The Effects of Critical Feature Handwriting Intervention on Early Literacy Skills Acquisition of Pre-K Students

By

Claudia Russell

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Literacy Studies

Middle Tennessee State University

August 2023

Dissertation Committee:

Dr. Katie Schrodt, Chair

Dr. Amy Elleman

Dr. Natalie Griffin

ABSTRACT

This study was conducted by utilizing an experimental handwriting intervention using eight critical features as identified by Reutzel et al. (2019). The intervention used lower-case letters to group letters with similar features for instruction for preschool-age children. These features were used to facilitate instruction with letter-writing fluency, letter-writing quality, letter names and letter sounds in a pre-K (3–4 years of age) classroom. The critical features of letters include short and long lines, short and long hooks closed and open curves, and a U-turn/hump and dot. This study examined the impact of a handwriting intervention using critical features on acquisition of letter names, letter sounds, phonemic awareness, and handwriting fluency and quality. This study included 29 pre-K students in private school settings, randomly assigned to form an experimental and a control group for each center. The intervention lasted 8 weeks, at 30-minute sessions per group. Small group instruction of the handwriting intervention took place in both centers with the experimental group. There were 2 small groups, $n = 29$, 15 in the experimental group and 14 in the control group. Quantitative data collection consisted of data from the pre-and post-handwriting analysis and FastBridge assessments for letter recognition and letter sounds. At posttest, ANCOVA analyses demonstrated statistically significant differences between the intervention group and control group on all measures (i.e., phonological awareness, handwriting quality, handwriting fluency, letter names, and letter sounds).

Keywords: handwriting, critical features, letter sound fluency, letter recognition, letter writing quality

DEDICATION

This body of work is dedicated to my family and friends who have supported me throughout my academic career. A special thank you to my mother Bessie Russell, who encouraged and supported me during the critical medical issues I experienced while completing this degree. My thanks also go to Robert Churchwell Jr., my best friend, who was also my inspiration and advisor during some challenging times when I was not sure it was worth all the pressure and time. I would like to express my appreciation of the help my sister Charlotte gave me in reading and editing papers – even though she said it bored her to tears, she still did it. Additionally, I wish to extend my thanks to the numerous other people who have assisted me, including Kathy Johnson and other friends who were in my corner, especially my advisor, Dr. Kim, my professors Dr. Albakry, Dr. Elleman, and my Committee Chair, Dr. Schrodt. Finally, I will not forget Dr. Oslund for sticking with me through stats.

Thank you!

TABLE OF CONTENTS

LIST OF FIGURES…….....vii

LIST OF TABLES…….……..…vii

CHAPTER ONE…….....….1

Historical Perspective and Previous Research…….……..……...….1

Historical Change Over Time…….…….....…3

The Importance of Early Letter-Naming Ability…….…..……...….4

Rationale for Review……..…….…5

CHAPTER TWO…….…….…..……..…7

Early Literacy Skills…….…..……...…7

Handwriting in Early Childhood……..……....….9

Handwriting Evolution…….....10

Critical Features in Early Handwriting…….....12

Why Critical Features in Handwriting…….…...…...…...…13

Letters as Symbols……...…...….16

National Reading Panel and NAEP……..…..…….....17

Alphabet Knowledge…….…….....19

Instruction Alphabets…….…….…….....20

Letter Recognition…….....……..20

Letter-Naming Fluency…….……..….21

Letter-Writing Quality……..…….....….21

Exclusions and Criteria……...…….....22

Discovery……22

Quantitative Experimental Studies……24

Considerations……24

CHAPTER THREE……28

Research Questions……30

Intervention Description (Appendix B) ……31

Settings and Participants……32

FastBridge Assessments……33

FastBridge Letter-Name Assessment……33

FastBridge Phonemic (Onset Sounds) ……34

Timed Letter-Writing Assessment……34

Handwriting Quality Assessment……35

FastBridge Letter Sounds Assessment……35

CHAPTER FOUR……37

Results ……38

Support of the Original Hypothesis……39

CHAPTER FIVE……43

Discovery……43

Implications……45

Limitations……47

Conclusions……48

REFERENCES……50

APPENDICES……77

Appendix A…….…….……...…62

Appendix B…….…….....….....71

LIST OF FIGURES

Figure 1…….…..……..….39

Figure 2 ……..…..……40

Figure 3……...……..……40

Figure 4……...……..41

Figure 5……..……42

LIST OF TABLES

Table 1…….....…….14

Table 2……..……...……..36

Table 3…….…….....38

CHAPTER ONE

INTRODUCTION

Handwriting has been found to be an important developmental component in early literacy skills. Researchers have called for more research addressing the actual development of handwriting (Graham et al., 2015). In our constant evolving technological world there are so many ways to communicate. However, being able to write on paper is an essential skill to practice in school and at home. Non-specific skills often taught during writing instruction for example letter writing in ABC order, have caused many to dismiss writing instruction as important in schools (Graham et al., 2015). Many local school districts are opting to put their priority and instructional focus on reading. Encouraging teachers to prioritize writing in daily literacy blocks as well as reading should be brought to the forefront of curriculum of early literacy instruction.

The purpose of the Critical Feature Handwriting Intervention is to include handwriting instruction in in pre-K classrooms to examine the effect it has on phonemic awareness, letter recognition, and handwriting. The Critical Feature Handwriting Intervention utilizes the critical features identified in Reutzel et al. (2019). Reutzel and colleagues' (2019) research on critical features was used as the framework for the Critical Feature Handwriting Intervention used in this study. The National Association of Educational Progress (NAEP), which began in 1969, puts out an annual report card after reviewing proficiency rates based on literacy skills and writing skills of young Americans. The National Writing Project (NWP) was created in 1974 to seek understanding of the deficiencies identified by NAEP and other organizations. This whole language and phonemic instruction war ensued based on what educators felt were

best practice for instruction of students during the literacy blocks (Whitehurst & Lonigan, 1998).

The National Commission on Writing in America's Schools and Colleges (2002) released a report, The Neglected "R." This report initiated much needed attention on the teaching of writing in schools. This concern for students writing skills was proven to be well deserved given the findings from the (NAEP, 2021). The data reviewed by NAEP (2021) indicated students in middle (8^{th}) and high school (12^{th}) grades were only able to demonstrate partial knowledge of writing skills needed to be considered proficient in writing at their assigned grade level.

Literacy development begins in the early years prior to children's formal education. Students have literacy skills that can be attained prior to entering school (Molfese et al., 2011; Whitehurst & Lonigan, 1998). Young children begin to demonstrate and develop literacy-like behaviors from exposure in their interactions with the environment and through caregivers. Everything one learns is taught and practiced, including speaking, reading, and writing. Subcomponents of literacy such as letter names, letter sounds, and writing can be introduced as soon as students are able to speak and hold a pencil (Molfese et al., 2011; Whitehurst & Lonigan, 1998). These have proven to be the core literacy skills to children becoming successful readers.

Early literacy skills include letter knowledge (being able to identify the letters' name), knowledge of letter-sound correspondences (being able to match the letter sound /k/ with the letter 'k'), phonemic awareness (the ability to segment a word into /k//a//t/), and concepts about print (reading text directionality and book features). Research syntheses consistently find that these early literacy skills, when mastered, can predict

reading development in elementary school. When students develop the ability to identify and write lower-case letters accurately and quickly, it is related to the ability to write fluently and with quality (James & Engelhardt, 2012).

Historical Change Over Time

The need to find best practices and stop the debate of the reading wars lead to the development of the National Reading Panel (2000). This panel was commissioned by the federal government in 1997. Congress asked the National Institute in Childhood Health to work with the U.S. Department of Education in organizing a National Reading Panel to address these issues. The national panel was charged with the task of evaluating existing research and evidence to find the best ways of teaching children to read. The National Reading Panel (2000) found that most emergent readers need phonological awareness to become successful readers. Systematic phonics instruction was also found to assist with the ability to successfully break the code of reading.

Over time and through trials and experimental research, handwriting instruction has been found to help students unpack literacy skills such as directionality, letter recognition, sounds in isolation, and letter-writing fluency (Huot & Perry, 2009). These literacy subskills correlate with decreasing cognitive confusion as students learn to master them early in their educational environments. As students are able to master the skill of fluent writing it has become one of the most important literacy skills that children learn at school. Handwriting is necessary for the child's ability to participate successfully in the classroom. Around 30 to 60 percent of the child's school day is allotted to fine motor activities, with writing as the predominant task (Tseng & Chow, 2000). Addressing

problems early in prewriting skills for young children is crucial to their overall language success.

