervention as well as a questionnaire. They utilized an anchored Likert scale to answer each question. Student participants also completed a questionnaire using an anchored Likert scale. The experimenter orally read the items on the questionnaire and the student was instructed to follow along, reading the items silently. The students recorded a response on their own copy of the questionnaire. For example, the students were asked, “Did you enjoy doing these reading exercises?” and circled one of the following responses: “Yes, very much,” “Yes,” “A little bit,” “Not really,” or “Not at all.”
CHAPTER 4: RESULTS

This chapter presents the results corresponding with each research question. The chapter begins with interobserver agreement and treatment integrity results. The research questions were examined using descriptive statistics and visual inspection of graphed data. Descriptive statistics and visual inspection of graphed data are the typical methods for evaluating single subject research data.

Interobserver Agreement

Five school psychology graduate students trained in the procedures of each experimental condition independently scored approximately 17% of the responses across all participants. Interobserver agreement was calculated using several methods. Interobserver agreement was first calculated using the following formula:

\[
\text{Interobserver Agreement} = \frac{\text{Agreements}}{\text{Agreements} + \text{Disagreements}} \times 100
\]

Agreement was scored each time both the experimenter and observer recorded that a word was read correctly or incorrectly when presented with the target word. Disagreement was scored each time only one observer recorded that the word was read correctly or incorrectly. Interobserver agreement between the observer and independent observers was 98% for daily intervention sessions. Interobserver agreement can easily be
inflated by extremes or have high variability. Hence, occurrence agreement and nonoccurrence agreement were also calculated. Occurrence agreement was calculated using the following formula:

\[
\frac{A_{\text{occurrence}}}{A_{\text{occurrence}} + D_{\text{occurrence}}} \times 100
\]

Occurrence agreement between the experimenter and independent observer was 97% for the daily intervention sessions. Nonoccurrence agreement was calculated using the following formula:

\[
\frac{A_{\text{nonoccurrence}}}{A_{\text{nonoccurrence}} + D_{\text{nonoccurrence}}} \times 100
\]

Agreement was scored for each time both observers recorded that a word was read incorrectly. Disagreement was scored each time only one of the observers recorded that the word was read incorrectly. Nonoccurrence agreement between the experimenter and observer was 84% for daily intervention sessions. The independent observers expressed that the task was difficult due to difficulty understanding the speech of two participants.

Alex replaced the /c/ sound with the /t/ sound. For example, he said “car” as “tar,” “coat” as “toat,” “come” as “tome” and “can” as “tan.” This also occurred with the “c” or “k” sound at the end of words, for example, “think” was pronounced “thint.” He also replaced the /g/ sound with a /t/ sound, for example, “gate” was pronounced “tate.”

During the pre-assessment, the examiner asked Alex for the definition of the mispronounced words. He was able to use words, such as “came” (pronounced “tame”) and “car” (pronounced “tar”) correctly in a sentence or describe the words properly. The
examiner was quickly able to understand Alex’s speech from conversations taking place before each session. However, outside observers did not have as much opportunity to become accustomed to his articulation. Julie also had speech concerns. Specifically, she had difficulty with the /sh/ sound and produced the /s/ sound instead. For instance, the word “she” was pronounced, “see” and “shoe” was pronounced, “sue.” This also occurred with ending sounds. She pronounced “cash” as “cass” and “wash” as “woss.”

Although outside observers were made aware of the speech concerns, it was difficult for them to determine whether certain words should be marked correct or incorrect. For participants without speech concerns, the IOA was 99.9%, the occurrence agreement was 99.2%, and the nonoccurrence agreement was 95.5%. The imperfect percentage resulted from a discrepancy regarding whether a word was pronounced correctly and confusion regarding whether words said at the 3 second mark were considered correct. There were a few occasions where students would say the word at the last millisecond, which posed difficulty in judging word accuracy.

*Treatment Integrity*

Treatment integrity data were collected on the implementation of each condition across approximately 20% of the sessions. The data were collected to ensure that the researcher implemented the procedures correctly. A checklist was used to assist the five graduate level school psychology students in the process (see Appendices F and G). The treatment integrity checklist consisted of the procedures used to implement each instructional condition. The observer circled “yes” if the researcher correctly implemented the step, “no” if the researcher did not correctly implement the step, or
“NA” if the step was not applicable to the condition. Treatment integrity was 100% across all observed sessions. Specifically, the experimenter introduced the intervention, timed each session, provided appropriate feedback contingent upon correct responses, and provided corrective feedback for words read incorrectly or words not read within 3 seconds.

Research Question Number One

Which method, incremental rehearsal or traditional drill and practice flashcard method, helps children read the most words correctly?

Table 4.1 includes the cumulative number of words mastered during the intervention sessions for all five students across the incremental rehearsal and traditional drill and practice procedures. Table 4.1 also provides a total number of words learned across all students for both instructional approaches. The data show that the students as a group learned a total of 935 words with variability in the number of words mastered across the conditions. It appears that the students mastered a greater number of words under the traditional drill and practice condition as compared to the incremental rehearsal condition.
Table 4.1

_Cumulative Number of Words Mastered by Students During Instructional Sessions_

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex</td>
<td>133</td>
<td>85</td>
</tr>
<tr>
<td>Julie</td>
<td>135</td>
<td>86</td>
</tr>
<tr>
<td>Nolan</td>
<td>96</td>
<td>56</td>
</tr>
<tr>
<td>Ronald</td>
<td>128</td>
<td>81</td>
</tr>
<tr>
<td>Jack</td>
<td>82</td>
<td>53</td>
</tr>
<tr>
<td>Group Total</td>
<td>574</td>
<td>361</td>
</tr>
</tbody>
</table>

Figures 4.1 through 4.5 provide the cumulative number of words mastered across all sessions for each of the participants, Alex, Julie, Nolan, Ronald, and Jack respectively. The data from these figures show consistent patterns of word acquisition for both instructional conditions. Differences occurred between the two conditions with TDP yielding a greater number of cumulative words read.

Figure 4.1 represents the cumulative number of words mastered for Alex. Alex participated in 14 sessions. The data show an increasing trend. It appears that the traditional drill and practice (TDP) instructional condition was more effective in terms of the cumulative number of words mastered during the instructional sessions.
Figure 4.1
*Cumulative Words Mastered During Sessions by Instructional Condition for Alex*

Figure 4.2 shows the cumulative number of words mastered across all sessions by Julie. Julie participated in 10 sessions of the study. Julie also showed an increasing trend in word acquisition across both instructional conditions. The TDP condition generally appeared to be more effective in the cumulative number of words mastered during the sessions.
Figure 4.3 shows the cumulative number of words mastered across all sessions by Nolan. Nolan participated in 11 sessions of each condition in the study. The data show a similar pattern to the previous two figures. Nolan showed an increasing trend in word mastery across both conditions. Nolan acquired more words under the TDP condition across sessions as compared to his performance under the incremental rehearsal.
Figure 4.3
*Cumulative Words Mastered During Sessions by Instructional Condition for Nolan*

Figure 4.4 shows the cumulative number of words mastered across all sessions by Ronald. Ronald participated in 14 sessions of each condition. Like other participants, Ronald’s data also showed an increasing trend in word mastery across both treatment conditions. The data revealed that Ronald mastered more words under the TDP condition than the IR instruction.
Figure 4.5 shows the cumulative number of words mastered across all sessions for Jack. Jack participated in 6 sessions. Similar to previous data, the reading data for Jack also showed an increasing trend in word mastery across both treatment conditions. The data showed that Jack mastered more words during the session under the TDP condition than under the IR condition.
The data were collapsed into group data in order to assess which instructional condition was more effective in terms of the number of cumulative words mastered among students as a group (see Appendix J). Figure 4.6 shows the data across participants for both instructional conditions. Each student participated in a different number of sessions. The data were averaged across the number of students participating in a particular sessions. Sessions 1-6 include all students. Sessions 7-10 include Alex, Julie, Ronald, and Nolan. Session 11 includes Alex, Ronald, and Nolan. Sessions 12-14 include only Alex and Ronald. The data showed a marked increase in the number of
words mastered during the TDP condition as compared to the IR condition. In other words, students tended to learn more words under the TDP condition over the course of the study.

![Graph showing cumulative words mastered by sessions for TDP and IR conditions across all participants.]

