# COMPARING THE EFFECTS OF GROUP ADMINISTERED DRILL INTERVENTIONS ON PRE-KINDERGARTEN EARLY LITERACY SKILLS

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Abstract: Children who enter school with limited literacy skills risk falling behind their peers. Early intervention could be used to remediate this issue by increasing the literacy skills of children at an early age. Early literacy skills, such as alphabet knowledge, are some of the first reading skills that children are exposed to and are often cited as necessary foundational skills for reading fluency. Drill interventions have been successfully used to teach basic academic skills to young children, but there is limited research on their use with a pre-kindergarten population. The purpose of this study was to examine the feasibility and effectiveness of using drill interventions to increase the letter name knowledge of pre-kindergarten students. Sixty-six pre-kindergarten students participated in the study. Individual pre-assessments of letter name knowledge were given to all participants at the beginning of the study. Participants within each classroom were randomly assigned to one of four drill intervention conditions: incremental rehearsal, interspersal, traditional drill, or the control group. Each group, not including the control, received a letter name intervention administered via small group instruction for approximately five minutes per day, one to four times per week. Participants were individually assessed on a weekly basis to measure rate of letter name acquisition. A split-plot factorial ANOVA revealed that there was no statistically significant difference in letter knowledge between intervention and control groups. In this study, drill intervention was not effective at increasing participant letter knowledge. Several limitations, including inconsistent length of intervention sessions, absenteeism among participants, and unexpected school closure due to the COVID-19 global pandemic, negatively impacted the results of the study. While the results of the current study were not statistically significant, they provide more information on the use of drill intervention with a pre-kindergarten population. Future research in this area should focus on increasing intervention integrity and consistent scheduling while maintaining participant attention and minimizing distractions. By doing so, future studies may result in more favorable outcomes and further implications for practice for this population.

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# CHAPTER I

## INTRODUCTION

Reading is a fundamental academic skill. Children who enter school with limited literacy skills risk falling behind their peers and developing other academic difficulties (Whitehurst & Lonigan, 2001). Early intervention, as emphasized by the No Child Left Behind Act (2001) and the Every Student Succeeds Act (2015), could be used to remediate this issue by increasing the literacy skills of children at an early age. Foundational literacy skills, such as alphabet knowledge and phonological awareness, are strong predictors of future reading ability (National Institute for Literacy, 2008). Over 40% of 3-year-old children and 60% of 4-year-old children in the United States attend some form of preprimary program (National Center for Education Statistics, 2019), meaning that nearly half of children in the country are provided some sort of educational experience before attending kindergarten. Providing interventions that target early literacy skills to children in this age group would allow for additional exposure to these concepts and an increase in early literacy skill development, both of which would better prepare children for the academic expectations of kindergarten (Oklahoma State Department of Education, 2017).

## Instructional Hierarchy

According to Daly, Lentz, and Boyer (1996), low literacy rates can be attributed to the use of insufficient methods when assessing and intervening on students' skills. They suggest using the Instructional Hierarchy to determine students' level of skill and tailoring interventions to match their level of academic responding. The Instructional Hierarchy (IH), developed by Haring, Lovitt, Eaton, & Hansen (1978), is an organizational system that divides the learning process into four levels of skill. Different intervention techniques are used depending on student skill level, and interventions are modified as students move from the initial acquisition of a skill to mastery. Pre-kindergarten students would be expected to be in the earliest stages of the IH when it comes to literacy. Using the IH to tailor interventions to their skill level would help them to effectively increase their skills until they reached the level of mastery.

## Early Literacy Skills

Early literacy skills include a variety of abilities considered necessary for reading. Some of these skills, such as alphabet knowledge, phonological awareness, rapid automatic naming of letters, and name writing are strong predictors of future reading ability, even when accounting for factors such as intelligence quotient (IQ) and socioeconomic status (National Institute for Literacy, 2008). Alphabet knowledge, which includes letter naming and letter sound knowledge, and phonological awareness are also some of the first reading skills that children are exposed to and are often cited as necessary foundational skills for future reading fluency (Adams, 1990; Burke, Crowder, Hagan-Burke, & Zou, 2009; Schatschneider, Fletcher, Francis, Carlson, & Floorman, 2004; Whitehurst & Lonigan, 1998). Intervention techniques used to increase these skills vary considerably, with goal setting, modeling, flashcard drills, and lesson plans being just a few examples (Griffin & Joseph, 2015; Kruse, Spencer, Olszewski, & Goldstein, 2015; Petursdottir, et al., 2009).

Developing alphabet knowledge in young children has been found to improve future literacy outcomes and contribute to the development of other early literacy skills (Hohn & Ehri, 1983; Johnston, Anderson, & Holligan, 1996). Research on alphabet knowledge suggests that several factors effect acquisition, including the order that letter names and sounds are taught and individual factors such as what letters are included in students' names (Piasta, Petscher, & Justice, 2012; Treiman & Broderick, 1998; Turnbull, Bowles, Skibbe, Justice, & Wiggins, 2010). While there is no clear consensus on which aspect of alphabet knowledge is most crucial to literacy development, it is agreed upon that all aspects of alphabet knowledge are necessary for future reading and these skills, along with phonological awareness, are often introduced to students within the first years of school (Drouin, Horner, & Sondergeld, 2012; Huang, Tortorelli, & Invernizzi, 2014; National Institute for Literacy, 2008; Piasta, Purpura, & Wagner, 2010).

**Drill Intervention**

Drill interventions are commonly used to increase student knowledge of basic academic skills. This intervention technique has been used to successfully increase a wide variety of student skills, including knowledge of multiplication facts (Burns, 2005), vocabulary (January, Lovelace, Foster, & Ardoin, 2017; Joseph, Eveleigh, Konrad, Neef, & Volpe, 2012), and letter sounds (Peterson, et al., 2014). At their most basic level, drill interventions involve presenting targeted content to students, often on flashcards. After the content is presented, the student has a limited amount of time to correctly identify or respond to the information. Positive reinforcement for correct answers and corrective feedback for incorrect answers are often given before moving to the next item. These interventions are considered beneficial because they effectively build automaticity of skills, but do not require considerable time or resources to implement (Griffin & Joseph, 2015).

Early research found the use of drill interventions to be more beneficial than reinforcement alone. Neef, Iwata, & Page (1980) were able to increase students' spelling knowledge by pairing a drill intervention with high density noncontingent reinforcement. This combination increased student acquisition at a higher rate than using noncontingent reinforcement alone. The intervention used in this study interspersed known items with unknown items in an alternating order. This method of drill intervention has since been used in several other studies, with varying ratios of known and unknown content (Burns & Boice, 2009; Cates et al, 2003; Nist & Joseph, 2008).

Other often used drill interventions include incremental rehearsal and traditional drill and practice. Incremental rehearsal (Tucker, 1989) uses a ratio of 10% unknown to 90% known content and involves presenting a single unknown item interspersed with eight known items in a specific sequence. Incremental rehearsal allows for many presentations of the unknown item in a single sequence and is thought to promote better retention of learned content over time compared to traditional drill or interspersal methods (MacQuarrie, Tucker, Burns, & Hartman, 2002). Traditional drill and practice, a technique in which only new or unknown content is presented to students, allows for high rates of learning and is thought by some to be more efficient and effective than other methods of drill intervention because it allows for more opportunities to respond to new content and an increased rate of skill acquisition (Burns & Sterling-Turner, 2010; Cates et al., 2003; Joseph et al., 2012; Tan & Nicholson, 1997).

**Drill Intervention Comparison**

To determine which flashcard drill intervention method is the most effective in regard to student acquisition, several studies have been conducted to compare traditional drill, interspersal, and incremental rehearsal techniques. While all three methods have been successfully used to increase students' skills, factors such as amount of new content learned, retention of learned content, and

length of time of intervention session have all affected the perceived efficiency and effectiveness of these methods (Cooke, Guzaukas, Pressley, & Kerr, 1993; MacQuarrie et al., 2002; Nist & Joseph, 2008). Though a body of research comparing drill intervention techniques exists, there is no clear consensus on which method is superior for student skill acquisition.