Over the years there has been a lot of political oversight based on reading. This attention to reading has made it one of the most talked about literacy skills in the press (Rosenblum, 2008). Most parents understand the importance of reading to young children, but do not always recognize the value of writing for their preschool children (Huot & Perry, 2009). Handwriting skills are positively correlated with the ability of young children to recognize letters, write letters fluently, develop phonemic awareness, spelling, and reading skills (Huot & Perry, 2009).

The Importance of Early Letter-Naming Ability

Alphabets and letter naming and its role in preparing children for literacy success has extensive roots in America's public schools (Chall, 1999; Durrell, 1980). There have been several decades of researchers discussing letter naming ability as an essential and important early learning skill (Piasta & Wagner, 2010). As students begin to master letter naming during preschool and kindergarten, the skill becomes a fundamental predictor of children's later literacy skills that contributes to successful reading (Hammill, 2004). The most recent report of the National Early Literacy Panel (2008) found a correlation of r = .54 between early letter knowledge and later decoding, spelling, and reading comprehension skills. These correlations in early letter knowledge and later literacy skills were found to be exclusive of the children's age, socioeconomic status, or IQ.

Knowledge concerning the necessary skills of student's early literacy has increased over the years and can be used to predict and track academic trajectories for children throughout their literacy development (Badian, 1995). This work has established

new and emerging understandings of letters and sounds and how important they all are as predictors of later academic mastery (Jordan et al., 2007). Because of the knowledge of literacy development, most states and local school districts have benchmarks for these concepts (Jordan et al., 2007). Beginning in preschool all the way to high school, academic expectations are set forth by federal, state, and professional organizations, such as "No Child Left Behind." These benchmarks are used to make essential educational and financial decisions for public school funding (National Association for the Education of Young Children, 1998; U.S. Department of Health and Human Services, Administration for Children and Families, 2003). According to the Office of Head Start, which has established such benchmarks for pre-K students, they are to make gains toward identifying at least ten letters of the alphabet (National Association for the Education of Young Children, 1998). Historically, students usually start with learning the letters in their own name (Powell et al., 2008). Students are assessed two to three times a year to measure growth on benchmark tests (Powell et al., 2008). This is a crucial point, given that teachers may be likely to focus instruction on just benchmarked skills without integrating literacy skills into one interdisciplinary literacy block.

Rationale for the Critical Feature Handwriting Intervention

Reutzel et al. (2019) found a relationship between letter-naming and letter-writing fluency. They also found a relationship between letter-naming fluency and successful reading development. They surmised the critical features (similar features in the shapes of letters identified in lower case alphabets) of letters have received less attention as a part of handwriting development and should be looked at further (Reutzel et al., 2019). Components of letter-writing fluency using four related tasks (i.e., identification of

features, writing features, association of letters to features, association sound to letters with same features) with kindergarten students(Reutzel et al., 2019). They demonstrated that recognition and manipulation of critical letter features correlate with letter-writing quality and writing fluency. Their findings suggest that awareness of critical features should be a part of early literacy instruction. Based on the findings of Reutzel et al. (2019), the current study's Critical Feature Handwriting Intervention included these critical letter features to teach to pre-K students.

The Critical Feature Handwriting Intervention is one of the first studies that worked exclusively with three- and four-year-old students in pre-K settings. The priority of Critical Feature Handwriting Intervention was to incorporate early literacy skills, such as letter knowledge, phonemic awareness and handwriting into one intervention based on grouping of letters identified by the features in the Reutzel et al. (2019) study. The critical feature letters were classified for weekly intervention in small groups in two pre-K sites. The Critical Feature Handwriting Intervention and instruction was used to examine the feature's effect on how students learn to recognize and manipulate letters on standardized assessments.

The goal of the Critical Feature Handwriting Intervention was to determine if the category of features influenced the dependent variables of letter name, letter sound, letter writing fluency, letter writing quality, and phonemic awareness.

CHAPTER TWO

LITERATURE REVIEW

Early Literacy Skills

The literature review has revealed handwriting as just one of the important early literacy skills associated with later academic success. The Critical Feature Handwriting Intervention study reviewed studies which examined handwriting in elementary schools. Graham and Weintraub (1996) found that when a child's handwriting is slow and difficult the child's attention is focused mostly on scribing and less on vocabulary. When students write the alphabet by hand, neurological scans show activation in the same area of the brain that is used for reading (Dinehart, 2013). Writing the alphabet by hand appears to activate areas more so than tracing letters or typing of letters (Dinehart, 2013). The range to which this process influences reading development is unknown, (James & Engelhardt, 2012). James and Engelhardt (2012) concluded that writing appears to scaffold the development of reading in young children. Dinehart (2013) aimed to isolate the effect of fine motor manipulation tasks. During the study, the researchers required preschoolers to build with blocks, weave string, lace beads, and cut with scissors (among other tasks). During these fine motor tasks, students were required to imitate strokes, copy letters, copy numbers, and shapes, as well draw simple objects (Dinehart, 2013). Fine motor skills correlated positively with later achievement, and fine motor writing skills in children consistently acted as an indicator of later reading and math skills.

Since the introduction of digital media instruments such as handheld computers, tablets, and cell phones, young children are getting fewer opportunities to develop fine motor skills such as writing prior to entering school (Asher, 2006). In its most basic form,

handwriting is fine motor control, and fine motor activities stimulate the prefrontal cortex of the brain (Asher, 2006). This is the area of the brain that houses elements of self-regulation and executive function. It was found that copying letters and symbols require that children possess or exercise the components of self-regulation, including flexibility, impulse control and working memory (Smits-Engelsman & Niemeijer, 2007).

A positive relationship has been identified between letter-naming and letter-sound fluency, and between letter-writing fluency and phonemic reading development (Paige et al., 2018). These have been shown to be prerequisites for children's success in beginning to develop phonemic awareness (Paige et al., 2018). One significant characteristic of early literacy is children's ability to break the sounds shared by speech and print. Ehri et al. (2009) identified this process through her developmental progression of letter awareness and alphabet knowledge. Young students during this phase may experience cognitive confusion for example letter reversals, therefore it is important that literacy skills are integrated scaffolding students through mastery of skills.

Most children enter school with an adequate vocabulary adequate enough for syntactic understanding and communication. Even though students are successful with many oral language skills, kindergarten students sometimes lack phonological skills and concepts of print. According to the National Center for Education Statistics (2001), the typical kindergarten child entering school in the U.S. is 5.5 years old. Approximately 66% of these children can recognize letters by name at kindergarten entry (National Center for Education, 2000). About the same number of students (60%) know that you start reading on the left and move right, but few can point to the letters representing sounds National Center Education, 2000). State and local school districts set kindergarten

benchmarks and expect them to master a minimum number of sight words and compound words by the end of the year (National Governors Association & Council of Chief State School Officers, 2012). The research indicates that the early basic literacy skills such as letter name and letter sound is needed for most students to master word reading skills (Huot & Perry, 2009).

Handwriting in Early Childhood

Handwriting in the early years of public schools in America was once taught as an independent subject (Bruner, 2010). Throughout the years, students received grades for handwriting on their report cards. Consequently, through educational legislation such as Common Core Standards, handwriting skills have been referred to as fine motor skills, graphomotor skills, and visual-motor integration. Confusions have set in over the years as terms are interchangeably used in the literature. This integration of terms appears to have confused teachers and curriculum specialists to what handwriting looks like in a specific grade level during literacy blocks (Berninger & Fuller, 1992).

The ability to recognize the writing system includes coding of visual symbols specific to symbols of letters, clusters of letters, and words (Smits-Engelsman & Niemeijer, 2007). This is often considered different than visual-spatial processing as measured by copying arbitrary patterns or letters (Reiter, 2017). Writing quickly may feel natural for adults but for young children, handwriting is a complex task. Writing requires coordination of several cognitive, motoric, and neuromotor processes (Reiter, 2017). Writing increases the cognitive development that assist children in understanding alphabetic systems (Reiter, 2017). Handwriting influences letter formation and the perceptual-motor skills that are required for the mastery of writing (Reiter, 2017).