Figure 4.6
*Cumulative Words Mastered During Sessions by Instructional Condition Across all Participants*

Figure 4.7 represents the number of words mastered during instructional sessions for Alex. The data show variability in the number of words mastered on a daily basis with TDP generally yielding a greater number of words mastered across students.
Figure 4.8 represents the number of words Julie mastered on daily instructional sessions for each condition. The data show initial variability with the traditional drill and practice (TDP) condition showing a steady trend of resulting in more words mastered per session than incremental rehearsal (IR).
Figure 4.8
*Number of Words Mastered During Sessions by Instructional Condition for Julie*

Figure 4.9 depicts the number of words Nolan mastered during daily instructional sessions for each condition. The data show that Nolan generally mastered more words under the traditional drill and practice condition than incremental rehearsal.
In figure 4.10, Ronald mastered more words under the traditional drill and practice condition than incremental rehearsal. The data show a generally stable trend with moderate variability across sessions.
Figure 4.10
*Number of Words Mastered During Sessions by Instructional Condition for Ronald*

Figure 4.11 indicates that Jack consistently mastered more words under the traditional drill and practice condition than the incremental rehearsal condition.
The data from the above graphical displays show regular patterns of word acquisition across both conditions. The data show a generally stable trend with moderate variability across sessions.

Research Question Number Two

Based on cumulative learning rate, which method, incremental rehearsal (IR) or traditional drill and practice (TDP), helps children read the most words correctly per minute of instructional time?

Table 4.2 provides a summary of the cumulative number of words learned, total time engaged in each condition, the rate (i.e., number of words learned per minute) of
word mastery under all three instructional conditions by each participant, and the group total across all participants.

Table 4.2

*Summary of Cumulative Words Learned, Time in Sessions, and Rate of Acquisition*

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Words (Words)</td>
<td>Time (Time)</td>
</tr>
<tr>
<td>Alex</td>
<td>133</td>
<td>140</td>
</tr>
<tr>
<td>Julie</td>
<td>135</td>
<td>100</td>
</tr>
<tr>
<td>Nolan</td>
<td>96</td>
<td>110</td>
</tr>
<tr>
<td>Ronald</td>
<td>128</td>
<td>140</td>
</tr>
<tr>
<td>Jack</td>
<td>82</td>
<td>60</td>
</tr>
<tr>
<td>Group</td>
<td>574</td>
<td>550</td>
</tr>
</tbody>
</table>

Additional data analysis is presented in Figures 4.7, 4.8, 4.9, 4.10, and 4.11, allowing for visual analysis of the data for each participating student.

Figure 4.12 shows Alex’s word mastery rate (words per minute of instructional time) across sessions. The data show that Alex mastered more words per minute of instructional time under the traditional drill and practice session than the incremental rehearsal condition.
Figure 4.12
*Learning Rate During Sessions by Instructional Condition for Alex*

Figure 4.13 showed that Julie mastered more words per minute under the traditional drill and practice condition than the incremental rehearsal condition. Initial variability and overlap between conditions are evident followed by clear and consistent distinction between the student’s performance between the instructional conditions.
In figure 4.14, Nolan generally mastered more words per minute of instruction under the traditional drill and practice condition than incremental rehearsal.
Figure 4.14
Learning Rate During Sessions by Instructional Condition for Nolan

Figure 4.15 demonstrates Ronald’s word mastery rate per session. Ronald mastered more words per minute when instructed using the traditional drill and practice method than the incremental rehearsal method. The lower TDP performance in session 9 resulted from difficulty learning four of the words presented that day. Ronald required extensive repetition of these words (‘rob,’ ‘well,’ ‘long,’ and ‘own’) as opposed to moving on to new words.
Figure 4.15  
*Learning Rate During Sessions by Instructional Condition for Ronald*

Figure 4.16 also demonstrates that Jack mastered more words per minute of instruction under the traditional drill and practice condition than the incremental rehearsal condition.
Figure 4.16  
*Learning Rate During Sessions by Instructional Condition for Jack*

Figure 4.17 demonstrates that Alex’s average rate of learning was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.17
Average Rate of Word Acquisition by Instructional Condition for Alex

Figure 4.18 demonstrates that Julie’s average rate of learning was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.18
Average Rate of Word Acquisition by Instructional Condition for Julie

Figure 4.19 demonstrates that Nolan’s average rate of learning was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.20 demonstrates that Ronald’s average rate of learning was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.20
*Average Rate of Word Acquisition by Instructional Condition for Ronald*

Figure 4.21 demonstrates that Jack’s average rate of learning was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Research Question Number Three

Which method, incremental rehearsal or traditional drill and practice, helps children maintain reading mastered words accurately based on the cumulative number of words recalled?

Table 4.3 shows the cumulative number of words recalled on next-day probes for all five students across the incremental rehearsal and traditional drill and practice procedures. Table 4.3 also provides a total number of words recalled across all students for both instructional approaches. The data shows that the students as a group recalled a total of 626 words with variability in the number of words mastered across the
conditions. The students recalled a greater number of words under the traditional drill and practice condition as compared to the incremental rehearsal condition. Table 4.3 shows the cumulative number of words learned as demonstrated on next-day retention probes. Students learned a greater number of words under the traditional drill and practice condition than in the incremental rehearsal condition.

Table 4.3

*Cumulative Number of Words Maintained on Next-Day Retention Probes*

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex</td>
<td>74</td>
<td>41</td>
</tr>
<tr>
<td>Julie</td>
<td>108</td>
<td>61</td>
</tr>
<tr>
<td>Nolan</td>
<td>54</td>
<td>29</td>
</tr>
<tr>
<td>Ronald</td>
<td>99</td>
<td>51</td>
</tr>
<tr>
<td>Jack</td>
<td>65</td>
<td>44</td>
</tr>
<tr>
<td>Group Total</td>
<td>400</td>
<td>226</td>
</tr>
</tbody>
</table>

Figures 4.22 through 4.26 provide the cumulative number of words recalled on next-day probes across all sessions for each of the participants, Alex, Julie, Nolan, Ronald, and Jack respectively. The data from these figures show consistent patterns of word retention across both instructional conditions.

Figure 4.22 shows the cumulative number of words recalled on next-day probes across all sections for Alex. Alex participated in 12 next-day retention probes. The
reading data for Alex showed an increasing trend in word recall across both treatment conditions. The data suggest that Alex recalled more words taught under the TDP condition than under the IR condition.

Figure 4.22
*Cumulative Number of Words Recalled on Next-Day Retention Probes by Instructional Condition for Alex*

Figure 4.23 represents the number of words recalled on next-day retention probes for Julie. Julie participated in 10 next-day retention probes. The data revealed an increasing trend in word recall for both treatment conditions. Alex recalled a greater
number of words under the traditional drill and practice condition compared to the incremental rehearsal condition.

Figure 4.23
*Cumulative Number of Words Recalled on Next-Day Retention Probes by Instructional Condition for Julie*

Figure 4.24 show the cumulative number of words recalled on next-day probes across all sections for Nolan. Nolan participated in 10 next-day retention probes. The reading data for Nolan show an increasing trend in word recall across both treatment conditions. The data suggest that Nolan recalled more words taught under the TDP condition than under the IR condition.
Figure 4.24
*Cumulative Number of Words Recalled on Next-Day Retention Probes by Instructional Condition for Nolan*

Figure 4.25 shows the cumulative number of words read correctly on next-day probes for Ronald. The data show an increasing trend in word recall across both instructional conditions. The data suggest that Ronald recalled more words the following day under the TDP condition compared to the IR condition.
Figure 4.25
_Cumulative Number of Words Recalled on Next-Day Retention Probes by Instructional Condition for Ronald_

Figure 4.26 shows the cumulative number of words read correctly on next-day probes for Jack. The data show an increasing trend in word recall across both instructional conditions. The data suggest that Jack recalled more words the following day under the TDP condition compared to the IR condition.
Figure 4.26
*Cumulative Number of Words Recalled on Next-Day Retention Probes by Instructional Condition for Jack*

Figure 4.27 displays the number of mastered words Alex recalled on next-day retention probes. Alex consistently read more words that were taught using the TDP condition than words taught using IR.
In figure 4.28, the number of words recalled by Julie on next-day retention is initially variable, followed by a consistent demonstration of more words recalled following the TDP condition than the IR condition.
Figure 4.28
Number of Words Read Correctly on Next-Day retention Probes by Instructional Condition for Julie

In figure 4.29, Nolan generally read more words accurately on next-day retention probes taught during the TDP condition as compared to the IR condition, with the exception of two sessions.
Figure 4.29
*Number of Words Read Correctly on Next-Day retention Probes by Instructional Condition for Nolan*