Additionally, factors such as the population chosen for intervention may also affect intervention success. Young children, English language learners, and students with intellectual disabilities, for example, may benefit more from less challenging ratios of known and unknown content (Burns & Boice, 2009; Peterson et al., 2014; Volpe, Burns, DuBois, & Zaslofsky, 2011). Drill intervention methods with high levels of known content, such as incremental rehearsal, provide increased opportunities for reinforcement, which may help to alleviate these issues by maintaining interest and engagement in these populations (Cooper, Heron & Heward, 2007).

**Considerations for Intervention Effectiveness**

The rate at which students learn new information should be considered when evaluating intervention effectiveness. Students who are given overly challenging ratios of known and unknown content may take longer to acquire new skills and exhibit frustration or problem behaviors during intervention sessions. It may also be more difficult to maintain engagement during sessions if students perceive interventions to be too difficult (Gickling & Armstrong, 1978). The amount of time necessary to administer interventions should also be considered, since time is often limited in academic settings (Skinner, 2008). While drill intervention methods each possess their own pros and cons, finding a balance between effectiveness and efficiency is an important consideration when choosing an intervention method.

## Early Childhood Drill Intervention

Drill interventions have been successfully used to teach basic reading and math skills to young children. Griffin & Joseph (2015) used flashcard drill interventions to increase letter-sound correspondence in six kindergarten students. Peterson et al. (2014) used an incremental flashcard intervention to increase letter sound knowledge in three kindergarten students who were English language learners. Volpe, et al. (2011) also used an incremental rehearsal intervention for their study. Using the computerized intervention, Tutoring Buddy, Volpe, et al. (2011) were able to increase the letter sound knowledge of four kindergarten students. Other studies conducted using the Tutoring Buddy program further support its use as an effective intervention for young children (DuBois, Volpe, & Hemphill, 2014; DuBois, Volpe, Burns, & Hoffman, 2016).

Despite evidence that flashcard interventions can be used with young children, there is limited research on their use with children younger than kindergarten age. Pre-kindergarten academic research, instead, has used other methods to measure and increase children's' skills, including small group instruction (Kruse, Spencer, Olszewski, & Goldstein, 2015; Piasta, et al., 2010), curriculum-based assessment (Vanderheyden, et al., 2004), and caregiver administered home-based interventions (Justice, Skibbe, McGinty, Piasta, & Petrill, 2011; Kraft, Findlay, Major, Gilberts, & Hofmeister, 2001).

## Research Question

Given the success of Dubois, et al. (2016) and other drill interventions used with kindergarteners, it seems possible that drill intervention can be successfully used with a pre-kindergarten population. The purpose of this study is to address this hole in the literature by examining the feasibility and effectiveness of using drill interventions to increase the academic skills of pre-kindergarten students.

The research questions this study seeks to answer are as follows:

1. Can drill intervention effectively increase the letter name knowledge of pre-kindergarten students?

2. Which method of drill intervention (traditional drill and practice, interspersal, incremental rehearsal) is most effective for pre-kindergarten skill acquisition?

It is hypothesized that drill intervention can be successfully implemented with pre-kindergarten students and that use of this intervention technique will increase the letter name knowledge of students. It is also hypothesized that incremental rehearsal will be the most effective method of drill intervention due to the high levels of reinforcement and engagement that this method provides.

# CHAPTER II

## REVIEW OF LITERATURE

Reading is a necessary skill for academic success. Children who are able to read and who practice reading possess a greater knowledge base and a wider vocabulary than same-age peers who are not avid readers, and children with rudimentary reading skills risk falling behind their peers, developing negative attitudes towards reading, and experiencing academic difficulties in other areas (Whitehurst & Lonigan, 2001). The No Child Left Behind Act (NCLB) of 2001 was created to address struggling students by emphasizing accountability and evidence-based intervention. The Every Student Succeeds Act (ESSA) of 2015 expanded on NCLB by further increasing accountability, measurement of academic achievement, and intervention implementation while also creating programs to address literacy and reading issues. Despite this legislation, however, national reading performance among fourth graders has only made a gradual increase between 2002 and 2017 (National Assessment of Educational Progress, 2017). In Oklahoma, reading performance has also improved minimally, with fourth graders in the state consistently scoring below the national average (National Assessment of Educational Progress, 2017).

A solution to improving reading performance mentioned in NCLB (2001) and ESSA (2015) is early intervention. The rationale behind this is that by addressing student reading issues early in their academic careers, more significant deficits can be avoided in the future. A possible method of early intervention is targeting students at the pre-kindergarten level. Students at this age are learning the foundational skills necessary for reading, and targeted interventions could help them to build and develop those early literacy skills. While children are not required to attend preschool, many students do attend some sort of preprimary program. According to the National Center for Education Statistics, in 2017, 40% of 3-year-old children and 60% of 4-year-old children nationwide attended programs that provide some form of educational experience, including preschools, nursery schools, or other early childhood education programs. In Oklahoma, pre-kindergarten education program attendance is even higher, with over 70% of 4-year-old children attending educational programs annually between 2006 and 2017 (National Institute for Early Education Research, 2017).

Because attendance in pre-kindergarten programs is so high, it is likely that students in Oklahoma will get their initial exposure to literacy concepts at this time. Providing interventions to students at this level has the potential to further develop their early literacy skills by giving them additional exposure to literacy concepts. More practice in these areas will better prepare students for the academic expectations of kindergarten, which include knowledge of phonics, print concepts, phonological awareness, and letter identification (Oklahoma State Department of Education, 2017).

**Instructional Hierarchy**

The Instructional Hierarchy (IH) is composed of four stages of learning: acquisition, fluency, generalization, and adaptation (Haring et al., 1978). During the acquisition and fluency stages, the student initially gains a skill and becomes fluent in that skill by appropriately

responding to skill-related stimuli. After skill fluency is obtained, the student will eventually demonstrate mastery of the skill by generalizing it to other settings and modifying their skill use to novel situations. Students move through the stages of the IH by practicing the skill using interventions. Interventions that address students' skill level move them through the IH more effectively than interventions that do not (Daly et al., 1996).

For children to become fluent readers, they must first acquire the basic prerequisite skills for reading. Students would need to reach mastery in these early literacy skills before they could master the skill of reading fluency. During the acquisition and fluency stages of the IH, interventions that include reinforcement and drill procedures can be beneficial (Daly et al., 1996). Interventions that include modeling, prompting, and cueing promote accurate responding and are also beneficial in moving students through the IH.

**Early Literacy Skills**

The National Early Literacy Panel (NELP) conducted a meta-analysis between 2002 and 2006 to identify the academic skills and abilities that children learn between birth and the age of five that predict future reading, writing, and spelling outcomes (National Institute for Literacy, 2008). Their results revealed medium to large correlations between six abilities or skills and literacy development. These abilities include: alphabet knowledge, phonological awareness, rapid automatic naming of letters or digits, rapid automatic naming of objects or colors, writing one's own name, and phonological memory. NELP also found five additional variables that correlated with at least one measure of future literacy development, though not as strongly as the previous six. These variables include knowledge of print conventions, print knowledge, reading readiness, oral language, and visual processing.

In their 2004 longitudinal study, Schatschneider, et al. used dominance analysis to compare kindergarteners' phonological awareness, alphabet knowledge, rapid automatic naming,

vocabulary, visual-motor integration, perceptual matching, expressive language, and receptive language skills to determine which factors had a more dominant effect on performance on the Letter-Word Identification and Passage Comprehension subtests on the Woodcock-Johnson Psychoeducation Test Battery-Revised and the Test of Word Reading Efficiency in first and second grade. The results of their analysis indicated that letter sound knowledge, rapid naming of letters, and phonological awareness are all strong predictors of kindergarteners' reading outcomes in first and second grade (Schatschneider et al., 2004).

Burke et al., found similar results in their 2009 longitudinal study. Using path models, Burke et al., (2009) studied the predictability of early literacy skills on reading fluency across time. They found that kindergarten early literacy skills such as phonological awareness, letter naming, phoneme decoding, and automatic word recognition were all predictors of reading fluency in first and second grade. Based on their results, Burke, et al. (2009) theorized that, while not sufficient for reading fluency on their own, these skills are all necessary foundations that build on each other to result in future fluent reading.