The connection of handwriting and academic achievement has been identified in the literature, however there is little experimental research to support the use of any specific handwriting curriculum. Programs such as Learning (Handwriting) Without Tears (2023) and Zaner-Bloser (2020) are used most often in school settings as a handwriting program especially in the elementary tier (Asher, 2006). Teacher's report using a variety of techniques with little consistency even within districts and school-based sites (Asher, 2006). Handwriting, identified to be crucial, is rarely prioritized by parents or teachers especially with young children (Asher, 2006).

Handwriting Evolution

As computers and other electronic devices have become widespread, handwriting instruction started to decline overall in the last few decades for both adults and children (Dinehart, 2015). In 2012, keyboarding skills in grade three through six became a curriculum standard (Dinehart, 2015). These same 2012 standards did not include any specific references to handwriting as a standard based measure (National Governors Association & Council of Chief State School Officers, 2012). The lack of standards for writing in print or cursive may have communicated to educators and families that handwriting is no longer relevant or important to children's success. Reutzel et al. (2019) found that recognition of letters with similar features and the graphomotor manipulation of the eight critical features used in the writing letters had a positive impact on letter naming. Emergent learners have to develop an awareness of the features that constitute letters, learn the names, and the sound of letters, and develop the motoric skills required to write them. The idea of requiring students to write early, as identified in Dinehart (2019), should direct practitioners to develop and implement literacy programs shown to

be best practice that include writing. Improving fine motor skills and handwriting readiness in the years prior to children entering kindergarten could prove critical to improving academic literacy skills overall. Prior research has consistently demonstrated that girls tend to be better writers than boys among elementary students (Reilly et al., 2019) It also anticipated that these individual differences in handwriting fluency could predict better writing quality (Reilly et al., 2019). Therefore, early handwriting instruction and or intervention with all students prior to kindergarten could positively increase writing quality for all students.

Primary grade students with more fluent handwriting quantitatively test better in written text than students with less fluent handwriting (Graham et al., 2015). The studies examining the relationship between elementary and middle grade have underestimated the contribution of handwriting fluency in the prediction of writing quality (Graham et al., 2015). Additional research is needed to replicate the findings of present studies. Replication should be conducted with a similar representative sample of primary grade students to determine how the relationship between handwriting fluency and writing quality plays out over a longer period of time. When formal handwriting instruction begins in pre-kindergarten or kindergarten, it should prove to be easier for children to become more fluent writers.

Development of fine motor skills necessary for handwriting begins around the same time babies start to grasp and hold items including bottles and toys (Case-Smith, 2002). Initially they begin by using their whole hands as they manipulate objects. Around their first birthday children should be able to use the tips of their thumbs and index fingers. These abilities eventually lead to gripping writing instruments and can be

developed more thoroughly through playing with building blocks, pegboards, dough, push buttons, spinning wheels, zippers, and rings.

Other activities that can be helpful as children continue to increase their fine motor skills include lacing, threading activities, puzzles, squeezing squirt bottles or tension balls. By the ages of two through four children should be taught to recognize and draw lines and shapes (Terepocki et al., 2002). These features include horizontal, vertical, and crossed lines. Circles, squares, and triangles should also be taught to mastery as well. These are the shapes and lines that are essential to writing letters.

Critical Features

The Critical Feature Handwriting Intervention was designed to facilitate handwriting through instructing students to write lower case letters grouped by features. Formation families distinguish letter features that require young writers return to the top of the first line to form necessary strokes in letter writing. Those letters that require moving to a new starting point or those that require clockwise versus counterclockwise curves were also grouped. These abilities eventually lead to gripping writing instruments and can be fostered not only through writing tasks but also through playing with building blocks, pegboards, dough, and motion boards (boards containing push buttons, spinning wheels, zippers, hooped rings) (Reed, 2019). The design and goal of the instruction is to facilitate children until they are able to adequately produce letters freehand with pencil on paper.

According to Graham et al. (2000), first-grade children experiencing handwriting and writing difficulties participated in 27 fifteen-minute sessions designed to improve the accuracy and fluency of their handwriting. In comparison to their peers in a contact

control condition receiving instruction in phonological awareness, students in the handwriting condition made greater gains in handwriting as well as compositional fluency immediately following instruction and six months later. The effects of instruction were similar for students with and without an identified disability. These findings indicate that handwriting is causally related to writing and that explicit and supplemental handwriting instruction is an important element in preventing writing difficulties in the primary grades.

The handwriting variables for both handwriting quality and handwriting fluency improved for students in the experimental group after controlling for pencil grip. Indicating that pre-K students when assisted and scaffolded in a well-designed integrated lesson can learn to write both fluently and with quality. The handwriting quality of the experimental group improved in directionality, writing letters in the correct direction. The other four quality indicators included line position how close the letters were to the line, circle closure and confirming that letters containing circles were closed. Finally, addressing letters containing straight lines, ensuring the letters were straight, neat, and easy to read.

Why Critical Features in Handwriting?

Table 1 contains critical features of letters as identified by Reutzel et al. (2019). These critical features were used as the start point for the Critical Feature Handwriting Intervention.

Table 1

Critical Features based on Reutzel et al. (2019)

v	l	r	f	o	c	n	i
Short line	Long line	Short hook	Long hook	Closed curve	Open curve	Humps	Dot

The difficult skill of learning to write for young children is complex, because it incorporates a variety of sub-skills, including fluency and quality (Olinghouse, 2008). Neuroscience research has indicated that the orthographic movements involved in forming letters in young children compliment the ability for letter-sound correspondences (Gibson & Levin, 1975). These skills such as letter sound correspondence are essential in establishing the connection to beginning reading.

Humans have a unique ability to develop, identify, and produce letters by hand. This ability has been studied as a psychological, educational, and cognitive phenomenon for many years, such as the ability to recognize letters that are distorted (Neisser & Weene, 1960). In addition, children and adults can develop the ability to recognize letters that are a distorted example of what we know as alphabets. Explaining how variations in letters are accommodated in human perception has yielded several theories about this unique human endeavor (Naus & Shillman, 1976). Other theories of letter perception have identified that humans can use their knowledge about letter formation as a type of mechanical function (Freyd, 1983). Based on the literature, it can be concluded that letter recognition includes both awareness of the letter shapes and the motoric memory it takes to create the letter. These skills do more than target shapes, it helps students identify distinctive features of overall letter forms.

The more complex the letter feature, the longer it can take to recognize and write the letter for novice learners (Pelli et al., 2006). So, grouping the letters by features can assist children in not only learning the features of one letter at a time but all letters with the same identified feature. As noted by Grainger (2008), letter features and memory of the features position in the letters are used to develop understanding and letter knowledge. It is this understanding of letters that could lead to feature-based instruction in lower case letters which consist of more complex features. The shape-invariant recognition continues as a major idea of current research on visual object perception (Pelli et al., 2003). This understanding has led to exciting new developments in the central topic of cognitive science. These skills have been shown to lead to success in letter naming and are considered to be a companion to letter writing fluency (Graham & Weintraub, 1996).

Individual strokes or features are observed as the most basic units of letter writing and can be seen as the foundation of writing (Graham & Weintraub, 1996). These strokes and features, range from a single simple form to more complex combinations shapes. Studying the effectiveness of a training method of children learning to produce letters showed that awareness of critical features assists students with discriminating letters from other forms (Graham & Weintraub, 1996). In a recent study of the critical features of letters, Pelli et al. (2006), found that complex letter forms are more difficult to identify than less complex letter forms. The authors discovered that detection of features in letters was an important factor in identifying letters, more than age or experience of students. This includes the overall contrast of a letter to its background, time of exposure to the letter, and how much it varied from other letters in size.

The ability for students to identify and to write lowercase alphabet letters can be measured as predictors of letter writing fluency as observed by (Reutzel, (2019). Letter naming fluency has been shown to be a predictor of reading and also correlates with letter writing fluency. Examining these relationships among these three literacy factors should add to the understanding of how early literacy skills develop and can inform instruction.

Letters as Symbols

An important foundational skill is the understanding of letters and the capacity to write them. This includes many complex configurations of distinctive critical features, which vary in their elements. These elements include simple lines and dots to combinations of lines and curves that are also distinguished by size, orientation, and overlap.