In Figure 4.30, Ronald generally read more words accurately following instruction with TDP as compared to IR.
Figure 4.30
*Number of Words Read Correctly on Next-Day retention Probes by Instructional Condition for Ronald*

Figure 4.31 displays that Jack recalled more words on next day retention probes under the TDP condition when compared to the IR condition, with the exception of two sessions.
Figure 4.31
*Number of Words Read Correctly on Next-Day retention Probes by Instructional Condition for Jack*

Figure 4.32 displays the percentage of words Alex read accurately on next-day retention probes. The data show that Alex generally recalled a greater percentage of words from the TDP condition. Specifically, he recalled a greater percentage of words from the TDP condition following 8 of the 12 sessions.
Figure 4.32
*Percentage of Words Read Accurately on Next-Day Retention Probes by Instructional Condition for Alex*

Figure 4.33 displays the percentage of words Julie read accurately on next-day retention probes. The data show that Julie generally recalled a greater percentage of words from the TDP condition. She recalled a greater percentage of words from the TDP condition following 5 of the 10 sessions. She recalled a greater percentage of IR words following 3 of the session and the same percentage for 2 of the sessions.
Figure 4.33
*Percentage of Words Read Accurately on Next-Day Retention Probes by Instructional Condition for Julie*

Figure 4.34 displays the percentage of words Nolan read accurately on next-day retention probes. The data show that Nolan generally recalled a greater percentage of words from the TDP condition. He recalled a greater percentage of words from the TDP condition following 5 of the 10 sessions. He recalled a greater percentage of IR words following 3 of the session and the same percentage for 2 of the sessions.
Figure 4.34
*Percentage of Words Read Accurately on Next-Day Retention Probes by Instructional Condition for Nolan*

Figure 4.35 displays the percentage of words Ronald read accurately on next-day retention probes. The data show that Ronald generally recalled a greater percentage of words from the TDP condition. He recalled a greater percentage of words from the TDP condition following 8 of the 13 sessions. He recalled a greater percentage of IR words following 3 of the session and the same percentage for 2 of the sessions.
Figure 4.35
*Percentage of Words Read Accurately on Next-Day Retention Probes by Instructional Condition for Ronald*

Figure 4.36 displays the percentage of words Ronald read accurately on next-day retention probes. The data show that Ronald generally recalled a greater percentage of words from the IR condition. He recalled a greater percentage of words from the IR condition following 3 of the 6 sessions. He recalled a greater percentage of TDP words following 2 of the session and the same percentage for 1 of the sessions.
Figure 4.36  
*Percentage of Words Read Accurately on Next-Day Retention Probes by Instructional Condition for Jack*

The data from the above graphical displays show regular patterns of word recall across both conditions. The figures suggest that that the TDP condition was more effective at increasing student’s word retention on next-day probes. Therefore, the data suggest that the TDP condition may be a more effective method for increasing word recall for students with reading difficulties.

*Research Question Number Four*

Based on cumulative words recalled, which method, incremental rehearsal or traditional drill and practice, helps children better maintain reading words accurately per minute?
Table 4.4 provides a summary of the cumulative number of words recalled on next-day probes, total time engaged in each condition, and the maintenance rate (i.e., number of words recalled per minute of instruction) of word retention under all three instructional conditions by each participant, and total across all participants.

Table 4.4

*Summary of Cumulative Words Recalled, Time in Sessions, and Rate of Retention (RR)*

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Words</td>
<td>Time</td>
</tr>
<tr>
<td>Alex</td>
<td>74</td>
<td>120</td>
</tr>
<tr>
<td>Julie</td>
<td>108</td>
<td>100</td>
</tr>
<tr>
<td>Nolan</td>
<td>54</td>
<td>100</td>
</tr>
<tr>
<td>Ronald</td>
<td>99</td>
<td>130</td>
</tr>
<tr>
<td>Jack</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>Group</td>
<td>400</td>
<td>510</td>
</tr>
</tbody>
</table>

Additional data analysis is presented in Figures 4.39, 4.40, 4.41, 4.42, and 4.43, allowing for visual analysis of the data for each participating student.
Figure 4.37 displays the number of words Alex retained per minute on next-day retention probes. The data show that Alex retained a greater rate of words from the TDP condition.

Figure 4.37
Number of Words Read Correctly per Minute of Instructional Time by Instructional Condition for Alex

Figure 4.38 displays the number of words Julie retained per minute on next-day retention probes. The data show that Julie generally retained a greater rate of words from the TDP condition. She retained more IR words per minute of instructional time for 2 of the 10 sessions.
Figure 4.38
*Number of Words Read Correctly per Minute of Instructional Time by Instructional Condition for Julie*

Figure 4.39 displays the number of words Nolan retained per minute on next-day retention probes. The data show that Nolan generally retained a greater rate of words from the TDP condition. He retained more IR words per minute of instructional time for 1 of the 10 sessions and the same number per minute for one of the sessions.
Figure 4.40 displays the number of words Ronald retained per minute on next-day retention probes. The data show that Ronald generally maintained a greater rate of words from the TDP condition. He retained the same number of words per minute of instructional time for 1 of the 13 sessions.
Figure 4.41 displays the number of words Jack maintained per minute on next-day retention probes. The data show that Jack generally retained a greater rate of words from the TDP condition. He retained more words per minute of instructional time for 1 of the 6 sessions.
Figure 4.41
Number of Words Read Correctly per Minute of Instructional Time by Instructional Condition for Jack

Figure 4.42 demonstrates that Alex’s average rate of words recall on next-day probes was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.42
Average Rate of Words Recalled on Nex-Day Probes by Instructional Condition for Alex

Figure 4.43 demonstrates that Julie’s average rate of word recall on next-day probes was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.43
*Average Rate of Words Recalled on Next-Day Probes by Instructional Condition for Julie*

Figure 4.44 demonstrates that Nolan’s average rate of word recall on next-day probes was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.44  
*Average Rate of Words Recalled on Nex-Day Probes by Instructional Condition for Nolan*

Figure 4.45 demonstrates that Ronald’s average rate of word recall on next-day probes was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
Figure 4.45
*Average Rate of Words Recalled on Nex-Day Probes by Instructional Condition for Ronald*

Figure 4.46 demonstrates that Jack’s average rate of word recall on next-day probes was higher under the traditional drill and practice condition compared to the incremental rehearsal condition.
End of Study Maintenance

Individually, Alex maintained 54.29% of the words under the TDP condition and 59.5% of the words under the IR condition. Julie maintained 71.1% of the words under the TDP condition and 70.9% of the words under the IR condition. Nolan maintained 56.9% of the words under the TDP condition and 53.8% of the words under the IR condition. Ronald maintained 55% of the words under the TDP condition and 54.79% of the words under the IR condition. Jack maintained 67% of the words under the TDP condition and 75.5% of the words under the IR condition. Only words presented on next-day probes were used in the end of study maintenance probe. On a few occasions, students were absent the day after engaging in the intervention, and no next-day probe
was provided. It was still possible to use these words when considering acquisition. However, the next-day probe provided an extra exposure or opportunity to practice the words that was not available for words followed by an absence (e.g., no next-day probe). Hence, to avoid inconsistency in the number of exposures students had to words, only words that were followed by a next-day probe were used as part of the end of study data.

Maintenance rates were assessed by calculating the number of words maintained, and dividing that sum by the cumulative amount of instructional time (10 minutes per session) spent in each instructional condition. Each of the participants maintained more words under the TDP condition, given the amount of instructional time (Table 4.5).
Table 4.5

*End of Study Number of Words Maintained (NWM) Maintenance Rate (MR), Percentage of Words Maintained (PWM), and Total Time per Instructional Condition*

<table>
<thead>
<tr>
<th>Student</th>
<th>Time</th>
<th>TDP</th>
<th>IR</th>
<th>TDP</th>
<th>IR</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alex</td>
<td>120</td>
<td>57</td>
<td>44</td>
<td>.48</td>
<td>.37</td>
<td>54</td>
<td>60</td>
</tr>
<tr>
<td>Julie</td>
<td>100</td>
<td>96</td>
<td>61</td>
<td>.96</td>
<td>.61</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Nolan</td>
<td>100</td>
<td>49</td>
<td>28</td>
<td>.49</td>
<td>.28</td>
<td>57</td>
<td>54</td>
</tr>
<tr>
<td>Ronald</td>
<td>130</td>
<td>66</td>
<td>40</td>
<td>.51</td>
<td>.31</td>
<td>55</td>
<td>55</td>
</tr>
<tr>
<td>Jack</td>
<td>60</td>
<td>55</td>
<td>40</td>
<td>.92</td>
<td>.67</td>
<td>67</td>
<td>76</td>
</tr>
<tr>
<td>Group</td>
<td>550</td>
<td>323</td>
<td>213</td>
<td>μ=.67</td>
<td>μ=.45</td>
<td>μ=61</td>
<td>μ=63</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SD=.25</td>
<td>SD=.18</td>
<td>SD=7.44</td>
<td>SD=9.64</td>
</tr>
</tbody>
</table>

*Research Question Number Five*

Which method, incremental rehearsal or traditional drill and practice, results in the most generalization to accurate word reading in sentences (pre-post sentences)?