Whitehurst & Lonigan (1998) describe phonological awareness and alphabet knowledge as "inside-out skills", or skills related to the mechanics of reading. These skills, combined with "outside-in" skills, or skills related to comprehension and context, allow for student literacy development. Whitehurst & Lonigan (1998) theorize that inside-out skills are necessary precursors for fluent reading and provide students with the tools necessary to successfully engage in sentence and word reading. Adams (1990) also noted the importance of students developing decoding skills for future reading fluency. She found that phonological awareness, alphabet knowledge, and rapid letter naming were all predictors of future reading ability in young children. She also noted that children who were skillful readers read quickly and effortlessly in part due to the automaticity of their decoding ability (Adams, 1990).

## Alphabet Knowledge

Alphabet knowledge includes knowing the names and corresponding sounds of the letters of the alphabet. While both aspects are important, there is some dispute regarding whether letter name knowledge or letter sound knowledge is most crucial to future literacy (Huang, Tortorelli, & Invernizzi, 2014; Piasta, Purpura, & Wagner, 2010). Letter naming knowledge is a strong predictor of future reading ability, while letter sound knowledge is a necessary prerequisite skill for decoding and aids in phonics instruction (Adams, 1990; Huang et al., 2014). Some argue that knowing the names of letters can provide students with clues as to what sounds some letters make, so students must have some letter name knowledge before they can successfully gain letter sound knowledge (Whitehurst & Lonigan, 1998).

Other research suggests that alphabet knowledge is a unidimensional construct. In their 2012 study, Drouin, Horner, & Sondergeld found that letter naming knowledge, letter sound knowledge, and letter recognition work together to represent the unitary concept of alphabet knowledge and provide varying levels of difficulty depending on the age of the child. Drouin et al. (2012) found that letter recognition was the easiest skill for students to master, followed by naming uppercase letters, naming lowercase letters, and then letter sound knowledge. This research provides a general guide for introducing alphabet knowledge concepts to a pre-kindergarten population. Based on their results, Drouin et al. (2012) theorized that the average four-year-old could complete letter recognition and uppercase letter naming tasks while the average five-year-old could complete these tasks and lowercase letter naming tasks. Both groups struggled with letter sound knowledge however, which suggests that it may be more appropriate to introduce this skill at the kindergarten level.

According to the National Institute for Literacy (2008), alphabet name and sound knowledge is often taught in tandem with phonological awareness. This may be due to the high

correlation between the two skills or the fact that students must have knowledge of both before they can successfully learn to decode. Early research supports the use of alphabet knowledge to facilitate phonological awareness. Hohn & Ehri (1983) compared the phonemic segmentation skills of groups of kindergartens using letter tokens and plain tokens versus a control. They found that the students who used letter tokens made fewer errors and had an easier time segmenting than students in the other groups. Hohn & Ehri (1983) theorized that, rather than confusing students, using letters when teaching segmentation helped students to better remember and distinguish between phonemes and helped to promote generalization of phonemic awareness.

Johnston, Anderson, & Holligan (1996) also found that alphabet knowledge contributes to students' development of phonological awareness. They evaluated the early literacy skills of pre-kindergarten students to determine how alphabet knowledge, rhyming ability, and word reading related to phonemic awareness. They found that students with prior alphabet knowledge were able to correctly perform phoneme segmentation tasks while students with no alphabet knowledge could not. They also found that rhyming ability did not contribute to the development of phonemic awareness, and that students who had little alphabet knowledge or phonemic awareness could not correctly read words. Based on their results, Johnston et al. (1996) theorized that prior alphabet knowledge is necessary to facilitate the development of phonemic awareness and, because phonemic awareness is a predictor of future reading ability, alphabet knowledge must be a predictor of future reading ability as well.

Other research has focused on how much alphabet knowledge is sufficient to improve future literacy and factors associated with alphabet knowledge acquisition. In their 2012 study, Piasta, Petscher, and Justice examined alphabet knowledge at the pre-kindergarten level and how this information predicted literacy in first grade. Piasta et al. (2012) found that students who knew 10 or more letter names in pre-kindergarten were less likely to have reading difficulties in first grade. Based on their results, Piasta et al. (2012) suggested that setting optimal benchmarks of 18

known uppercase letters and 15 known lowercase letters for pre-kindergarten students would help to improve literacy outcomes for students in first grade.

Students' acquisition of alphabet knowledge can be affected by their understanding of their own name. Treiman & Broderick (1998) found that pre-kindergarten, kindergarten, and first-grade students were all more likely to recognize the initial letter in their name compared to other letters. Later research further explored this phenomenon, with results suggesting that student knowledge of the initial letter in their name did not significantly impact lowercase letter recognition (Turnbull, Bowles, Skibbe, Justice, & Wiggins, 2010). Turnbull et al. (2010) did, however, find that pre-kindergartners with knowledge of specific uppercase letters were more likely to have knowledge of corresponding lowercase letters compared to students who did not possess this knowledge. They also found that students were more likely to recognize lowercase letters that were similar in appearance to their uppercase counterparts or appeared often in printed English. Based on these studies, individual and general factors can impact alphabet knowledge acquisition and differential instruction may be necessary when deciding the order to introduce letters to students.

**Early Literacy Intervention**

In their meta-analysis, NELP found that code-focused interventions, or interventions designed to teach children skills related to understanding the alphabet and phonological awareness, consistently resulted in positive effects towards children's literacy skills. These interventions were also found to largely correlate with early literacy skill development and future literacy (National Institute for Literacy, 2008). Code-focused interventions can vary widely in their techniques and target skills. Griffin & Joseph (2015) used flashcard interventions to increase letter-sound correspondences among six kindergarten students. By comparing traditional massed practice, traditional distributed practice, and incremental rehearsal, they found that massed

practice resulted in higher rates of letter-sound correspondences than the other two conditions. Based on their results, Griffin & Joseph (2015) theorized that the massed practice condition was more effective than the other conditions because it allowed for fewer incorrect responses from students compared to the other conditions.

Petursdottir et al. (2009) used brief experimental analysis (BEA) to choose effective interventions for kindergarten students. For each participant, instructional strategies including modeling, goal setting with an incentive, and modeling plus goal setting with an incentive were briefly tested to see if they would improve outcomes on letter sound and decoding measures. After each strategy was tested, the most effective intervention method for each student was chosen and implemented. Petursdottir et al. (2009) found that different participants responded to the strategies differently, but that using BEA to choose interventions was effective.

Kruse et al. (2015) used a small group intervention to increase phonological awareness in pre-kindergarten students. The intervention involved a series of scripted 10-minute lessons designed to teach blending, segmenting, and letter sound identification through games and activities. After 10-15 weeks, Kruse et al. (2015) found that their intervention increased phonological awareness of all participants with over half of participants maintaining similar levels of phonological awareness three weeks after intervention.

**Drill Intervention**

Early drill intervention research established that this type of intervention could be used to successfully increase students' specific academic skills. Neef, Iwata, & Page (1980) were able to use a drill intervention paired with noncontingent reinforcement to increase the spelling abilities of three adult students with intellectual disabilities. During the study, students were verbally given a word and asked to correctly write it on a piece of paper. They were given verbal praise for spelling the word correctly and corrective feedback for misspellings. Using an alternating

treatments design, Neef et al. (1980) provided either noncontingent reinforcement of on-task behaviors or noncontingent reinforcement paired with a drill intervention to participants. The drill intervention consisted of presenting students with ratio of 50% known and unknown words in an alternating order. The results of their study indicated that students mastered more words and did so at a faster rate during the drill condition than during the noncontingent reinforcement only condition. Their results provided evidence for the efficacy of using drill techniques over reinforcement alone to shape student academic behavior and provided a basis for future drill and intervention research.

Since Neef et al.'s (1980) study, drill interventions have been used to efficiently and effectively increase student skills in reading and mathematics. Burns (2005) used the drill intervention incremental rehearsal to increase knowledge of multiplication facts among three children with learning disabilities. After nine weeks of receiving the intervention, all three participants were able to significantly increase their single-digit multiplication fact fluency. Joseph et al. (2012) compared the effectiveness of using the drill interventions traditional drill and practice and incremental rehearsal to increase first graders' sight word reading ability. While traditional drill and practice resulted in more mastered words than incremental rehearsal, both interventions increased the number of known sight words for all participants. Similarly, January et al. (2017) found that incremental rehearsal and an alternative form of incremental rehearsal that included elements of traditional drill and practice (strategic incremental rehearsal) were both effective methods of increasing first graders' knowledge of sight words, though strategic incremental rehearsal was found to be more effective than incremental rehearsal. Incremental rehearsal was also used by Peterson et al. (2014) to increase letter sound knowledge among three kindergarten students who were English language learners. Using this method, Peterson et al. (2014) were successfully able to increase the letter sound knowledge of all participants.