Alphabet and foundational literacy instruction has proven to enhance students' literacy skills when teachers develop methods that integrate names, sound, and written formation of alphabets (Peverly et al., 2014). Jones and Christian (2012) reported scores as points for letter components based on per minute rates of two sub-scores: (a) accuracy of critical feature recognition and (b) the total time to manipulate the features for all letters. They found that this progression for instruction built young learners' knowledge and interest in how letters are formed.

Phonological Awareness

Phonological awareness is defined as the ability to focus on and manipulate phonemes in spoken words (Yopp, 2000). It has been found to be a critical process in learning to read (Yopp, 2000). Phonemic awareness is important in the development of early reading because it helps children to associate sounds with letters, a necessary skill

needed for decoding (Foorman et al., 2003). When children understand that words consist of smaller sound segments, they can be taught to match sounds in words to printed letters. This is an important skill which increases the ability of children being able to sound out written words. Historical and recent research suggests a strong link exists between phonemic awareness and word recognition, which leads to reading comprehension (Adams, 1990).

The literacy process of writing consists of logographic, alphabetic, and orthographic phases, which have been identified in many studies (Adams, 1990). It is important to teach PA skills beginning at an early age (Adams, 1990). These skills should be taught systematically and explicitly (Ehri et al., 2001). For kindergarten children identified in the at-risk category, teaching phonological awareness skills is critical and aides word reading (Foorman et al., 1997). When explicit instruction in letter-sound correspondence is provided to children in early grades, results include substantial improvement in reading ability when compared to no phonemic awareness instruction (Ball & Blachman, 1991).

Findings suggest that even young children can learn multiple letter-sound correspondences and that these can include sounds represented by single letters and those represented by two-letter combinations (Vadasy & Sanders, 2021). It is possible for three and four-year-old with limited literacy knowledge to balance their learning of letter names with letter sounds, opposed to learning only the alphabet exclusively (Vadasy & Sanders, 2021).

National Reading Panel & NAEP

The National Reading Panel (2000) identified the tasks and assessments used to assess phoneme isolation (recognizing individual sounds in words), phoneme identity (recognizing common sounds in different words), phoneme categorization (recognizing the word with the different sound in a sequence of words), phoneme blending (combining them to form a recognizable word), phoneme segmentation (breaking a word into its sounds), and phoneme deletion (what word remains when a phoneme is removed). According to researchers from the National Institute of Health and the U.S. Department of Education, there should be additional research to document literacy development in diverse populations (Nichols et al., 2004). The National Research Panel concluded when teachers are trained in phonemic awareness and explicitly instructed students in phonemic skills, children were more successful on state and local benchmark assessments. Even though some letters were found to be more difficult to learn, consistent and explicit instruction paired with assessment driven planning was found to raise test scores in foundational skills overall (Nichols et al., 2004).

The Report of the National Reading Panel (2000) firmly established phonemic awareness as one of the two best predictors of future reading achievement and as an essential ingredient in evidence-based reading instruction. In a follow-up discussion of the National Early Literacy Panel's (2008) meta-analysis of early literacy research, Phillips and Piasta (2013) noted that phonemic awareness serves as a predictor of the amount and quality of the text's students produce. Phillips and Piasta (2013) found the

ability to write fluently is a significant factor in creativity of thought, organization, comprehensiveness, and clarity of expression in their writing.

In addition, it could be determined that when explicit phonemic awareness instruction based on diagnostic data is provided, it enhances the student's development of phonemic awareness (Nichols et al., 2004). It not only benefits average learners; it also improves reading performance for underperforming students as well (Nichols et al., 2004). This included those from low socioeconomic backgrounds and for those whose primary language is not English. A successful reader must understand conventions and functions of print to become fluent readers (Nichols et al., 2004).

Researchers have found that instruction in alphabet knowledge is beneficial for children (Rachmani, 2020). The ability to recognize letters correlates with successful decoding (Rachmani, 2020). First grade children who are instructed in letter-sound correspondence outperformed students in control groups without letter-sound correspondence instruction both in reading and in spelling measures (Foorman et al., 1991). Blachman et al. (1994) also found that instruction connecting the phonemic segments to alphabet letters yielded beneficial results. Bradley and Bryant (1983) reported an eight-to-ten-month advantage when compared to students who were not taught phonics. Seidenberg and McClelland (1990) concluded even the children who received high scores on phonemic awareness and alphabet knowledge benefited from explicit instruction in decoding as well.

Instruction of Alphabets

Alphabet knowledge over the years has been identified as the single best indicator of the development of successful reading and writing success (National Early

Literacy Panel, 2008). Teaching alphabet knowledge may appear easy for some teachers however, it is a complex skill for young children to master. Letter identification includes being able to differentiate between individual letters and their shapes (features). The research implies this stage of instruction should be taught in conjunction with letter sounds (Dinehart & Manfra, 2013). There is evidence identifying a bidirectional relationship between reading and writing abilities in school-aged elementary children (Graham et al., 2000).

This relationship can be explained by the fact that both processes reading and writing share several literacy subskills, such as the same phonological and semantic systems (Graham et al., 2000). This requires learners to retrieve these components from memory therefore making it a fluent process. Letters are essentially recognized according to their overlap of physical features as an accepted mental model (Petscher et al., 2011). . These matching models take on several shape-exemplars of a given letter and are stored in memory (Pelli et al., 2003). The recognition of these shapes consists of finding the best match between the letter and one of these memories (Pelli et al., 2003). Humans use information about how a letter is constructed as a mechanical function that they then are able to form the letters in writing (Pelli et al., 2003). Using ambivalent characters, Naus and Shillman (1976) found that both physical and functional qualities are processed, and humans develop rules for connecting these two domains cognitively.

Young children appear to learn to recognize letters before learning how to form them by hand (Gibson et al., 1962). From a developmental perspective, Gibson et al. (1962) found that as children progress, their discernment and understanding of the letters motor movement improves. Through various degrees of contortion, children learn the

letter features, their dimensions or differences which are critical for distinguishing letters. At all ages, visual perspective transformations can cause errors, as well as topological transformation that reveals lines and curves (Gibson et al., 1962). Topological transformation allows one to track the different ways that a particular lexical category circulates through the writing (Gibson et al., 1962). Most of the educational researchers agree these are the basics tenants of alphabet knowledge.

Letter-Naming Fluency

Prerequisites and predictors of children's success in beginning to read and in developing phonemic awareness can be traced back to writing fluency and letter-naming fluency (Dinehart & Manfra, 2013). These phases include a logographic phase, which associates oral words with features of print, in addition to alphabetic and orthographic phases. The National Reading Panel's (2000), report emphasized the importance of auditory skills. Hardy et al. (1974) concluded that it is essential for students to understand both auditory and visual concepts. These skills are essential to succeed in early foundational literacy mastery.

The pre-alphabetic phase, as described by Ehri (1992) and Juel (1991), is the phase where children have learned most of the shapes and names of the letters of the alphabet. They have acquired low levels of phonemic awareness that enables them to focus on the beginning and ending sounds in words and in letter names. Data from summative tests on differentiating letters from non-letters is more complex, literate individuals' development a variety of ways to make meaning and understand the complex written structure of the English language (Kalantzis & Cope, 2012).

Within a literate society, a successful individual must have mastered literacy. Developing this skill in early childhood often leads to future success beyond school (Kalantzis & Cope, 2012). These early literacy emergent skills are seen as precursors to skilled writing and fluent reading (Whitehurst & Lonigan, 1998). The contribution of writing and its role in children's literacy development, especially in letter-naming fluency, are therefore the focus of the Critical Feature Handwriting Intervention study.

Letter-Writing Quality

Letter writing quality consists of the ability to write correctly, concise, and neatly. Letter writing quality and letter writing fluency have been found as a predictor of children phonemic awareness skills (Kim et al., 2014). This is especially noteworthy in spelling. This literacy sub skill requires the use of visual cues. The visual cues assist students in performing letters efficiently, legibly, and automatically (Kim et al., 2014). Mastery of letters and the ability to write them consist of students developing the skill as automatic and unconscious over time (Kim et al., 2014). The action of writing letters, or critical characteristics of letters, facilitates the learning of letters (Gibson & Levin, 1975). Word-reading skills are improved through the practice of word writing skills (Gibson & Levin, 1975).