Specifically, students were asked to read thirty sentences, each containing one word that was determined unknown during the preassessment activity. All of the words were randomly placed into the word instruction phase of the study. Half of the words read in generalization sentences were placed into each instructional condition. Students were
asked to read the sentences again following instruction to determine which instructional method yielded the greatest amount of mastered words generalized to reading sentences. Target words were considered generalized when the student accurately read the word within the context of the sentence. Sentences that were determined unknown during the preassessment but read correctly during the generalization preassessment were replaced with another word, resulting in 30 sentences with unknown target words before the instructional phase began. Generalization data were taken following the last instructional phase. Table 4.6 represents the number of words correctly generalized (WG), percentage of words generalized (PWG) for each student and for all students as a group across both instructional conditions. Overall, generalization to reading sentences was variable, ranging from 33% to 100%.
Table 4.6

*Number of Words Generalized (WG) and Percentage of Words Generalized (PWG) for each Student and Condition Totals*

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WG</td>
<td>PWG</td>
</tr>
<tr>
<td>Alex</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Julie</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>Nolan</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>Ronald</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Jack</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>Group</td>
<td>µ=98</td>
<td>µ=65</td>
</tr>
<tr>
<td></td>
<td>SD=17.21</td>
<td></td>
</tr>
</tbody>
</table>

*Research Question Number Six*

Which method, incremental rehearsal or traditional drill and practice, results in the most generalization to accurate word reading in sentences per minute of instruction (generalization rate)?

Data were collected from generalization student sessions to examine this research question. Table 4.7 represents the words generalized, the amount of time in each instructional session and the rate of generalization. Overall, the generalization rate was low, ranging from to 0.7 to 0.4 words per minute of instructional time.
Table 4.7

Summary of number of words generalized, time in sessions, and rate of generalization (GR)

<table>
<thead>
<tr>
<th>Student</th>
<th>TDP</th>
<th>IR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
<td>GR</td>
</tr>
<tr>
<td>Alex</td>
<td>24</td>
<td>0.17</td>
</tr>
<tr>
<td>Julie</td>
<td>20</td>
<td>0.20</td>
</tr>
<tr>
<td>Nolan</td>
<td>24</td>
<td>0.22</td>
</tr>
<tr>
<td>Ronald</td>
<td>10</td>
<td>0.07</td>
</tr>
<tr>
<td>Jack</td>
<td>20</td>
<td>0.33</td>
</tr>
<tr>
<td>Group</td>
<td>98</td>
<td>μ=0.18</td>
</tr>
</tbody>
</table>

Research Question Number Seven

Are the three instructional approaches a socially valid way to assess and teach word reading skills to students with reading difficulties?

Each of the five student participants completed a social validity interview following the completion of the intervention, post-test, and generalization activities. The interview consisted of seven questions. All questions were read verbally to the students with the participants following along on their own copy of the questionnaire. Questions such as, “Did you enjoy doing these reading exercises,” “Did doing these reading exercises help you learn new words,” and “Which of the reading exercises did you think
was the most helpful” were asked to examine the social validity of the instructional approaches (Appendix H).

The results indicated that each of the five students enjoyed working on the reading intervention activities. When asked whether they enjoyed doing the reading exercises, three students responded, “Yes, very much,” and two students responded, “Yes.” The students also expressed that they felt the reading exercises helped them to read better. One student chose “Yes, very much,” three students responded, “Yes,” and one student chose, “A little bit.” Each student indicated that the reading exercises helped them to learn new words. Three students responded, “Yes, very much,” one student chose, “Yes,” and one student said, “A little bit.” The student participants were asked whether they felt the reading exercises would help other students read better. All but one student felt that the exercises would help other students. Two students chose “Yes, very much,” two responded, “Yes,” and one student chose, “Not really.” The students were given the opportunity to choose which intervention they preferred. The experimenter presented both instructional conditions to remind them of the procedures associated with each instructional treatment. Three out of the five students preferred the traditional drill and practice condition. Two students preferred incremental rehearsal because they felt it was easier.

Each student participant was educated in the same classroom. The teacher of the participants completed a social validity form following the completion of the instructional conditions (see Appendix I). The questionnaire consisted of six questions with response options presented on an anchored Likert scale. Responses to questions like,
“Which instructional method would be most effective in enhancing student word reading performance,” and “Do you feel as though the instructional methods appear to be appropriate approaches for helping students improve their reading performance” were assessed to evaluate the social validity of the instructional approaches. The teacher did not notice a difference in the students’ overall reading performance while participating in the study. As compared to traditional drill and practice, incremental rehearsal was judged to be most enjoyable for students, most effective for enhancing word reading performance, and most efficient for enhancing student word reading performance. The teacher reported feeling that both instructional methods appear valid and appropriate for helping students improve their reading performance. She indicated that she would consider using both instructional techniques as part of her instruction to teach reading.
CHAPTER 5: DISCUSSION

This chapter discusses the results of the study, which looked at the effectiveness and efficiency of two instructional techniques on word reading performance when controlling for time. These results are discussed according to each of the research questions. Comparisons to previous research, implications for practice, limitations of the study, and directions for future research are discussed.

The current study is an extension of the research conducted by Cates et al. (2003) and Nist and Joseph (2008). The current study extended upon the methods and findings obtained in previous studies. The aim of the current study was to examine the instructional effectiveness and instructional efficiency of two flashcard drill methods for teaching first graders word recognition skills when time allocated for instruction was controlled and learning trials were varied. In prior studies time allocated for instruction was not controlled which resulted in certain flashcard drill procedures taking longer to administer than others. Specifically, the study examined whether traditional drill and practice or incremental rehearsal is most effective and efficient given 10 minutes of allotted instructional time.

Instructional Effectiveness

The first research question pertained to intervention effectiveness and aimed to determine which method, incremental rehearsal or traditional drill and practice, helps
children read the most words correctly. Results indicated that word acquisition increased for each of the participants under both instructional conditions. However, the results revealed that one condition produced higher acquisition and acquisition rate than the other condition. The participants learned the most words and learned them most quickly under the traditional drill and practice condition. One explanation for the participants’ higher performance under the TDP procedure may have to do with the fact they were presented more unknown words and had more opportunities to read unknown words in the 10 minute allotted instructional time than in the IR condition. This is consistent with several previous studies (Cates et al., 2003; Joseph & Nist, 2006; and Nist & Joseph, 2008). However, Neef, Iwata, and Page (1977) found that interspersing known words facilitated the acquisition of unknown words more effectively than presenting all unknown words to students with cognitive delays. The students in the current study were not identified as having cognitive delays.

Specifically, the participants in this study were considered students with mild delays in reading rather than severe delays, as may be found with individuals with intellectual disabilities. MacQuarrie (2002) found that verbal ability accounted for the retention of words when using the TDP method, but performance was independent of verbal ability when using IR. Many of the participants in the current study demonstrated word reading skills in the Low Average range on the WJ-ACH. Although the students were behind their peers in reading, they were not identified as having a severe reading deficit. This implies that a student’s current reading achievement levels may impact instructional decision-making when choosing the most appropriate intervention. For
instance, several other studies found interspersal techniques to be more effective with students with disabilities. Neef et al. (1977; 1980) found interspersal techniques to be more effective for students with cognitive disabilities. Burns, Dean, and Foley (2004) found that the incremental rehearsal procedure resulted in improved reading fluency and reading comprehension skills for students with learning disabilities. Burns (2005) found positive results on the acquisition and retention of single digit multiplication facts of three students identified with a Specific Learning Disability in mathematics calculation when using the Incremental Rehearsal procedure. While all of the participants in the current study were behind their peers in reading, none of the students were diagnosed with a disability. Hence, students with a higher level of measured ability may benefit from the traditional drill procedure, whereas, students with lower ability may benefit more from the incremental presentation of unknown words during the IR procedure.