## Interspersal

The drill intervention technique Neef, Iwata, & Page (1980) used in their study is often referred to as the interspersal method. When using this technique, unknown content is mixed in or interspersed with known content when presented to students. Specific ratios of known and unknown content used in interspersal drill interventions are highly variable, with ratios ranging from 50-75% being observed (Burns & Boice, 2009; Cates et al, 2003; Nist & Joseph, 2008). Cates et al. used two interspersal ratios in their 2003 comparative study. One ratio, called interspersal training, used a ratio of 50% unknown content while the other, called high-p sequencing, used a ratio of 25% unknown content. Results of the study indicated that students learned more words using a traditional drill and practice ratio of 100% unknown content compared to the interspersal conditions. Of the interspersal conditions, interspersal training was found to produce higher rates of learning than high-p sequencing. The high-p sequencing condition required more time to complete than the other conditions and resulted in fewer opportunities for students to respond to new content due to the high ratio of known versus unknown items used (Cates et al., 2003).

Nist & Joseph (2008) compared traditional drill and practice, incremental rehearsal, and interspersal with a ratio of 66% unknown content in their study and Burns & Boice (2009) did a similar comparison study using an interspersal ratio of 33% unknown content. In both studies, the interspersal condition was not found to be the most effective or efficient intervention method, but it did result in an increase in student learning.

## Incremental Rehearsal

The drill intervention technique, incremental rehearsal, has a higher ratio of known to unknown content than interspersal, and is thought to result in better retention over time than interspersal or traditional drill and practice. This type of intervention, however, requires more

time to complete compared to other drill interventions because of the larger sets of items involved (Tucker, 1989). When using incremental rehearsal, a single unknown item is interspersed with eight known items in a specific sequence. The unknown item is presented first followed by the first known item. After this, the unknown item is presented again followed by the first known item again and then the second known item. This pattern continues until the unknown item has been presented nine times and all eight known items have been presented. After the sequence is complete, the first unknown item is considered to be known, and the sequence is repeated with a new unknown item. In total, a student is presented with 45 items total (9 unknowns and 36 knowns) in one sequence (Tucker, 1989).

The incremental rehearsal procedure, along with a preteaching strategy, was used by Burns, Dean, & Foley (2004) to increase reading fluency and comprehension among students with learning disabilities in reading. Incremental rehearsal was chosen for the study because it was believed to produce better retention rates than other drill interventions. As a result of their study, Burns et al. (2004) found that preteaching words was an effective intervention for children with reading deficits.

While incremental rehearsal interventions are generally believed to be effective, they can take considerable time to administer. Swehla et al. (2016) attempted to address this issue by comparing incremental rehearsal as described by Tucker (1989), in which spacing of known items increases by one each time (widely spaced IR) with a shorter version where the spacing of known items is increased exponentially (IR-EXP). Students in the IR-EXP condition were shown a series of items with one, two, four, and then eight knowns after the presentation of one unknown. This was done to reduce intervention administration time while still allowing for the high rates of retention the incremental rehearsal method is known for. In their results, Swehla et al. (2016) found that both incremental rehearsal methods increased students' vocabulary word knowledge, but students retained more vocabulary words in the widely spaced IR condition than in the IR-

Exp condition. Based on these results, the method of incremental rehearsal developed by Tucker (1989) continues to be the most effective version of this drill intervention.

**Traditional Drill and Practice**

In contrast to incremental rehearsal, traditional drill and practice can be implemented quickly and with smaller sets of items. When using traditional drill, students are only presented with unknown items. This drill ratio is considered to be more challenging than interspersal and incremental rehearsal, and allows for more exposure to new items than other drill intervention methods. Tan & Nicholson (1997) were able to improve the reading ability of 42 elementary students using traditional drill and practice over five 20-minute sessions. During each session, students in the experimental condition received a traditional drill and practice word reading flashcard intervention. By the end of the study, students in the drill conditions read faster, read more accurately, and comprehended their reading better than students in the control condition. Further research on traditional drill intervention has found it to result in high rates of skill acquisition and increased opportunities to respond to new content, leading some to consider it more effective and efficient compared to interspersal and incremental rehearsal techniques (Burns & Sterling-Turner, 2010; Joseph et al., 2012).

**Drill Intervention Comparison**

Traditional drill and practice, incremental rehearsal, and interspersal are all effective drill intervention methods for increasing student skills. However, due to the limited time and resources available in the school environment, much research has been devoted to determining which method is the most effective for student skill acquisition. Factors used to measure effectiveness vary, but time necessary to complete the intervention, the amount of new content that can be learned per session, and the amount of new content retained post-intervention are all variables

that are often considered when determining intervention effectiveness (Burns & Sterling-Turner, 2010; Cooke, Guzaukas, Pressley, & Kerr, 1993; Joesph et al., 2012; Nist & Joseph, 2008).

In their 1993 study, Cooke, Guzaukas, Pressley, & Kerr compared the effects of using an interspersal technique with 30% unknown items to using a traditional drill technique with 100% unknown items on student spelling acquisition, math fact fluency, and reading ability. While both intervention techniques were effective, Cooke et al. (1993) found that traditional drill was the more efficient intervention method and resulted in more new content learned per session. When students were asked which method they preferred, however, most favored the interspersal technique, and said that it was the easier of the two.

Nist & Joseph (2008) compared the effectiveness and instructional efficiency of incremental rehearsal, traditional drill, and interspersal with 60% unknown content on student word acquisition. They found that while incremental rehearsal was the most effective method for students overall, traditional drill was the most efficient. While students in the incremental rehearsal condition maintained more words over time, the incremental rehearsal sessions took longer to complete than the traditional drill or interspersal sessions. Based on their results, Nist & Joseph (2008) theorized that the effectiveness of incremental rehearsal may be due to not only the number of times a word is rehearsed but in the incremental nature of word presentation.

In 2002, MacQuarrie et al. compared the effects of traditional drill, incremental rehearsal, and interspersal with 30% unknown content on students' retention of Esperanto words. The results of their study revealed that students in the incremental rehearsal condition retained more words after 1, 2, 3, 7, and 30 days than those in the interspersal or traditional conditions. MacQuarrie et al. (2002) noted that, while effective, the incremental rehearsal sessions took twice as long to complete (15-25 minutes) as the interspersal and traditional drill conditions (5-10

minutes). They went on to suggest that the effectiveness of the incremental rehearsal intervention might outweigh the increased time necessary to complete it.

In their comparative study of traditional drill and incremental rehearsal, Burns & Sterling-Turner (2010) found that traditional drill was significantly more efficient than incremental rehearsal, requiring less time to complete and resulting in more words learned per minute. Joseph, et al. (2012) also found higher learning rates using traditional drill versus incremental rehearsal. In both studies, however, there were few differences in number of words retained between the incremental rehearsal and traditional drill groups over time.

Despite the vast body of research comparing drill techniques, it is still unclear which method is superior. While incremental rehearsal promotes retention and maintenance over time, traditional drill provides more opportunities to respond to the new material and takes less time to implement over other techniques (MacQuarrie, et al., 2002; Nist & Joesph, 2008). The population the intervention is used with may also be a factor when considering a drill intervention. Certain populations, such as students with intellectual disabilities, English language learners, and young children may benefit from less challenging ratios of known to unknown content (Burns & Boice, 2009; Peterson et al., 2014; Volpe, Burns, DuBois, & Zaslofsky, 2011). For these populations, maintaining engagement may be an important factor in intervention success. Drill intervention methods with high ratios of known content allow for higher rates of reinforcement, and more opportunities for reinforcement should lead to more engagement from respondents (Cooper et al., 2007).