Related Studies

Graham and Sandmel (2011) reviewed twenty-nine experimental and quasi-experimental studies on participants included students in Grades 1–12. The study included copying and writing assessments. Researchers concluded that after early instruction in elementary school, writing instruction and writing fluency improved the

overall quality of writing produced by students in general education classes in upper elementary.

A review from Dinehart (2013) also addressed studies for the effect of handwriting instruction; over 4,000 students participated in the total review. Dinehart (2013) examined distinct types of assessment in this review of handwriting instruction and the results indicated a need for further research in early childhood writing to determine what is important to teach during handwriting instruction that will facilitate writing fluency and writing quality of students. The Ehri et al. (2001) meta-analysis and the National Reading Panel research included students in pre-K through first grade. Fifty-two studies concluded students performed better on writing fluency and phonemic awareness assessments when phonemic awareness was taught with letter recognition and handwriting in the literacy blocks.

A qualitative study for handwriting performed by Huot and Perry (2009) analyzed students' handwriting for quality and fluency. The intention was to assist teachers in creating formative and summative assessment in writing fluency to systematically inform skills taught in the literacy blocks and decrease the individual biases often found in teacher-made assessments evaluating handwriting quality.

One qualitative study for phonemic awareness that aligns closely with the Critical Handwriting Intervention was Fiset et al. (2008). The small features identified in Fiset et al. (2008) represented several spatial scales used to describe or classify the extent, size, or length of letters studied, unlike the lines and dots of Reutzel's critical features. The small features helped readers to discriminate among visually similar letters. The scales were used to assist their writing knowledge and writing quality (Fiset et al., 2008). The Critical

Feature Handwriting Intervention will also use eight identified features to help students visually discriminate and write letters in weekly integrated lessons in the literacy block in the experimental pre-K classroom.

Graham et al. (2000) focused on handwriting instruction with children who had handwriting difficulties and found students who participated in the handwriting instruction in addition to phonemic awareness had higher effects. Molfese et al. (2011), examined name writing and letter writing and found that students who scored higher in letter writing had better letter and word reading scores than name writing scores. This supports the theory that pre-K students can learn to write all letters versus just the letters in their name.

This early literacy phonemic and letter writing instruction support should have long-term beneficial outcomes in early childhood settings. Nichols (2004) found that students who are learning to read need to be taught how to address phonemes and to develop an understanding of letter formation. This phonemic and writing study was two-fold. They began by examining demographic characteristics that included gender, socioeconomics, preschool experience, and race to determine how these factors related to phonemic awareness and concepts of print development for kindergarten students. It was surmised that children from low SES and Latino children are at greater risk of not being successful at phonemic awareness in kindergarten. Additional data collected and analyzed to examine the low SES and Latino children's knowledge of letter recognition and concepts of print development. It was discovered that along with development, a diagnostic approach that guides phonemic awareness instruction, handwriting concepts and print awareness enhances kindergarten students' phonemic awareness.

Considerations

Considering the research that handwriting and phonemic awareness have been identified as a value in all areas of academic learning, schools should provide instructional activities to promote writing fluency along with phonological awareness. This should begin during the first stage of foundation literacy skill instruction. It is indicated that young children learn to recognize letters before learning how to form them (Naus & Shillman, 1976). From a developmental perspective, as children age, they improve in their understanding of letters with different degrees of success (Dinehart, 2015). It should be noted that children learn the letter features and differences of letters which are critical for identifying alphabets (Dinehart, 2015). This development has a progression that might inform instruction. For example, the skill of recognizing uppercase letters, appears to be somewhat easier than perceiving lowercase letters (Dinehart, 2015). As well, hand-written letters that include more complicated letter features are more difficult to identify (Reutzel et al., 2019). It is essential to include mental representatives in support of these higher-order processes in order to facilitate the great cognitive demand which are place on novice learners (Lopez et al., 2022).

In some academic and literate circles across the world, handwriting training for younger children is still controversial such as in Jerusalem where children are taught writing at later ages (Har-Zvi & Lifshitz, 2015). Empirical data and the action of certain principles support the overall merits of establishing a curriculum that integrates handwriting, letter knowledge, and explicit phonics simultaneously in language arts instruction, even in early childhood settings (Har-Zvi & Lifshitz, 2015). Some experts and practitioners have questioned if such a program would result in frustration (Lifshitz

& Har-Zvi, 2015). While others support the idea that it is crucial to prepare children early for the literacy demands through writing skills in school (Har-Zvi & Lifshitz, 2015). The Critical Feature Handwriting Intervention results can be used to lay some of the concern to rest.

In early childhood and elementary settings, writing is often taught in a disjointed way and is disconnected from other literacy material focusing entirely on mechanics, syntax, and grammar (Graham et al., 2000). Often the developmental and academic level of children often dictate the type of exposure to writing they receive during their literacy blocks (Graham et al., 2000). Even when using standardized measures, the effect is moderate to large when at least one writing intervention is included.

Findings from previous studies suggest that explicit integrated instruction benefited students by synthesizing foundational skills that directly influence phonemic awareness and reading content even in the presence a student's reading difficulties (Graham et al., 2000). This research informed the Critical Feature Handwriting Intervention to create an integrated intervention for all students in an early childhood setting. The research suggests high quality programs are essential to the success of early language arts foundational skills. The literature agrees on the basic tenants of literacy which include alphabet knowledge and phonemic awareness as the cornerstone to literacy success (Graham et al., 2000).

The Critical Feature Handwriting Intervention is different from previous research reviewed in that it is being performed solely in an early childhood setting with three- and four-year-old students. The intervention used handwriting as the basis for the components of literacy to also address writing fluency and writing quality. It was concluded that

integrating subcomponents of literacy in one intervention, phonological awareness, letter names, letter sounds was beneficial to students. Previous studies suggest that instructing young students in a comprehensive approach without departmentalizing foundational literacy skills has the potential to increase the number of kindergarten students entering school phonemically aware of letters, sound correspondence, and writing fluency (Har-Zvi & Lifshitz, 2015). Writing and teaching of writing has been shown to contribute to students' growth in handwriting quality and handwriting fluency (Graham et al., 2000). Overall, writing and reading share many similarities but are not identical, and instruction in writing can improve both writing and reading (Graham et al., 2000).

Teachers often dismiss the various literacy strategies such as handwriting due to time and planning. There is a need for educators to understand the influence of handwriting on phonemic awareness and other foundational literacy skills. This understanding has the ability to change the outcomes for instructing young children and provide a new perspective for developing new and effective lesson plans.

CHAPTER THREE

METHODOLOGY

Research Questions

The study and intervention were guided by the five research questions: 1. Does the Critical Feature Handwriting Intervention affect the acquisition of letter names on a standardized measure? 2. Does the Critical Feature Handwriting Intervention affect the acquisition of a letter sound on a standardized measure? 3. Does the Critical Feature Handwriting Intervention impact handwriting fluency on a standardized handwriting assessment? 4. Does the Critical Feature Handwriting Intervention impact handwriting quality on a standardized handwriting assessment? 5. Does the Critical Feature Handwriting Intervention impact phonemic awareness?

Modifications in writing conditions influence handwriting performances in general and for non-automatized beginning writers, it was necessary initially to assist young children in writing skills. The students were taught the tripod grip during the intervention and by the end of the study few needed the extra support. In order to investigate and instruct the students in writing letters it was important to give them a chance to practice the strokes on larger size paper and other mediums until they could control the ability to write letters on lined paper (Gerth, 2016). National Association for the Education of Young Children (singing, talking, reading, writing, and playing) were all integrated into the Critical Feature Handwriting Intervention daily instruction.

The study utilized a standardized assessment called FastBridge Research-Based Assessments Illuminate Education (2018), as a pre- and post-assessment, for letter name, letter sound, and phonemic awareness onset. The assessments for letter recognition

assessed students on knowledge of upper and lower-case letters. The Critical Feature Handwriting intervention taught students in all lower-case letters because of the complex features in the letters as compared to upper case letter with less complex features. Students were assessed for letter writing fluency during a timed two-minute test as they wrote as many letters as possible, they knew without support or visuals. Finally, students were asked to write the letters to the best of their ability, with the support of a visual printout of the letters; they will have a copy of Student Copy Form 1 letters, a pencil, and lined standard 8 x 11 paper.