A second explanation for greater success under the traditional drill and practice condition is that, in the current study, more words were presented to students during the TDP condition than in the IR condition in any given session. This was different than previous studies that suggested that the success of folding-in techniques can be directly attributed to the number of practice trials (Daly, Hintze, & Hamler, 2000). In the current study, controlling for time limited the number of trials and number of words presented in any given session. Mastery was reached at the child’s pace as opposed to requiring the child to complete an extensive number of trials before moving to the next word. In this study, a word was considered mastered after it was read correctly four times in a row instead of requiring the student to complete a predetermined number of trials. The TDP
condition may have resulted in greater success because time was not expended presenting known words as is the case during the IR condition. The findings suggested that the TDP condition was more effective at increasing student’s word mastery during sessions. Therefore, the data suggested that the TDP condition is a more effective method of teaching words to these students with reading difficulties.

Instructional Efficiency

The second research question in the current study was related to instructional efficiency. The goal was to determine which method, incremental rehearsal or traditional drill and practice, helps children read the most words correctly per minute of instructional time. Instructional efficiency refers to the rate of learning, defined as the number of words mastered per minute of instruction. Knowing how much learning may be expected as a function of the amount of time required to implement an intervention procedure facilitates educators in making better decisions regarding intervention selection (Bramlet, Cates, Savina, & Lauinger, 2010). For each condition in the current study, learning rate was calculated by dividing the number of words read correctly by ten minutes. Cumulative learning rates across sessions for each condition were also calculated and compared to the instructional effectiveness data. The prevention and remediation of academic skill deficits requires school personnel to determine which interventions are most efficient by measuring students’ learning rates under different instructional conditions (Skinner, Belfiore, & Watson, 1994). Examination of the instructional efficiency data in the current study shows that traditional drill and practice was more efficient than the IR procedure. Each of the five students displayed higher learning rates
under the traditional drill and practice condition. The results suggested that even when time is controlled, students demonstrated greater rates of word acquisition under TDP. This is consistent with previous research that did not control for time (Cates et al., 2003; Joseph & Nist 2006; Nist & Joseph 2008).

For the purpose of this study, instructional efficiency was narrowly defined as the number of words students read per minute of instructional time. However, several other factors may contribute to the actual efficiency of an instructional procedure. For instance, the amount of time required to prepare the intervention may be a consideration. Teachers have time constraints and time preparing for instruction may limit the amount of time that is available for implementation. Additionally, viewing instructional efficiency as more than the initial acquisition of words may have important implications. Fluency, maintenance, and generalization should also be considered when defining efficiency. In the current study, students generalized more words taught under the IR procedure. Hence, it could be said that IR was actually more efficient because students were able to apply more words from this condition when provided the same amount of instructional time as given in the TDP condition. When making decisions regarding the efficiency of an intervention, the number of students that can be taught at one time should also be considered. For instance, an intervention that can be used with a small of large group may be more time efficient than working with students individually if the students are able to effectively learn the material in a group setting.

*Next-Day Retention*
Retention data were also collected on the day following each intervention session. There is great overlap when comparing the percentage of words retained on next-day probes under the two instructional conditions. Students mastered more words during the TDP condition and were consequently presented with more words from that condition on next-day retention probes. Thus, the participants recalled a greater number of words under the TDP condition. For this reason, the percentage of words retained under each condition was calculated. Results show that the students as a group recalled either the same or higher number of words on next-day retention probes for 43.1% of the sessions under the IR condition as compared to the TDP condition. This suggests that, similar to previous studies, (Cates et al.; 2003, Joseph & Nist, 2006; and Nist & Joseph, 2008) although the IR condition may be less efficient, it continues to provide good retention, even when controlling for time.

**Maintenance**

The third research question aimed to determine which method, incremental rehearsal or traditional drill and practice, helps children maintain reading words accurately. The ability of students to maintain information learned during intervention is essential for determining the overall effectiveness of an intervention. Maintenance measurement occurred at the end of the study following the intervention phase. Flashcards containing words mastered during the intervention conditions were presented in random order and the student was asked to read each one. As a group, participants maintained more words (323 out of 528 words) learned during the TDP condition than learned during the IR condition (213 out of 338 words). The students maintained words
mastered during the study at fairly equal percentages across instructional techniques. This supports previous findings that although IR is a less efficient technique, it appears to correlate with high maintenance of learned words (Cates et al., 2003, Joseph & Nist, 2006; Nist & Joseph, 2008). As a group, they maintained 61.2% of words mastered under the TDP condition and 63.0% of words mastered under the IR condition. However, three of the five students maintained slightly more words under the TDP condition than under the IR. It is important to remember that the group maintenance total may be misleading because one student who maintained more words under the IR condition (Jack) participated in fewer sessions than the other students. Hence, fewer words are contributed to the overall total for this student. Individually, Alex maintained 54.29% of words under the TDP condition and 59.5% of words under the IR condition. Julie maintained 71.1% of words under the TDP condition and 70.9% of words under the IR condition. Nolan maintained 56.9% of words under the TDP condition and 53.8% of words under the IR condition. Ronald maintained 55% of words under the TDP condition and 54.79% of words under the IR condition. Jack maintained 67% of words under the TDP condition and 75.5% of words under the IR condition. However, although the percentage of words maintained at the end of the study were somewhat comparable, the overall number of words maintained at the end of the study was much greater under the TDP condition than the IR condition.

The goal of the fourth research question was to determine which method, incremental rehearsal or traditional drill and practice, helps children maintain reading words accurately per minute. Maintenance rates were assessed by calculating the number
of words maintained, and dividing that sum by the cumulative amount of instructional time (ten minutes per session) spent in each instructional condition. Each of the participants maintained more words under the TDP condition, given the amount of instructional time. The maintenance rate for students as a group under the TDP was an average of .96 words per minute and .44 words per minute under IR. This indicates that TDP may result in a greater number of words maintained per minute of instructional time than IR.

Generalization

The fifth and sixth research questions asked which method, incremental rehearsal or traditional drill and practice, results in the most generalization to accurate word reading in sentences (pre-post sentences) and which procedure resulted in the most generalization per minute of instruction (rate)? A measure of generalization was administered to determine whether the students were able to generalize words read correctly on the maintenance probes to other contexts. The participants were given a probe consisting of sentences identical to the probe administered in the pre-assessment phase of this study. Students were asked to read the sentences containing the mastered “unknown” words that were targeted for instruction under the treatment conditions. The goal of this procedure was to determine whether the students were able to generalize the acquired words to reading within text as opposed to words presented in isolation. Generalization was calculated by dividing the number of correct responses by the total number of responses and multiplying that sum by 100. To determine generalization rate, the number of words read correctly was divided by the cumulative amount of
instructional time. As a group, students generalized more words mastered under the incremental rehearsal condition than under the traditional drill and practice condition. The data show that the participants generalized their word reading ability for 85% words (98 words) mastered during the IR condition but only 65% of words (127 words) mastered during the TDP condition. All but one of the students followed this trend. Nolan actually generalized more words under the TDP condition (80%) than under the IR condition (77%). Word generalization occurred at rate of 0.18 words per minute under the TDP condition and 0.23 words per minute under the IR condition. Superior generalization of words mastered under the IR procedure to reading in sentences may have occurred as a result of the nature of the procedure, such as incrementally increasing the number of known words between presentations of difficult target words, potentially resulting in more opportunities to practice reading words accurately, or increased opportunities for errorless learning and remaining motivated due to experiencing success on reading known words.