In a replication of MacQuarrie, et al. (2002), Burns & Boice (2009) found that incremental rehearsal was more effective than traditional drill or interspersal techniques for word retention among students with intellectual disabilities. As in other research, the incremental rehearsal sessions (25 minutes) took longer to complete than the interspersal (15 minutes) and

traditional drill (20 minutes) conditions. Burns & Boice (2009) noted that the additional time necessary to complete the traditional drill session was likely due to the increased repetition of unknown content that students needed to master the given words. They went on to suggest that the effectiveness of the incremental rehearsal session was due to the higher number of opportunities to respond compared to the other two conditions. The success of the incremental rehearsal condition over the traditional drill condition may have also been due to a higher rate of reinforcement. Because the traditional drill condition contained so many unfamiliar items, participants were allowed fewer opportunities to obtain reinforcement by providing correct answers (Cooper et al., 2007).

**Acquisition Rate**

When discussing interventions and intervention effectiveness, it is important to also consider acquisition rate. Acquisition rate refers to the amount of new information that a student can successfully recall and rehearse during a single intervention session (Burns, Zaslofsky, Maki, & Kwong, 2016). Acquisition rate can be calculated by counting the number of items a student correctly identifies before making three errors (Burns, 2001). This information can be useful in determining appropriate intervention intensity and increasing intervention efficiency.

Early research in instructional levels led to the development of the concept of acquisition rates. Gickling & Armstrong (1978) found that, by adjusting the ratios of known and unknown content during academic tasks, they could tailor the difficulty of their interventions and affect students' task-completion and on-task behavior. They found that if an intervention was too easy or too difficult, students would provide fewer correct answers and were more prone to engaging in off-task behavior. Based on their results, Gickling & Armstrong (1978) theorized that there is a relationship between instructional difficulty and learning, and that tasks must be set at an appropriate level of difficulty to result in high rates of engagement and correct responding.

Acquisition rate has since been used to research intervention effectiveness. Haegele & Burns (2015) used acquisition rate to determine appropriate set size for an incremental rehearsal intervention. They compared retention and intervention efficiency for students with learning disabilities when intervention set size was determined via acquisition rate and when intervention set sizes were determined arbitrarily. The results of their study revealed that students retained significantly more words when intervention set size was based on acquisition rate. Haegele & Bruns (2015) theorized that using acquisition rate to determine set size could help examiners to tailor interventions to students' appropriate instructional level, while increasing their effectiveness and minimizing frustration.

In a replication of Haegele & Burns (2015), Burns et al. (2016) used acquisition rate to determine set sizes when teaching multiplication facts to third and fourth grade students. When comparing retention among students, they found that students whose set sizes were determined using acquisition rate were able to retain more multiplication facts than students in other intervention groups. This research provides further support for keeping students' instructional level in mind when choosing intervention set sizes.

**Learning Rate**

Skinner (2008) suggests that a learning problem should be seen as a failure to acquire a skill within an expected period of time rather than a failure to learn. He argues that a skill deficit could be considered an issue of learning rate and that the time necessary for a student to learn a skill should not be overlooked when developing interventions. Because time is limited in academic settings, interventions must be as effective and efficient as possible. To examine intervention efficiency, Skinner (2008) suggests holding intervention time constant and comparing the amount of content learned per minute of instructional time per intervention. If this method is used to compare the traditional drill, intersperal, and incremental rehearsal conditions

of Nist & Joseph's 2008 study, traditional drill would be considered the most efficient intervention method. Because of the high ratio of unknown to known content, students in the traditional drill condition were able to learn more words in a shorter amount of time than students in the other two conditions. Skinner (2008) argues that intervention research that focuses on learning rates is more relevant to practitioners. Teachers and other educational professionals have limited time to remediate student skill deficits, so learning rates must be considered when developing interventions for use in educational settings.

**Small Group Intervention**

Small group intervention involves administering additional academic instruction to a group of three or more students with similar skill deficits. Providing interventions in this manner can be a practical alternative to increasing student skills rather than one-on-one interventions. The Institute of Education Sciences has found strong evidence to support the use of small group interventions at the tier 2 level when using a multi-tiered academic intervention system. They recommend that students at this level receive 20 to 40 minutes of small group instruction three to five days per week (Gersten et al., 2008).

Additional research supports the use of small group interventions to address reading deficits. Kamps et al. (2008) used small-group interventions to increase the early literacy skills of a group of kindergarteners with reading difficulties. They also compared the use of general reading interventions, such as guided reading, and interventions that utilize direct instruction. After two years of intervention, they found that students who had received targeted direct intervention performed better on reading measures than students who received more general interventions. Kamps et al. (2008) noted that their findings provide further support for the use of highly structured interventions and the implementation of early interventions to address academic deficits before they become more severe. Nielsen & Friesen (2012) were also able to increase

students' reading skills using small-group interventions. They implemented a 12-week small-group intervention consisting of three 30-minute lessons per week using children's books with kindergarten students with vocabulary deficits. Their results suggested that students who received the intervention had a greater increase in vocabulary than students in the control group. Nielsen & Friesen (2012) attribute this gain to the explicit instruction and practice of vocabulary words that students in the intervention group received.

In their 2018 meta-analysis, Hall & Burns examined the effectiveness of small group administered reading interventions and factors associated with intervention effectiveness. Overall, they found that small group interventions were an effective method of increasing student skills, and several factors, including targeted skill, interventionists' level of training, and group size could potentially impact intervention effectiveness. Overall, Hall & Burns (2018) found that interventions administered in small groups were moderately effective at increasing reading skills of elementary and secondary students, with interventions being most effective for students at the elementary level. They also found that interventions that targeted specific skills were more effective than those with a broader focus, and interventions administered by highly trained individuals, such as researchers and outside interventionists, were generally more effective than interventions administered by volunteers. Targeted interventions and group size were observed to have the largest effect on intervention success. Hall & Burns (2018) went on to suggest that groups of no more than five students would produce better outcomes than larger groups of students.

**Early Childhood Flashcard Drill Intervention**

Flashcard drill interventions have previously been used to increase early literacy skills in young children. Griffin & Joseph (2015) and Peterson et al. (2014) both successfully increased the letter sound knowledge of kindergarten students in their studies. Volpe et al. (2011) also

increased the letter sound knowledge of kindergarten students using a computerized flashcard drill intervention, Tutoring Buddy. Tutoring Buddy is a program designed for use during tutoring sessions. The program involves a pre-intervention assessment, an incremental rehearsal procedure, and a summary of results at the end of each session. During sessions, the program presents a series of letters to the student while the tutor asks the student to provide the correct letter sound. The tutor may then record the student's response as either correct or incorrect, by pressing the up or down-arrows on the computer keyboard. The student is presented with a ratio of 80% known content during intervention sessions. The known and unknown letters are determined during the pre-assessment and four known and two unknown letters are chosen by the tutor before each session. Using this tutoring program, Volpe et al. (2011) was able to increase the letter sound knowledge of all four participants by six to nine letter sounds.

DuBois, Volpe, & Hemphill (2014) used the Tutoring Buddy program with a group of 30 kindergarten and first grade students in a replication of Volpe et al. (2011). DuBois et al. (2014) found that students who used the Tutoring Buddy program significantly increased their letter sound knowledge and their letter sound fluency and nonsense word fluency scores on AIMSweb progress-monitoring probes compared to the control group. Based on their results, DuBois et al. (2014) suggested that the Tutoring Buddy program could be an efficient and effective intervention method for young children.

Further research into the Tutoring Buddy program investigated its feasibility as a parent-administered home-based tutoring program. DuBois, Volpe, Burns, & Hoffman (2016) trained the parents of three pre-kindergarten children to use the Tutoring Buddy program with their children over a six-week period. Their study resulted in significant increases in nonsense word fluency, letter sound fluency, and letter sound knowledge for all three participants.

While the Tutoring Buddy program appears to be a promising early literacy intervention, it and other flashcard interventions are not commonly used with pre-kindergarten students. Instead, pre-kindergarten academic research has focused on other methods for measuring and increasing student skills. Piasta et al. (2010) and Kruse et al. (2015) used lesson plans administered to small groups of students to increase alphabet knowledge and phonological awareness respectively in pre-kindergarten students. Vanderheyden et al. (2004) created curriculum-based measures for assessing pre-kindergarten early numeracy skills, including number naming and object counting. Justice et al. (2011) provided caregivers with a home-based reading intervention to successfully increase print concept knowledge in language impaired pre-kindergarten students. Kraft et al. (2001) also used a caregiver administered home-based reading program to increase letter sound knowledge among kindergarten students.