A rubric was used to assess the quality of their writing. Trained assessors assisted with the rescoring thirty percent of all assessments. Cicchetti (1994) defined 0.4 to 0.59 as fair, 0.60 to 0.74 as good, and above 0.75 as excellent interrater reliability. The pre-test agreement was 77% and 75% for post-assessments for the assessors. Based on the standards of Cicchetti, the correlation as inter-rater reliability the scores of seventy-seven and seventy-five is a good fit. Because the primary researcher scores were more conservative, the decision was to go with the more conservative scores when in question, this decision brought the correlation to 100% agreement on final scores.

The primary researcher trained the assistant assessor to ensure the fidelity of implementations in each day's instruction of critical features and handwriting intervention. The fidelity check included all five components in the Critical Feature Handwriting Intervention. These five indicators were on a checklist that included: 1. Introduce new letters 2. Review all letters sounds and names that were taught in the preceding week. 3. Chant letter names 4. Chant letter sounds 5. Complete a handwriting task. 95% of the time, the fidelity checks included all five components. The training took

place via web video and lasted approximately thirty minutes per session. There were approximately 3 sessions completed during the duration of the intervention in addition to email communication as needed.

Intervention Description

The Critical Feature Handwriting Intervention lasted 8 weeks due to time constraints and access to students in the centers. The lessons per session were 30 minutes to make sure all students were able to complete writing assignments daily. As some of the students were developing fine motor skills to write, the interventionist would assist students as needed 1:1 with the grip to make sure writing tasks were complete that day. The rotation of letters introduced and the features they represent are in Appendix B. The five early literacy practices outlined by the National Association for the Education of Young Children (singing (chanting letters), talking (identifying letters), reading (identify letters), writing (weekly writing of feature letters), and playing (sand, markers, drawing of letters) were all integrated into the Critical Feature Handwriting intervention daily instruction, which are in Appendix B. This type of cyclical instruction design was used to ensure a more developmentally appropriate pace for three and four-year-old students.

The Critical Feature Handwriting Intervention collected data from FastBridge (2018) assessments and writing rubrics were used to examine both the statistical values and the effect sizes of the dependent variables. The dependent variables for the intervention were letter recognition, letter-sound identification, letter writing, letter fluency, and letter writing quality. The FastBridge (2018) assessment was used as a pre-test and post-test to examine the effect of the instruction. It is an empirical observation

instrument designed to yield scores on tasks essential to effective early foundation literacy.

The research conditions for both the control group and the experimental group consisted of daily lessons with their adopted curriculum Frog Street (2020). In addition, the experimental group also participated in the Critical Feature Handwriting Intervention four days a week. The intervention took place over eight weeks, four days a week, thirty minutes a day.

Setting and Participants

Participants for this study consisted of pre-K students (n = 29), with 14 students in control and 15 students in the experimental group. The participants in this study are from families of various socioeconomic statuses (SES). All of which the centers identified as working-class parents. The setting for students in this study in school one attended a private pre-K program at a Church preschool in the suburban area on the southeastern part of the country. It is an early childhood campus with an age range of three to five years old, with approximately sixteen students enrolled in the fall of 2022. The interventionist was able to acquire twelve students from this center. School two was a pre-K site in the urban downtown area of the same city located in the southeastern part of the country. This site's campus enrollment for three- and four-year-old students was approximately thirty. All students in the experimental group and control group were assessed using FastBridge Research-Based Assessments Illuminate Education (2018). The students' ages ranged from three years of age to four years old in each center, with a mean age average of 3.6 at the beginning of the intervention.

Sampling Procedures

The students were randomly assigned using stratified random assignment. The selection consisted of a coin flip to decide the assignment of each participant for each of the two groups (control versus treatment). The sample size was small, both due to enrollment and parental permission. Students from school one was assigned numbers as identification and students from school two were assigned letters for record keeping. There were no payments made to any of the participants or centers and all ethical standards as set forth by the university were met. As a part of universities protocol all participants involved had signed participation by parents and oral permission from students based on protocol for minor children participating in research.

Students in the control group (n =14) were taught by classroom teachers in control group / non-critical feature classrooms, using the Frog Street Pre-K 2020 Curriculum-Dual Language. The Frog Street Curriculum focuses on letter recognition during the early spring. A total of fifteen students in the experimental (seven in school one and eight in school two) group received Critical Feature Handwriting Intervention four times a week, in addition to the Frog Street Curriculum. A room was provided for the interventionist to conduct assessments and intervention in both centers. The students were pulled from their classes prior to their daily instruction to meet with the Critical Feature Handwriting interventionist. Room assignments changed in both schools during the course of the intervention based on what was happening in the centers. School one had an onsite reading specialist which worked with pre-K teachers to make sure the Frog Street Curriculum was implemented correctly. She did not work or interact with the students in an academic capacity. Her role was to make sure teachers are adequately

trained on the Frog Street Pre-K 2020 Curriculum, Dual-Language. School two did not have a full-time teacher until three weeks into the intervention.

FastBridge Letter-Name Assessment

The Fast Bridge Letter Name Assessment (2018) was used to answer research Question 1. Does the Critical Feature Handwriting Intervention affect the acquisition of letter names on a standardized measure? The materials include Screening Form 1, the test of letter names. FastBridge Early Reading assessments (2018) were conducted using pencil and paper procedures. The test of letter names begins with a student practice by asking the students to tell the assessor the name of each letter. There is a practice page in front of the student with the letter 'f' and 's' on it. It began with, "what is the name of this letter?" Then, the assessor points to the letter 's.' The assessor checks the students to see if they are correct and provides feedback if they are not. If the answer was incorrect the assessor says, "The name of this letter is "s" and encourages students to say it along with them. If students do not know the name of a letter, they are assured that it is okay and encouraged to just do their best. They then move on to the battery of letters and complete the assessment. The assessor records correct letter names on the scoring sheet as well as errors the students make. The reported test-retest reliability for kindergarten grade level assessments as reported by FastBridge is .74.

FastBridge Phonemic Awareness Assessment (Onset Sounds)

The FastBridge Phonemic Awareness Assessment was used to answer the research question 2, does the Critical Feature Handwriting Intervention affect the acquisition of phonemic awareness? This is an open-ended assessment and is not a timed test. The assessor gives students five seconds to respond to each item before moving on.

The material for the phonemic awareness assesses included Student Form A. The assessment begins with a student practice page. The practice page has pictures of a key, bat, dolphin, and water and placed in front of the student. The assessor points to the picture and asks the student to look at the pictures. The assessor tells the students "This a key, bat, dolphin, and water. Which one of the words begins with the /k/?" If the student gets this incorrect, the assessor points to the key and says "This begins with /k/, then moves to the next picture. The assessor began by stating "Let us try another one. Tell me which word begins with the /b/ sound?" Repeat, if necessary, until the child can identify the sound and understands the concept. Begin the assessment and continue through 16 items. The range for the Onset Assessment was 0-16. The FastBridge kindergarten test-retest reliability is .74.

Timed Letter Fluency Assessment

Timed Letter Writing Assessment is a two-minute timed assessment. This is an assessment of letter writing fluency to analyze data for research question 3. Does the Critical Feature Handwriting Intervention impact handwriting fluency on standardized handwriting assessment? The process used for letter fluency included giving students two minutes to write as many letters as possible. If the letters are recognizable, one point is awarded for every letter the student produces, with the range of points being 0-52. Capital letters are accepted as letters as well even though the intervention did not include capital letters. The reported test-retest reliability for kindergarten for the assessment is .74.

Letter-Transcribing for Handwriting Quality Assessment

This assessment provided data to address research question 4. Does the Critical Feature Handwriting Intervention impact handwriting quality on a standardized

assessment? The quantitative data collected from this assessment came from the rubric evaluating the Test of Writing Quality. The writing quality of all twenty-six letters was based on five categories aligned with the critical features. The five screening categories to evaluate quality in writing were: 1. Directionality, 2. Line Position, 3. Circle Closure, 4. Straight Lines, 5. Neatness. Each of the categories are on a scale of 0-4. With 0 = weak, 1 = poor, 2 = fair, 3= good, and 4 = outstanding. The total possible score for this assessment is 20. Process: the students each have a copy of Form 1, and they have lined up tablet paper to write letters on. Untimed, they are asked to write the letters from Form 1. The students can complete assessment at their own pace, and the test does not discontinue if the student is unable to finish within a reasonable time frame. This can be administered to the whole class. However, all Critical Feature Handwriting Intervention assessments were administered 1:1 with the students in both centers.