Social Validity

The seventh research question aimed to determine which method, incremental rehearsal or traditional drill and practice, is viewed as most useful by first grade teachers and students. The current study included student rating scales (see Appendix H) and teacher questionnaires (see Appendix I) to assess the social acceptability of each instructional method. The results indicated that each of the five students enjoyed working on the reading intervention activities. The students also expressed that they felt the reading exercises helped them to read better. Each student indicated that the reading
exercises helped them to learn new words. The student participants were asked whether they felt the reading exercises would help other students read better. All but one student felt that the exercises would help other students. The students were given the opportunity to choose which intervention they preferred. The experimenter presented both instructional conditions to remind them of the procedures associated with each instructional treatment. Three out of the five students preferred the traditional drill and practice condition. Two students preferred incremental rehearsal because they felt it was easier. Interestingly, both students showing preference for the IR procedure scored the lowest on the Woodcock-Johnson III Tests of Achievement letter-word subtest. Additionally, each of these students had more difficulty learning the words as evidence by slower learning rates and more repetition before mastery. This indicates that the IR procedure may be more beneficial for students with lower reading ability while the TDP procedure may benefit more advanced readers. The teacher of the participants completed a social validity form following the completion of the instructional conditions. The questionnaire consisted of six questions with response options presented on an anchored Likert scale. Responses to questions like, “Which instructional method would be most effective in enhancing student word reading performance,” and “Do you feel as though the instructional methods appear to be appropriate approaches for helping students improve their reading performance” were assessed to evaluate the social validity of the instructional approaches. The teacher did not notice a difference in the students’ overall reading performance while participating in the study. This may be due to the relatively short amount of time in which the investigation was conducted. The students were able to
generalize learned words to simple sentences containing the mastered words. However, generalization to more difficult paragraphs may not have occurred during the course of the study. Ideally, as students continue to practice the words through repeated exposure, their ability to generalize will increase.

Traditional drill and practice, incremental rehearsal was judged to be most enjoyable for students, most effective for enhancing word reading performance, and most efficient for enhancing student word reading performance. The teacher reported feeling that both instructional methods appear valid and appropriate for helping students improve their reading performance. She indicated that she would consider using both instructional techniques as part of her instruction to teach reading.

**Comparison to Previous Research Studies**

The current study extended previous research examining the effectiveness and efficiency of traditional drill and interspersing instructional procedures. Previous studies focused on spelling (Cates et al., 2003), whole word reading (Joseph & Nist, 2006; Schmidgall & Joseph, 2007; Joseph & Schisler, 2007; Nist & Joseph, 2008), and reading comprehension (Schisler, Joseph, Konrad, & Alber-Morgan, 2010). Although the current investigation expanded on word reading like some listed above, studies of intervention effectiveness and efficiency often held constant the number of trials. In contrast, the current study examined the effectiveness and efficiency of two whole word instructional procedures, holding the amount of instructional time constant. The amount of instructional time between the interventions varied in previous studies based on the number or trials. However, many of the previous studies examined instructional
efficiency by calculating leaning rates based on the amount of time spent in each instructional condition. In the current study, each intervention session was ten minutes long for both instructional conditions.

Incremental rehearsal and traditional drill and practice have been shown to be effective for increasing word reading for students in a number of studies (Burns, Dean, & Foley, 2004; MacQuarrie, Tucker, Burns, & Hartman, 2002; Nist & Joseph, 2008). With regard to within-session word acquisition, the results of this study are commensurate with other studies that considered the amount of instructional time. The current and previous studies found the traditional drill and practice procedure to be the most efficient intervention approach. However, this study differs from the previous findings that interspersing procedures (containing known items) were the most effective and TDP was the most efficient in improving word reading skills. The current study found TDP to be more efficient and effective with regard to word mastery during sessions. Nist and Joseph (2008) found that incremental rehearsal was the most effective method for students, whereas, traditional drill and practice was the most efficient method. In Nist and Joseph’s study, the number of trials was increased to match the number of times students were exposed to the target words under the incremental rehearsal condition in order to determine which variable(s) were responsible for the greater effectiveness of the incremental rehearsal technique. The results of the study indicated that incremental rehearsal again led to greater instructional effectiveness, whereas traditional drill and practice led to greater instructional efficiency. In the current study, the amount of time
was controlled resulting in traditional drill and practice being the most efficient and effective instructional technique.

Previous intervention studies have resulted in uncertainty regarding retention of newly learned stimuli. For example, some studies found that the number of opportunities to respond to the new stimuli affected retention more than the ratio of unknown to known items (Burns, 2007; Szadokierski & Burns, 2008). Another study found that IR led to better retention than TDP even when opportunities to respond were held constant (Nist & Joseph, 2008). Consequently, researchers have suggested that future studies examine more comparable definitions of mastery and how different definitions of mastery would affect retention with IR methods (Burns & Sterling-Turner, 2010). An attempt was made in the current study to match the mastery criteria between the two instructional conditions by requiring four correct pronunciations of a word for mastery to be achieved in either condition. In other studies, the instructional conditions used different definitions of mastery. For instance, in Burns and Sterling-Turner (2010), the TDP approach relied on three consecutive correct responses, whereas the IR condition used completion of the instructional procedure, namely, eight consecutive correct responses. As a result, the authors stated that the causal mechanism of the superior retention corresponding with the IR condition is unknown (Burns & Sterling-Turner, 2010).

The results of the current study are in contrast to a previous research finding that incremental rehearsal led to better retention of words than other approaches (MacQuarrie, Tucker, Burns, & Hartman, 2002). The results of the current study indicate better next-day and end of study maintenance under the TDP condition than under the IR condition.
However, findings were comparable to other studies with regard to generalization, as students were able to read more words in sentences learned under the IR than TDP condition. An explanation for this may be that the students had more opportunities to practice the same words under the IR, and overlearning has been suggested to lead to better generalization. Specifically, Ardoin, McCall, and Klubnik (2007) stated that multiple opportunities to practice words helps to develop strong stimulus control, allowing for accurate and fluent reading of text. Once stimulus control is developed for words, fluent responding to those words ideally generalizes when they appear in different contexts. When the incremental rehearsal procedure was time-limited, the TDP condition corresponded with better next-day retention with regard to the number of words recalled.

On a measure of maintenance, the results of this study were in contrast to previous studies. A greater number of words were maintained under the TDP condition than maintained under the IR condition. An interesting finding is that while more words were recalled on the next-day retention probe under the TDP condition, and more words were maintained at the end of the study under this condition, more words from the TDP condition were also forgotten during the time period between next-day retention probes and end of study maintenance. Specifically, as a group, the students recalled 73% of words learned under the TDP condition on next-day probes and 66.9% of words learned on next-day probes under the IR condition. At the end of the study participants maintained an average of 61.2% of words taught under TDP and an average of 63% of words taught under the IR condition. Hence, students forgot 11.8% (77) of words learned under the TDP condition and only 3.9% (13) of words learned under the IR condition.
Cates et al. (2003) found the maintenance of mastered words to be closely related to intervention efficiency. Treatment conditions that resulted in higher mastery rates also resulted in higher maintenance rates. Therefore, Cates et al. argued that their research findings demonstrate that basing decisions on effectiveness data may lead to educational practices that fail to maximize learning rates. The findings of the current study are consistent with these results. In the current study, participants mastered more words under the TDP condition and subsequently maintained words at a much higher rate.

Nist and Joseph (2008) also found that the students as a group maintained and generalized reading more words under the incremental rehearsal condition than the traditional drill and practice or interspersal condition. However, this study demonstrates similar results similar to those indicated by Nist and Joseph (2008) with regard to generalization. In both studies, students generalized the highest percentage of words read under the incremental rehearsal condition. However, unlike the current study, the Nist and Joseph (2008) study included a measure of generalization to spelling. The authors found that generalization to spelling was low for both instructional procedures.

In order to compare the two intervention procedures while controlling for time, it was necessary to allow mastery within sessions to be reached at the student’s pace as opposed to requiring the child to complete a set ratio of trials during the IR condition. As a result, children were not provided with as many trials under the IR procedure as presented in the other studies. Additionally, participants generally reached a mastery level before the point where 9 known words were presented between the presentations of the unknown target word. This may have resulted in decreases in the procedure’s best
qualities such as over-learning and more time between presentations of the target word to move the word from short-term to long-term memory. However, it could be argued that the rate of within-session mastery would be increased from other studies resulting from the decrease in unnecessary trials. For students without disabilities who are behind their peers in reading, higher learning rates may be of greater value than providing a more in-depth, time intensive intervention.

Several significant differences in methodology exist between the current study and the Cates et al. (2003) study. First, the current study looked at word reading performance, whereas the Cates et al. (2003) study examined spelling performance. Second, in the current study, an initial assessment was conducted to identify known and unknown words for each student. In the Cates et al. (2003) study, an initial assessment was conducted to identify known words only. The current study examined the incremental rehearsal technique instead of the interspersal or high-p-sequencing techniques that were implemented in the Cates et al. study. Cates et al. (2003) found that the high-p-sequencing condition, with high ratios of known items to unknown items, may reduce learning rates. In the current study, the incremental rehearsal procedure included higher rates of known items and, similarly, may have reduced learning rates. Unlike the Cates et al. study, the current study included a generalization measure, specifically, reading the target word in a sentence. The methodology of the current study was similar to that of Nist and Joseph (2008), as both studies included a preassessment measure, a measure of generalization, interventions, and maintenance measures. However, the current study compared only two different interventions. The most distinct difference in
the current study, as compared to previous work, is that the interventions were conducted within a specified amount of time.