Few of the studies included in NELP's meta-analysis focused on teaching preschool-aged children. An age-level comparison of interventions revealed, however, that interventions that were effective when used with a kindergarten population were also effective when used with a preschool population. Though more research is needed in this area, NELP's findings provide some support for the use of code-focused instruction with children under the age of five (National Institute for Literacy, 2008). Based on this finding, interventions that have been effectively used with a kindergarten population, such as flashcard interventions, may also be beneficial for pre-kindergarten students.

# CHAPTER III

# METHODOLOGY

## Participants

Participants included sixty-one pre-kindergarten students from three general education classrooms at a local elementary school in central Oklahoma. No eligibility criteria were required for participation, and all students enrolled in pre-kindergarten at the school were invited to participate. Written parental consent was obtained before any student was admitted into the study. Of the participants, 26 were female and 35 were male. Participants ranged in age from four to five years old.

Pre-assessments, post-assessments, progress monitoring, and intervention sessions were conducted by the principal investigator and three graduate students from the Oklahoma State University School Psychology program. All graduate student examiners were trained in intervention and assessment procedures prior to their participation in the study.

## Materials

Materials used during the study included PowerPoint presentations and data collection sheets created by the principal investigator. The PowerPoints contained specific sets of uppercase letters or numbers. Each letter or number was presented in isolation in black 200pt Times New Roman font on a white background. Data collection sheets for each session included all of the items presented during the session. When using a data sheet, the examiner would circle "Y" for a correct response and "N" for an incorrect response or no response.

## Experimental Design and Analysis

This study used a stratified randomized design. Participants within each classroom were randomly assigned to one of four conditions: incremental rehearsal, interspersal, traditional drill, or control. Each group, not including the control, received a letter name intervention administered via small group instruction. The control group received a number identification intervention also administered via small group instruction. Intervention groups consisted of no fewer than two and no greater than four participants. There were 19 groups in total: five incremental rehearsal, five interspersal, five traditional drill, and four control. 16 participants were in the incremental rehearsal condition, 16 participants were in the interspersal condition, 16 participants were in the traditional drill condition, and 13 participants were in the control condition.

Data was analyzed using a split-plot factorial analysis of variance (ANOVA). This method of analysis is used to compare the statistical significance of difference between and within groups. The between group factor was the type of drill intervention method used during intervention and the within group factor was the difference in letter name knowledge between the pre- and post-assessments. This information was calculated and compared to determine effectiveness of intervention methods.

**Independent Variable.** The independent variable was the ratio of known to unknown content provided during intervention. Those in the incremental rehearsal condition received a ratio of 90% known to 10% unknown content, with known and unknown items presented in sequence as outlined in Tucker (1989). Those in the interspersal condition received a ratio of 50% known to 50% unknown content, with known and unknown items presented in an alternating order. Those in the traditional drill condition received a ratio of 0% known to 100% unknown content, with unknown items presented in a random order. Those in the control condition were shown a series of random numbers between 1 and 20 in sets of ten. Each group was to receive their intervention for approximately five minutes a day for three to four days each week.

**Dependent Variable.** The dependent variable was the number of known uppercase letter names acquired after nine weeks or thirty-six intervention sessions. The number of known letter names for each participant was collected during pre-assessment, weekly progress monitoring, and post-assessment. Criteria for a letter to be considered known varied. During pre- and post-assessments, a letter was considered known if the student correctly identified the letter within three seconds of its presentation two times in one session. During progress monitoring, a letter was considered known if the student correctly identified the letter within three seconds of its presentation one time in one session. For each intervention group, individual pre- and post-assessment data was analyzed to determine the number of known items for the group. If the majority of individuals in the group (51% or more) correctly identified the letter, then the letter would be considered known for the group.

## Procedures

**Pre- and Post-Assessment**. All participants were individually assessed at the beginning of the study to measure prior letter-naming knowledge. Participants were also to be assessed at the end of the study to determine intervention effectiveness. During pre- assessment, students were presented with a PowerPoint presentation of 52 uppercase letters in a random order. Letters

were presented in isolation in black 200pt Times New Roman font on a white background. Each letter of the alphabet was presented to students twice. During these assessments, the examiner would present a letter to the student and ask, "what letter is this?" If the student provided the correct answer within three seconds, the letter was considered correct and the next item was presented. If the student provided an incorrect answer, no answer, or did not respond within three seconds, the letter was considered incorrect and the next item was presented. The examiner did not acknowledge correct responses or give corrective feedback during pre-assessment.

During the course of the study, schools statewide were unexpectedly closed due to global pandemic (Oklahoma Department of Education, 2020). Because of this, the post-assessment could not be administered. Instead, participants' most recent progress monitoring data was used to compare letter knowledge before and after intervention. Though it was not administered, the post-assessment would have been conducted using the same procedures as the pre-assessment.

Individual pre-assessment data was analyzed to determine the number of known letter names for each group prior to intervention. If the majority of individuals in a group (51% or more) correctly identified the letter during pre-assessment, then the letter was considered known for the group. A similar procedure would have been used to determine the number of known letter names for each group during post-assessment.

**Intervention.** Participants received their designated intervention once a day for one to four days per week. All intervention sessions took place in a commons area located near the pre-kindergarten classrooms. Participants were placed in small groups of no more than four and no fewer than two during intervention sessions. Each intervention session lasted approximately five minutes and, during intervention, the examiner presented content to students via PowerPoint in a predetermined order. The examiner was to repeat the PowerPoint sequence with the group of students until five minutes had elapsed. The number of correct and incorrect responses for each

group was then recorded. Participants received their designated intervention for 12 intervention sessions occurring over a six-week period. Intervention sessions occurred even if some group members are absent. As long as two or more participants in a group were present, the intervention was provided for the group.

When a letter was presented, the examiner asked the group, "what letter is this?" then cued the participants to respond. If all group members provided the correct answer within three seconds, the letter was considered correct and the examiner provided verbal praise and repeated the name of the letter before moving on to the next item. If the majority (51% or more) of the group members provided the correct answer within three seconds, the letter was also considered correct and the examiner provided verbal praise and repeated the name of the letter before continuing on to the next item. If half of the group members or fewer (50% or less) provided the correct answer within three seconds, the letter was considered incorrect and the examiner provided corrective feedback before moving on to the next item. Students who provided an incorrect response or no response to an item were given the correct answer and asked to repeat the correct answer after the examiner before the group was presented with the next item.

**Progress Monitoring**. Participants were individually assessed on a weekly basis to measure letter-naming knowledge and rate of letter name acquisition. During progress monitoring, students were presented with a PowerPoint presentation of 26 uppercase letters in a random order. Letters were presented in isolation in black 200pt Times New Roman font on a white background, and each letter of the alphabet was presented to students one time. Each time a letter was presented to students, the examiner would ask, "what letter is this?" If the student provided the correct answer within three seconds, the letter was considered correct and the next item was presented. If the student provided an incorrect answer, no answer, or did not respond within three seconds, the letter was considered incorrect and the next item was presented. During

progress monitoring, the examiner did not acknowledge correct answers or provide corrective feedback for incorrect answers.

Letter name knowledge was monitored weekly for each group. Individual progress monitoring data was used to determine group progress monitoring data. If the majority of individuals in a group (51% or more) correctly identified the letter during individual progress monitoring for the week, then the letter was considered known for the group. If half of the individuals in the group or fewer identified the letter during individual progress monitoring (50% or fewer), then the letter was considered unknown for the group. Progress monitoring occurred at the end of each week, and still occurred if fewer than four intervention sessions were conducted that week.

**Inter-Rater Reliability**

Inter-rater reliability was assessed by having two examiners record data independently during intervention sessions. The first examiner conducted the intervention and recorded student responses while the second examiner monitored fidelity, noted any student behavioral issues, and also recorded student responses. Examiners compared data at the end of the session to measure consistency. Over the course of the study, inter-rater reliability data was collected for 28% of intervention and progress monitoring sessions. Raters were in agreement 40% of the time, and there was only a 1-2 point difference in scores when they were not in agreement. When raters were not in agreement, the scores of the rater conducting the intervention were used.