FastBridge Letter-Sound Assessment

This is a timed test (two minutes), which was used for collecting data for research question 5, does the Critical Feature Handwriting Intervention impact phonemic awareness? The test of letter sounds practices page and assessment have both uppercase and lowercase letters. After completing the practice page, form one is placed in front of the children and the assessor says, “You will tell me the sound of each letter. If you do not know the sound of a letter, that’s okay. Just do your best.” Accordingly, the students say the sound for as many letters as possible in the two-minute time frame.

Below in Table 2 is the research condition outline for the control group and experimental groups in the Critical Feature Handwriting Intervention.

Table 2

Research Conditions

Control Group	***Experimental Group***
Frog Street Curriculum	Frog Street Curriculum
Usual Curriculum	Critical Feature Intervention
No Handwriting Task	Weekly Grouping of Letters
Based on Critical Features	Introduction/Review
	Chant: Names
	Chant: Sounds
	Writing Task (letters)
	(mediums, markers, sand,
	tablet, pencil and paper)

CHAPTER FOUR

RESULTS

A check for normality using the Shapiro-Wilk was conducted. Based on Shapiro-Wilk analysis letter name pre and post as well as letter sound pre and post were found to be normally distributed. However, based on skewness and kurtosis scores only pre-handwriting fluency was not normally distributed. All others were normally distributed with letter sounds exceeding the kurtosis value above 2 yet its skewness was within 2 (George & Mallery, 2021). Taken together, it can be said that data was normally distributed.

Below you will find the descriptive data of the Critical Feature Handwriting Intervention pre and post. The line charts that follow represent post outcomes for each variable assessed and explained by means and effect sizes.

Table 3

Descriptive statistics for pre and posttest for the Critical Feature Handwriting Intervention and control group.

	Critical Feature Handwriting Intervention $n = 15$				Control $n = 14$			
	Pretest		Posttest		Pretest		Posttest	
	M	*(SD)*	*M*	(SD)	*M*	(SD)	*M*	(SD)
Letter Names	16.3	(11.26)	23.69	(13.44)	18.6	14.2	21.1	(17.09)
Letter Sounds	2.63	(3.74)	13.69	(7.85)	6.92	8.6	8.33	(11.781)
HW Fluency	1.81	(2.64)	11.5	(2.7)	5.92	7.6	5.83	(8.8)
HW Quality	4.00	(3.2)	9.50	(4.88)	7.2	6.5	4.83	(6.28)
Phonemic Awareness	6.93	(4.4)	12.8	(4.097)	6.75	5.5	7.0	(5.7)

Note: HW = handwriting.

Pretest Differences between Conditions

To examine the equivalency of the groups at pretest, ANOVA were conducted on each outcome at pretest. The groups were not significantly different on letter names (F (1, 29) =.223, p = .641), letter sounds (F (1, 29) = 3.211, p = .085), handwriting fluency (F (1, 29) = 4.018, p = .005), handwriting quality (F (1, 29) = 2.59, p = .120), and phonemic awareness (F (1, 29) = .012, p = .915) at the pre-test phase. However, it should be noted that the sample sizes were low, and the tests may not have been powered up enough to detect significant differences between groups pre-intervention.

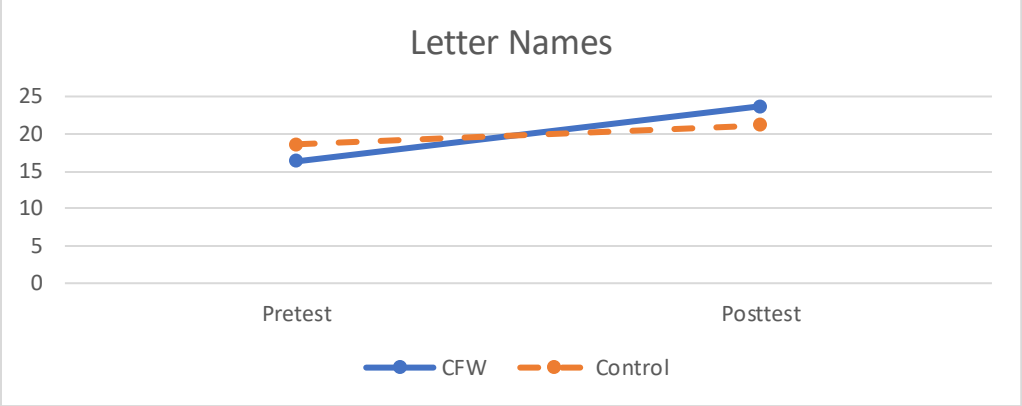
Posttest Outcomes for Critical Feature Handwriting Intervention

Letter Names. For the letter names outcome, the Critical Feature Handwriting Intervention performed better than the control group. An ANCOVA using pretest as a

covariate showed that the Critical Feature Handwriting Intervention did have a statistically significant effect on the student's ability to write letter names (F (2, 27) = 3.019, p = .005) with a moderate effect g = 0.563, compared to the control group.

Figure 1

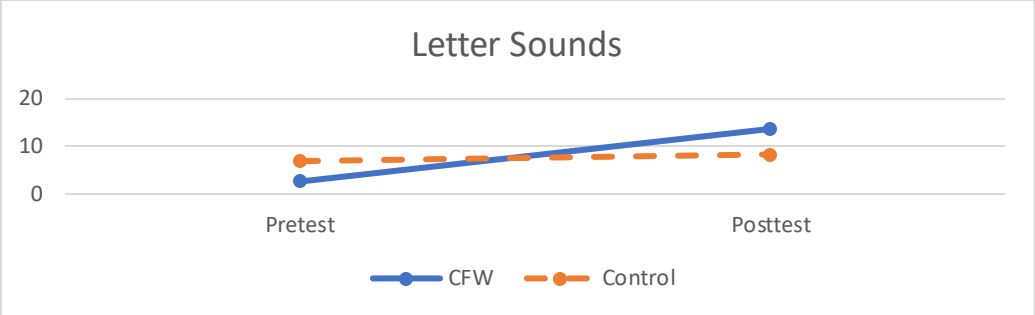
Difference Between Critical Feature Handwriting Intervention and Control Group for Letter Names



Letter Sounds. For the letter sounds outcome, the Critical Feature Handwriting Intervention group performed better than the control group on the letter sounds outcome. ANCOVA using pretest as a covariate showed that the Critical Feature Handwriting Intervention had a statistically significant effect on the students' letter sound knowledge, (F (2,27) = 4.690, p = .000), with a large effect, g = 0.874, compared to the control group.

Figure 2

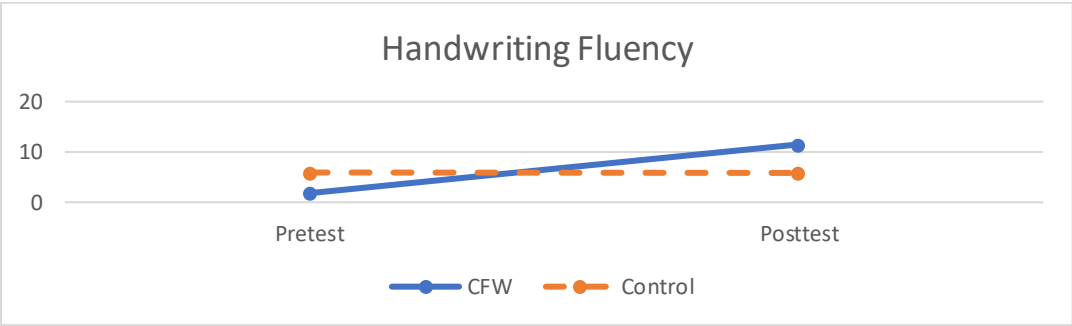
Difference Between Critical Feature Handwriting Intervention and Control Group for Letter Sound



HW Fluency. For the HW Fluency outcome, the Critical Feature Handwriting Intervention group performed better than the comparison group. For the HW Fluency outcome, an ANCOVA using pretest as a covariate showed that the Critical Feature Handwriting Intervention had a statistically significant effect on the students' HW fluency, (F (2, 27) = 3.933, p = .001), with a moderate effect, g = 0.733, compared to the control group.