Limitations

Several limitations exist within the current study. First, only five students participated in the study. The small sample size reduces the external validity of the study. Therefore, it cannot be determined whether other individuals would display similar learning rates under the instructional conditions. Second, the racial diversity at the elementary school where the study took place was minimal. All of the participants and 80% of the students in the school were Caucasian. A more diverse population would allow for better generalization of the study.

Another limitation of the study is that there was no measure of pacing with regard to the implementation of the interventions. While the examiner repeatedly practiced the intervention and recording procedures, no direct measure was obtained. Hence, there is a risk that interventions were delivered at a different pace across session which could be a confounding variable. Future studies may wish to have outside observers rate whether the interventions were implemented evenly, without long pauses while procedures were presented.

Students may have received a greater number of chances to rehearse information in the IR condition as compared to the TDP condition. As a result, this may affect the extent to which the two interventions are comparable. Controlling the amount of rehearsal may be beneficial in future studies of academic interventions.
The methodology for collecting social validity from students may also have limitations. Students were shown each of the intervention procedures and asked to pick which one they preferred. A stronger method would be to have a series of sessions where students were able to choose which intervention they wanted to engage in that day. This would have minimized any influence the examiner may have had on the student’s choice.

In order to most effectively control for potential treatment interaction effects, the examiner could have continued the most effective and efficient intervention alone. Analyzing whether the trend continues to increase at the same pace provides information regarding the extent that this intervention may be depended on the other intervention. If a decrease in the trend line is observed, then an interaction effect is considered likely. However, if the most effective intervention continues to progress a similar amount, then a researcher may assume that the other treatment had no affect on this intervention.

Another limitation is that only first grade students participated in the study. An increased sample including students of various ages and grade levels may enhance the ability to generalize results of the instructional conditions. The threat of interaction effects, or the potential for the effects of one treatment to be influenced by or carry over to another treatment is another potential weakness of the study (Kennedy, 2005). In an effort to avoid interaction effects, the treatment conditions were counterbalanced, so that the procedures did not occur in the same order during every session. Counterbalancing the instructional conditions minimizes interaction effects but fails to eliminate all risk.

Although the purpose of the study was to examine which instructional method was more efficient, it should be recognized that the presentation of unknown words was
not equivalent across instructional methods in any given session. Students were typically exposed to more words in a session under the TDP condition than during the IR condition.

Methodologically, no baseline was included in this alternating treatments design. The design would have been strengthened by a final phase in which only the most effective treatment was implemented. This would have allowed the experimenter to better assess multiple treatment interference (Cooper, Heron, & Heward, 2007). In addition, the study did not include a control group of participants receiving only general curriculum and no treatment.

**Implications for Practice**

The findings from the current study have many significant implications for educational practitioners and researchers. Both the TDP and IR instructional techniques resulted in word acquisition for all six students. Therefore, for students who are referred to Intervention Assistance Teams for word reading difficulties, these instructional techniques may be an effective way to help students acquire more words. The general finding related to instructional efficiency is significant when recommending intervention approaches to teachers. Procedures selected for intervention should focus on the amount of instructional time involved and the amount of learning that students acquire during that time (Cates, Burns, & Joseph, 2010).

Burns and Sterling-Turner (2010) suggested that taking maintenance data into account is important when assessing intervention efficiency. Thus, the question is not necessarily which intervention should be used but when the interventions should be used.
The authors suggest that within an RTI framework, an intervention that is effective but requires a great amount of time may be more appropriate for a targeted population (tier 3) but less useful for a universal (tier 1) or selected (tier 2) group. Additionally, IR may be more beneficial when working with students with severe deficits (Burns & Sterling-Turner, 2010).

Directions for Future Research

Skinner (2008) made suggestions with regard to future research on examining instructional effectiveness and instructional efficiency variables. Skinner contends that by holding time constant researchers may be able to better determine which method yields the most learning within an allocated period of time. The current study is the first intervention study in this line of research to hold time, as opposed to trials constant. Further research controlling for time is warranted across different populations, academic skills, and intervention techniques.

Word reading was investigated in the current study; however, it is inconclusive as to whether the findings would generalize across academic areas. Future research should be conducted examining the extent to which findings would generalize across other academic subject areas, such as mathematics, reading fluency, reading comprehension, and writing. Additionally, while the current study examined whole word reading approaches, research evaluating the effectiveness and efficiency of phonic analysis procedures would be beneficial. Additionally, investigations of the extent to which similar findings would be found for teaching students sounds or syllables on flashcards
(e.g., ear, ee, ea) should be conducted. Finally, research across specific populations such as older students, children with disabilities, and the ELL population is warranted.

Burns and Sterling-Turner (2010) discuss an interesting direction for future research on the effectiveness and efficiency of interventions. The authors suggest that the time involved in reteaching would inform the efficiency of an intervention, and provide the following example: If a child requires 5 minutes to learn five words (one word per instructional minute) but then only retains two words, the remaining three words would have to be retaught presumably at the same rate. Therefore, the total instructional time needed for these five words (assuming 100% retention of the retaught words) would be 8 minutes, and the efficiency rate would be .63 words per minute, rather than one word per minute. Given that the amount of teacher time required to deliver instruction has become an important consideration due to the large amount of content teachers are required to cover, intervention efficiency should be considered in intervention decision-making and further researched (Cates, Burns, & Joseph, 2010).

It may be interesting if future efficiency studies included instructional conditions that involved a more challenging ratio of unknown and known words as well as removing the “folding in” component of an incremental or interspersal procedure.

It would also be interesting to determine differential effects in performance if items in one condition were spaced throughout the school day and items in another condition were administered immediately after one another.

Summary
The current study indicated the positive effects of both instructional procedures for increasing the students’ word reading performance. While both procedures were beneficial, the traditional drill and practice condition resulted in the most effective and efficient word acquisition. On social validity measures, the majority of students preferred the traditional drill and practice procedure, however, two of the five students preferred incremental rehearsal, indicating that both procedures may be socially valid ways to increase word reading. The findings indicate that while both procedures would be beneficial in classroom instruction or remedial intervention, the traditional drill and practice procedure may result in greater learning rates than incremental rehearsal.
REFERENCES


Stahl, S., & Yaden Jr., D. (2004). The Development of Literacy in Preschool and Primary Grades: Work by the Center for the Improvement of Early Reading


Appendix A

Letter to Parents
Dear Parent(s)/Guardian(s),

As a professor at the Ohio State University, I have worked collaboratively on projects within the Hamilton Local School District for the past 8 years to help children improve their academic achievement. I would like to invite your child to participate in a study I am conducting in reading. Your child was identified by his or her teacher as a student who may benefit from interventions in the area of reading. Upon your voluntary written consent, your child will have the opportunity to participate in a study designed to compare the effectiveness of two different teaching methods on your child’s word reading performance. Your child will receive the following two instructional methods: (1) flashcard drill and practice of unknown words and (2) incremental rehearsal (presenting one unknown word prior to nine known words). All children who participate in this study will be administered a brief portion of the Woodcock Johnson-III tests of Achievement to determine basic reading skills.

The primary goal of the study is to determine which of the two interventions is most effective in helping children to increase their word reading learning rate. The study will take place at Hamilton Local Elementary School. Granted permission, your child will participate in five sessions per week for approximately 20 minutes of their school day. Children participating in this study will not be removed from their classrooms during critical instructional time or during specials such as music class, physical education, etc. All identifying information will be kept confidential. Students will be given code numbers so that names will not be used on any data recording sheets or forms. Participation in this study is completely voluntary, and you have the right to remove your child from participating at any time without penalty.

The principal investigator in this study is Dr. Laurice Joseph, Associate Professor of School Psychology at The Ohio State University. The interventions will be conducted by a doctoral candidate in the School Psychology program at The Ohio State University. If you agree to have your child participate, we hope that you will find this experience valuable for your child in regard to helping him/her improve his/her reading performance.

If you have any questions, please feel free to contact Dr. Laurice Joseph at 614-688-4992.

Sincerely,

Laurice Joseph, Ph.D.
Associate Professor of School Psychology
School of Physical Activity and Educational Services.
Appendix B

Consent for Participation in Research
I consent for my child's participation in the study entitled: Examining Instructional Efficiency Among Flashcard Drill and Practice Methods with a Sample of First Graders.