# CHAPTER IV

## FINDINGS

A split-plot factorial analysis of variance (ANOVA) was used to analyze the data. This method of analysis is used to evaluate the statistical significance of difference between and within groups. The between groups factor in this analysis was the intervention group participants were assigned to. Participants were assigned to one of four groups: control (CON), traditional drill and practice (TDP), intersperal (IS), or incremental rehearsal (IR). The within groups factor was the difference in letter name knowledge between the pre- and post-assessments. The level of significance used for this analysis was ($\alpha = .05$), and the statistical program SPSS was used to calculate all statistics.

Descriptive data for pre-assessment and post-assessment is presented in Table 1 and Figure 1. Pre-assessment mean scores ranged from 16-20 with an average mean score of 17.79. Post-assessment mean scores ranged from 20-23 with an average mean score of 21.68. All intervention groups increased their mean scores between pre- and post-assessment with an average increase of 3.89.

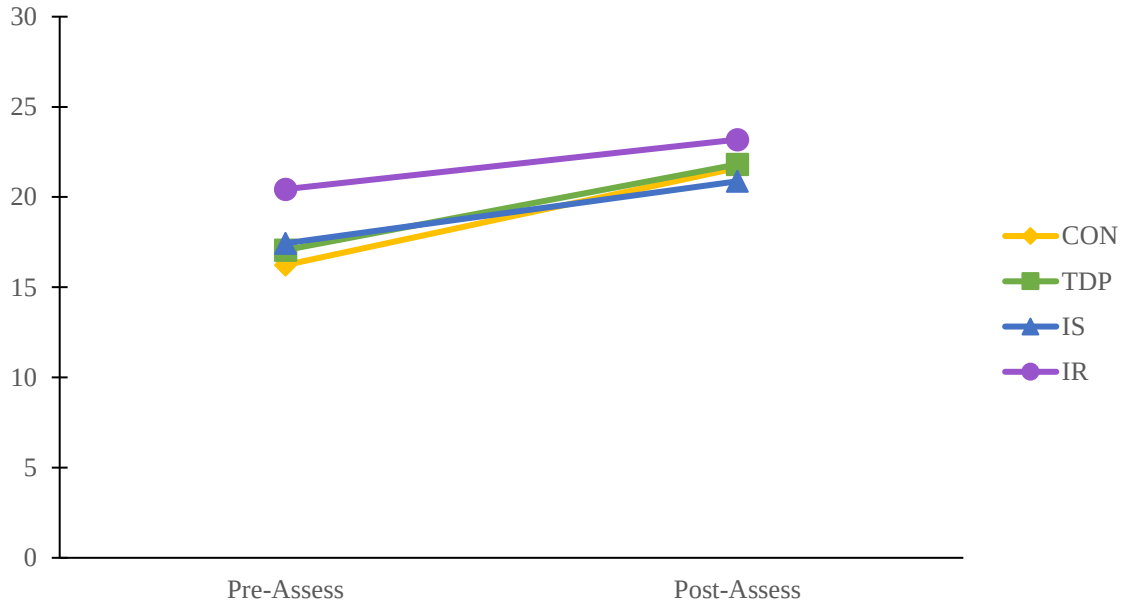
Table 1.

*Descriptive Statistics*

| | Pre-Assessment | | | Post-Assessment | | | |
|---|---|---|---|---|---|---|---|
| Group | *n* | *M* | *SD* | *n* | *M* | *SD* | Difference |
| CON | 13 | 16.23 | 7.57 | 13 | 20.85 | 5.46 | 4.62 |
| TDP | 16 | 20.44 | 4.73 | 16 | 23.19 | 3.73 | 2.75 |
| IS | 16 | 17.06 | 8.53 | 16 | 21.81 | 5.45 | 4.75 |
| IR | 16 | 17.44 | 7.06 | 16 | 20.87 | 6.96 | 3.43 |

Figure 1.

*Group Alphabet Knowledge Growth in Number of Known Letters*




The assumption of normality was not met for all groups. Data for the IS pre-assessment ($p$ = .039), IS post-assessment ($p$ = .001), CON post-assessment ($p$ = .026), IR post-assessment ($p$ = .001), and TDP post-assessment ($p$ = .001) groups were not normally distributed. The assumption of homogeneity of variance was not met for pre-assessment data ($F$ (3, 57) = 3.434, $p$ = .023) but was met for post-assessment data ($F$ (3, 57) = 1.401, $p$ = .252). The assumption of sphericity was met.

The results of the split-plot factorial ANOVA revealed that there was no statistically significant interaction between intervention groups and known letters ($F$ (3, 57) = 1.606, $p$ = .198), indicating that intervention group did not have a significant effect on the change in participant letter knowledge between pre- and post-assessment. There was a statistically significant main effect of known letters ($F$ (1, 57) = 75.862, $p$ = .000), indicating a significant difference between participant letter knowledge between pre- and post-assessment. There was no statistically significant main effect for intervention group ($F$ (3, 57) = .760, $p$ = .521), indicating that there was no significant difference in letter knowledge between the intervention groups.

Because intervention group was not found to have a significant effect on letter knowledge, a second split-plot factorial ANOVA was conducted to analyze the effect of classroom on participant letter knowledge. The between group factor in this analysis was the pre-kindergarten classroom that participants were assigned to (A, B, or C), while the within group factor remained the difference in letter name knowledge between pre- and post-assessments.

Descriptive data is presented in Table 2 and Figure 2. Pre-assessment scores ranged from 15-20 with an average mean score of 17.95, while post-assessment scores ranged from 20-23 with an average mean score of 21.91. All classes increased their mean scores between pre- and post-assessment with an average increase of 3.96.

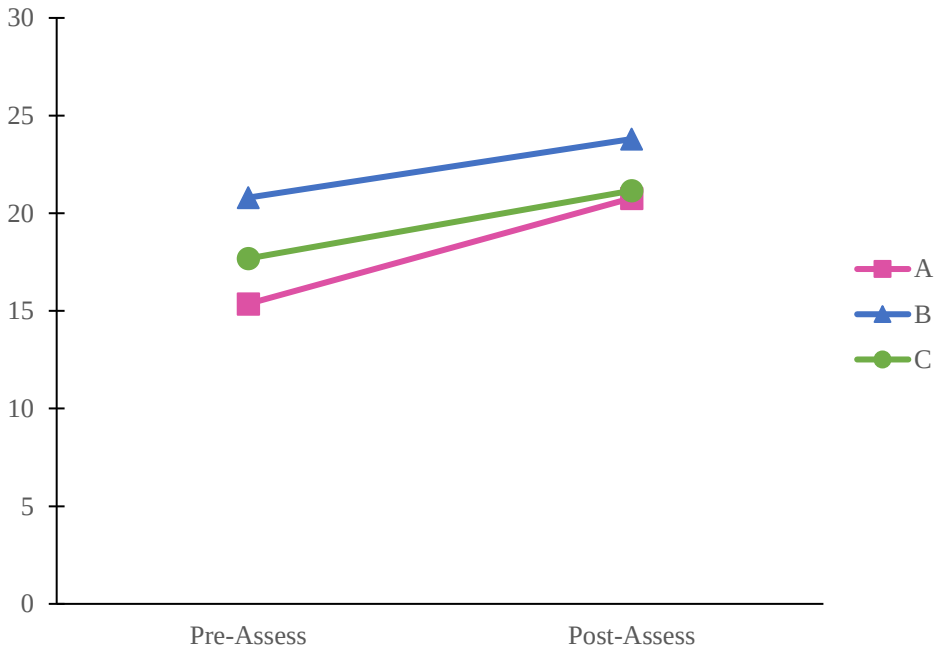
Table 2.

*Descriptive Statistics*

| | Pre-Assessment | | | Post-Assessment | | | |
|---|---|---|---|---|---|---|---|
| Class | *n* | *M* | *SD* | *n* | *M* | *SD* | Difference |
| A | 22 | 15.36 | 7.13 | 22 | 20.77 | 5.75 | 5.41 |
| B | 20 | 20.80 | 5.70 | 20 | 23.80 | 3.41 | 3.00 |
| C | 19 | 17.68 | 7.54 | 19 | 21.16 | 6.21 | 3.48 |

Figure 2.

*Class Alphabet Knowledge Growth in Number of Known Letters*




The assumption of normality was not met for all groups. Data for Class B pre-assessment ($p$ = .003), Class B post-assessment ($p$ = .000), Class A post-assessment ($p$ = .004), and Class C post-assessment ($p$ = .000) were not normally distributed. The assumption of homogeneity of variance was not met for post-assessment data ($F$ (2, 58) = 3.340, $p$ = .042) but was met for pre-assessment data ($F$ (2, 58) = 1.345, $p$ = .269). The assumption of sphericity was met.

The results of the split-plot factorial ANOVA revealed that there was no statistically significant interaction between class and known letters ($F$ (2, 58) = 2.658, $p$ = .079), indicating that class did not have a significant effect on the change in participant letter knowledge between pre- and post-assessment. Again, there was a statistically significant main effect of known letters ($F$ (1, 58) = 73.536, $p$ = .000), indicating a significant difference between participant letter knowledge between pre- and post-assessment. There was no statistically significant main effect

for class ($F$ (2, 58) = 2.846, $p$ = .066), indicating that there was no significant difference in letter knowledge between Class A, Class B, or Class C.

An analysis of covariance (ANCOVA) was also conducted to analyze the effect of intervention group on letter knowledge while controlling for prior letter knowledge. Intervention group was used as the independent variable, post-assessment score was used as the dependent variable, and pre-assessment score was used as the covariate. The results of the ANCOVA revealed that, when controlling for prior letter knowledge, there was no statistically significant effect of group on post-assessment score ($F$ (3, 61) = .982, $p$ = .408). These results suggest that intervention group did not significantly affect participant post-assessment letter knowledge, even when taking prior letter knowledge into account.

# CHAPTER V

# DISCUSSION

Given the lack of research on the use of drill intervention with a pre-kindergarten population, the purpose of the current study was to address this hole in the literature by examining the feasibility and effectiveness of using drill intervention to increase the academic skills of pre-kindergarten students. This study sought to answer the following research questions: 1.) can drill intervention effectively increase the letter name knowledge of pre-kindergarten students, and 2.) which method of drill intervention is most effective for pre-kindergarten skill acquisition? To answer these questions, the current study compared the effectiveness of three drill intervention methods (traditional drill and practice, interspersal, incremental rehearsal) and a control on increasing letter naming knowledge of pre-kindergarten students.

It was hypothesized that drill intervention could be successfully implemented with pre-kindergarten students and that use of this intervention would increase the letter name knowledge of students. While all participants increased their number of known letters between pre- and post-assessments, a split-plot factorial ANOVA revealed that there was no statistically significant interaction between intervention groups and known letters and no significant difference in letter knowledge between the intervention and control groups. This data suggests that participants' increase in letter knowledge cannot be attributed to the use of drill intervention. Because the control group increased their letter knowledge at a similar rate as the intervention groups, drill intervention was not effective at increasing participant letter knowledge in this study.

It was also hypothesized that incremental rehearsal would be the most effective method of drill intervention due to the high levels of reinforcement and engagement that it provides. Of the three intervention methods used, interspersal resulted in the greatest increase in letter knowledge between pre- and post-assessment, meaning that it could be considered the most effective intervention method of the three. However, given that none of the interventions made a significant impact on participant letter knowledge, this is only a technicality.

During the course of data collection, participants from one classroom consistently produced higher progress monitoring scores than participants from other classes. Because of this, a second split-plot factorial ANOVA was conducted to determine if participants' assigned classroom had an effect on letter knowledge. Results of this analysis revealed no statistically significant interaction between class and known letters and no significant differences in letter knowledge between classes. These results suggest that participants' increase in letter knowledge between pre- and post-assessment cannot be attributed to the classroom they were assigned to and that participants increased their letter knowledge at a similar rate, no matter which class they were in.

*Limitations*

Several limitations were noted during the course of the study. Examiners were only able to deliver the intervention an average of 1-2 times per week instead of the intended four times per week. Interventions often had to be rescheduled or canceled due to school events, and sudden changes in class schedules due to school-related activities. Interventions were also negatively impacted by absenteeism among participants, as many students were absent for several days due to illness. Had these events not occurred, the intervention could have been implemented more consistently, which may have increased intervention effectiveness.

Another limitation of the study was inconsistent length of intervention sessions. Intervention sessions were intended to be approximately five minutes in length, but sessions often had to be cut short. This was often due to scheduling and school-related events, but participant inattentiveness also had an effect. Participants were often distracted by students and other passersby walking near the area used for interventions. Some students also became more inattentive and susceptible to these distractions when they could not identify the letters given. Having intervention sessions in a quieter location and having a second examiner available during sessions to redirect participants and manage any participant problem behavior could have assisted in increasing consistency in intervention session length.

A third limitation is the length of time of the study. The study was originally intended to occur over a nine-week period, but had to be ended after six weeks. Schools in Oklahoma were unexpectedly closed in March due to the COVID-19 global pandemic. Because of this, data collection had to be ended prematurely. Had the study continued for the full nine-week period intended, results may have been more favorable.

*Implications for Practice*

While the results of the current study were not statistically significant, they provide more information on the use of drill intervention with a pre-kindergarten population. These findings suggest that drill intervention can be implemented with pre-kindergarten students, but additional measures must be taken to ensure consistency of intervention delivery and implementation and to maintain student attention. Careful considerations must be made to ensure that school events do not interfere with intervention scheduling. Minimizing distractions by administering interventions in a quiet environment would also help to improve intervention delivery.

Results also suggest that intervention delivery via small group instruction may be a viable option for pre-kindergarten. While most studies with pre-kindergarten participants use one-on-one intervention sessions, the results of this study provide evidence for the feasibility of administration of small group intervention with this population.

*Future Research*

Further research in this area should focus on increasing intervention integrity and consistent scheduling while also maintaining participant attention and minimizing distractions. Given the population, future studies will have to balance structure, novelty, and the challenges of providing interventions within the school environment for successful implementation. Additional research in this area should also include a replication of this study with a greater number of participants, a longer data collection window, and more researchers involved. With these resources, future studies may result in more favorable outcomes and further implications for practice for this population and method of intervention delivery.

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APPENDIX A
INSTUTIONAL REVIEW BOARD APPROVAL LETTER

**Oklahoma State University Institutional Review Board**

| | |
|---|---|
| Date: | 09/11/2019 |
| Application Number: | ED-19-100 |
| Proposal Title: | Comparing the Effects of Group Administered Drill Interventions on Pre-kindergarten Early Literacy Skills |
| Principal Investigator: | Loren Nelson |
| Co-Investigator(s): | |
| Faculty Adviser: | Gary Duhon |
| Project Coordinator: | |
| Research Assistant(s): | |
| Processed as: | Exempt |
| Exempt Category: | |

**Status Recommended by Reviewer(s): Approved**

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The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in 45CFR46.

**This study meets criteria in the Revised Common Rule, as well as, one or more of the circumstances for which continuing review is not required. As Principal Investigator of this research, you will be required to submit a status report to the IRB triennially.**

The final versions of any recruitment, consent and assent documents bearing the IRB approval stamp are available for download from IRBManager. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be approved by the IRB. Protocol modifications requiring approval may include changes to the title, PI, adviser, other research personnel, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any unanticipated and/or adverse events to the IRB Office promptly.
4. Notify the IRB office when your research project is complete or when you are no longer affiliated with Oklahoma State University.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact the IRB Office at 405-744-3377 or irb@okstate.edu.

Sincerely,
Oklahoma State University IRB

VITA

Loren Taylor Nelson

Candidate for the Degree of

Doctor of Philosophy

Dissertation: COMPARING THE EFFECTS OF GROUP ADMINISTERED DRILL INTERVENTIONS ON PRE-KINDERGARTEN EARLY LITERACY SKILLS

Major Field: School Psychology

Biographical:

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Completed the requirements for the Doctor of Philosophy in School Psychology at Oklahoma State University, Stillwater, Oklahoma in July, 2021.

Completed the requirements for the Master of Arts in School Psychology at University of Central Oklahoma, Edmond, Oklahoma in 2015.

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Experience:

*August 2019 – Present*
OTISS External Coach (Supervised by Gary Duhon, Ph.D.)
*June 2019 – May 2020*
Clinic-Based Practicum (263 hours; Supervised by Terry Stinnett, Ph.D.)
*August 2018 – December 2018*
School-Based Practicum (250 hours; Supervised by Gary Duhon, Ph.D.)

Professional Memberships:

National Association of School Psychologists, Member: 2017 – Present
Oklahoma School Psychological Association, Member: 2017 – Present