Laurice Joseph, Principal Investigator, or her authorized representative, Elisha Eveleigh, has provided information regarding the purpose of the study, the procedures to be followed, and the expected duration of my child's participation. Possible benefits of the study have been described, as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Furthermore, I understand that my child is free to withdraw consent at any time and to discontinue participation in the study without prejudice.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:                      Signed:  
___________________________  _________________________

(Participant)

Signed:                      Signed:  
___________________________  _________________________

(Principal Investigator or her Authorized representative)  (Person authorized to consent for participant)

Witness:

________________________________________
Appendix C

TDP Intervention Script
Traditional Drill and Practice

Examiner starts timer and states, “I am going to read some words so listen carefully as I read each word because I’m going to ask you to read it after me.”

Examiner reads aloud each of the six target words and asks the student to repeat the word by saying, “Now you read it,” before moving on to the next. If read correctly, experimenter makes one of the following comments, “Nice work, good job, excellent.” If read incorrectly, the examiner says, “Listen again…” and repeats the word. The examiner shuffles the index cards for random ordering and states, “Now, we’re going to go through the words again, only this time you will be reading them by yourself.

“Ready?”

Examiner shows each of the index cards one by one to the student. If read correctly, the examiner says either, “Nice work, good job, or excellent.” If read incorrectly or there is no response within 3 seconds, the examiner provides corrective feedback. Examiner continues until timer rings and immediately stops when timer rings.
Appendix D

IR Intervention Script
Incremental Rehearsal

Examiner starts stopwatch and states, “I am going to read some words. Listen carefully as I read each word because I’m going to ask you to read it after me.” Examiner reads aloud each of the six target words and asks the student to repeat the word by saying, “Now you read it,” before moving on to the next. If the student reads it correctly, the examiner makes one of the following statements, “Nice work, good job, or excellent.” If read incorrectly, the instructor says, “listen again . . .” and repeats the word. Examiner shuffles the six known words for random ordering and states, “Now we’re going to go through the words again. Ready?” Examiner shows the first target word, and before the student can respond, the examiner reads the word aloud to the student. Then the first known word is presented for the child to read. Next, the first unknown word is presented again, followed by the first known word, and then a second known word for the child to read. Again, the first unknown word is presented, and the pattern is continued until the timer rings. Once the student and instructor get through all of the words, the first target word becomes a known word (placed in the 6th position), and the last known word is taken out of the pile and replaced with the second target word.
IR Procedure:

1. Present first unknown word.
   Present first known word.

2. Present first unknown word.
   Present first known word.
   Present second known word.

3. Present first unknown word.
   Present first known word.
   Present second known word.
   Present third known word.

4. Present first unknown word.
   Present first known word.
   Present second known word.
   Present third known word.
   Present fourth known word.

5. Present first unknown word.
   Present first known word.
   Present second known word.
   Present third known word.
   Present fourth known word.
   Present fifth known word.

6. Present first unknown word.
   Present first known word.
   Present second known word.
   Present third known word.
   Present fourth known word.
   Present fifth known word.
   Present sixth known word.
Appendix E

Session Record Form
<table>
<thead>
<tr>
<th>Word</th>
<th>Previous Day</th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
<th>Trial 6</th>
<th>Trial 7</th>
<th>Trial 8</th>
<th>Trial 9</th>
<th>Trial 10</th>
<th>Trial 11</th>
<th>Trial 12</th>
<th>Trial 13</th>
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Appendix F

Traditional Drill and Practice Treatment Integrity Form
**TREATMENT INTEGRITY CHECKLIST: Traditional Drill and Practice**

1. Examiner starts timer and states, “I am going to read some words. Listen carefully as I read each word because I’m going to ask you to read it after me.”

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
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</table>

2. Examiner reads aloud each of the six target words and asks the student to repeat the word by saying, “Now you read it,” before moving on to the next.

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<thead>
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<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</table>

3. If the word is read correct, examiner says “Nice work, good job, or excellent.” If read incorrectly, examiner says, “listen again…” and repeats the word.

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<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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<tbody>
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</table>

4. Examiner shuffles the index cards for random ordering.

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<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</table>

5. Examiner states, “Now, we’re going to go through the words again, only this time you will be reading them by yourself. “Ready?”

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<th>Yes</th>
<th>No</th>
<th>N/A</th>
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6. Examiner shows each of the index cards one by one to the student.

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<th>Yes</th>
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<th>N/A</th>
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<tbody>
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7. Examiner records whether each response is correct or incorrect.

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<th>N/A</th>
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</table>

8. If correct, “Nice work, good job, or excellent” If incorrect or no response within 3 seconds, the examiner provides corrective feedback.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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9. Examiner continues until timer rings.

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<th>Yes</th>
<th>No</th>
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10. Examiner stops when timer rings.

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**Total Procedural Integrity**

__________________
Appendix G

Incremental Rehearsal Treatment Integrity Form
TREATMENT INTEGRITY CHECKLIST: Incremental Rehearsal

1. Examiner starts timer and states, “I am going to read some words. Listen carefully as I read each word because I’m going to ask you to read it after me.”
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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2. Examiner reads aloud each of the six target words and asks the student to repeat the word by saying, “Now you read it,” before moving on to the next.
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
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3. If the word is read correct, examiner says “Nice work, good job, or excellent.” If read incorrectly, examiner says, “Listen again…” and repeats the word.
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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4. Examiner shuffles the index cards for random ordering.
   
<table>
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<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
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</tbody>
</table>

5. Examiner states, “Now, we’re going to go through the words again, only this time you will be reading them by yourself. “Ready?”
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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<tbody>
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6. Examiner shows each of the index cards one by one to the student.
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
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7. Examiner records whether each response is correct or incorrect.
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

8. If correct, “Nice work, good job, or excellent” If incorrect or no response within 3 seconds, the examiner provides corrective feedback.
   
<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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<tbody>
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</table>

9. Examiner continues until timer rings.
   
<table>
<thead>
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<th>N/A</th>
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</thead>
<tbody>
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</tbody>
</table>

10. Examiner stops when timer rings.
    
    | Yes | No | N/A |
    |-----|----|-----|
    |     |    |     |

Total Procedural Integrity

_____________________

185
Appendix H

Social Validity Student Questionnaire
1. Did you enjoy doing these reading exercises?
   Yes, very much   Yes   A little bit   Not really   Not at all

2. Did doing these reading exercises help you to read better?
   Yes, very much   Yes   A little bit   Not really   Not at all

3. Did doing these reading exercises help you to learn words?
   Yes, very much   Yes   A little bit   Not really   Not at all

5. Do you think that doing these reading exercises would help other students to read better?
   Yes, very much   Yes   A little bit   Not really   Not at all

6. Which of the reading exercises did you think was the most helpful?
   Traditional Drill and Practice   Incremental Rehearsal

7. Which of the three reading exercises would you choose to do again?
   Traditional Drill and Practice   Incremental Rehearsal
Appendix I

Social Validity Teacher Questionnaire
1. Did you notice any difference in your student’s overall reading performance while he/she was participating in this study?

Yes, very much   Yes   A little bit   Not really   Not at all

2. After examining the description of each intervention (attached), which instructional method do you think students would find most enjoyable?

Traditional Drill and Practice   Incremental Rehearsal

3. Which instructional methods would be most effective in enhancing student word reading performance?

Traditional Drill and Practice   Incremental Rehearsal

4. Which instructional method used, would be most efficient in enhancing student word reading performance?

Traditional Drill and Practice   Incremental Rehearsal

5. Do you feel as though the instructional methods appear to be valid approaches, or appropriate approaches, for helping students to improve their reading comprehension?

Yes, very much   Yes   A little bit   Not really   Not at all

6. Which methods would you consider using in the classroom as part of your instruction to teach reading?

Both   Traditional Drill and Practice   Incremental Rehearsal   None
Appendix J

Word List per Instructional Condition
<table>
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<tr>
<th>Take</th>
<th>Keep</th>
<th>Lamp</th>
<th>Mother</th>
<th>Note</th>
<th>Family</th>
<th>Again</th>
<th>An</th>
<th>Sale</th>
<th>Lake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upon</td>
<td>Get</td>
<td>Lick</td>
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<td>Eat</td>
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<td>Childre</td>
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<td>Hard</td>
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<td>Evenin</td>
<td>Ring</td>
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