Figure 3

Differences between Critical Feature Handwriting and Control Group for Handwriting Fluency

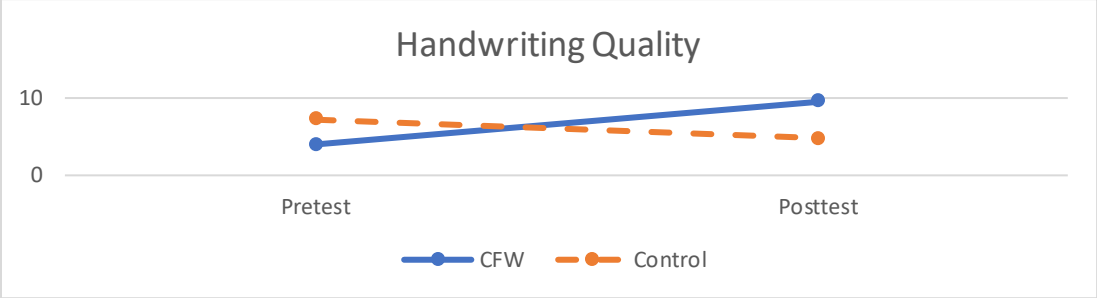


HW Quality. For the HW Quality outcome, the Critical Feature Handwriting Intervention group performed better than the comparison group. For the HW Quality outcome, an ANCOVA using pretest as a covariate showed that the Critical Feature

Handwriting Intervention had a statistically significant effect on the students' handwriting quality, ($F(1, 29)$ = 3.224 p = .003), with a moderate effect, g = 0.601, compared to the control group.

Figure 4

Difference Between Critical Feature Handwriting Intervention and Control Group for Handwriting Quality

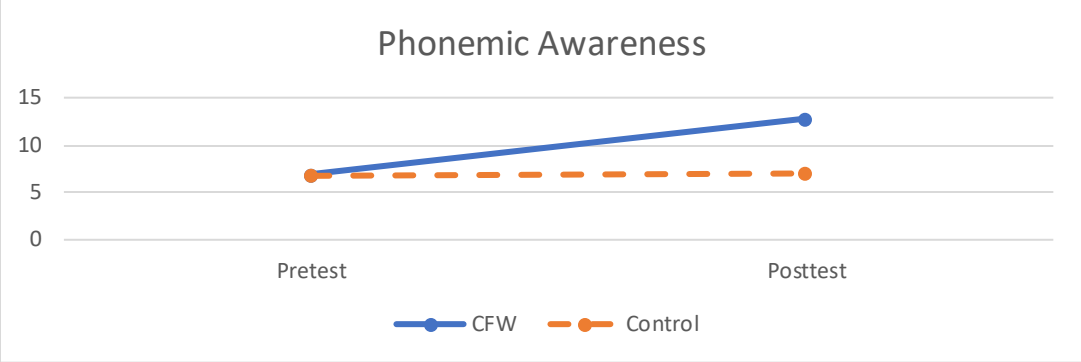


Phonemic Awareness (Onset). For the Phonemic Awareness outcome, the Critical Feature Handwriting Intervention group performed better than the comparison group. For the Phonemic Awareness outcome, an ANCOVA using pretest as a covariate showed that the Critical Feature Handwriting Intervention had a statistically significant effect on the students' Phonemic Awareness, (F (2, 27) = 4.132, p = .000), with a moderate effect, g = 0.770, compared to the control group.

Post assessment intervention group handwriting quality improved in directionality by writing letters in the right direction. The intervention group improved in the ability to write straight lines neatly. They also improved in the task of letter closure. Overall, their writing was neater and easier to identify.

Figure 5

Difference Between Critical Feature Handwriting Intervention and Control Group for Phonemic Awareness



CHAPTER FIVE

DISCUSSION

The Critical Feature Handwriting Intervention within a pre-K setting is unique compared to the research reviewed for this study. The research literature was searched to identify variables that integrated phonemic awareness and letter knowledge with handwriting fluency and quality in one intervention. The Critical Feature Handwriting Intervention integrated these key components into one intervention. Santangelo and Graham (2016) conducted a meta-analysis which included studies addressing handwriting quality and handwriting fluency in kindergarten and first grade. The studies in this meta-analysis showed similar effect sizes in handwriting fluency and handwriting quality as the Critical Feature Handwriting Intervention. This review included several studies addressing both handwriting quality and handwriting fluency including the program Learning (Handwriting) Without Tears, 2023, which was designed to support the progression of a child's fine motor skills along with visual skills through fun and interactive activities. The effects on handwriting quality were moderate to large, $d = 0.77$. The Critical Feature Handwriting Intervention examined in this study demonstrates that this integrated approach to handwriting and phonemic awareness instruction could significantly increase young children's foundational literacy skills.

Graham, (2000) found that handwriting quality and fluency has moderate effects, $d = 0.54$, $d = 0.72$ comparing handwriting instruction to phonological instruction in first grade. The Critical Feature Handwriting Intervention's effect sizes for handwriting fluency, $g = 0.73$, and handwriting quality, $g = 0.60$, were similar, falling with the moderate to large effect range. There are correlational studies that use critical features to

look at handwriting quality and or handwriting fluency in kindergarten and first grade classrooms such as Reutzel al. (2019). However, no study, has examined the effects on the five variables used in this study. The uniqueness of this study adds to the current literature and encourages literacy teachers and researchers to seek this integrated approach.

As noted by Grainger (2008), letter features and their position in letter information are used in developing letter perception. This is supported by the findings in the Critical Feature Handwriting Intervention as the experimental group outperformed students in letter names who did not have features in their instruction. It is this level of sophistication that might enable feature-based models to better account for patterns in the empirical data such as letter confusion (Grainger, 2008). Research on human perception of letters that attends to distinctive features may serve to elucidate this gateway to early reading based on the phonemic awareness effect size in the Critical Feature Handwriting Intervention, $g = 0.77$, where phonemic awareness acts as a precursor to early reading according to the National Reading Panel (2000). Ehri posited a developmental progression of letter awareness which begins with pre-alphabetic stage. This stage of pre-alphabetic focuses initially on students making a visual connection through visual clues before learning to attach the names or sounds. Introducing students to letters that have similar features correlates positively to writing letters and identifying them from sight. The Critical Feature Handwriting Intervention used this premise of features to support the students in the experimental group resulting in an effective outcome. In addition to letter naming and sound production another potential component of both letter recognition and letter writing fluency is the ability to distinguish critical features of letters and attach

them to other subcategories of literacy, including the letter names and letter sounds by chanting them daily.

The five early literacy practices outlined by the National Association for the Education of Young Children (singing, talking, reading, writing, and playing) were all integrated into the Critical Feature Handwriting Intervention daily instruction. According to the research of early childhood, listening, speaking, reading, and writing contribute to the relationship between letters and sounds (Reutzel et al., 2019). Practitioners can intervene early in pre-K classrooms to reduce the cognitive load of young children by synthesizing literacy skills that directly impact pre-reading success.

Implications

These outcomes of the Critical Feature Handwriting Intervention align with other literature reviewed. Results suggest that explicit integrated instruction benefited students by synthesizing foundational skills that directly influence phonemic awareness, letter names, letter sounds and handwriting. The research suggests high quality programs are essential to the success of early language arts foundational skills. The culminated claims in the literature suggest these skills are the cornerstone to all literacy success. The students who participate in handwriting instruction in addition to phonemic awareness had higher scores (Molfese et al., 2011). Students who scored higher in letter writing scores correlated strongly to letter and word reading scores than name writing scores. This supports the theory that pre-K students can learn to write all letters, not just the letters in their name. Awareness of critical features may precede letter identification and letter forming speed. In a more recent study of the critical features of letters found that complex letter forms are more difficult to identify than less complex letter forms (Pelli et

al., 2006). According to these authors, critical feature detection was a significant factor in identifying letters, even more important than age of reader, experience of reader, and duration of exposure to the letter. It is assumed that letter recognition subsumes both their shapes and motoric memory of uniform forms. The Critical Feature Handwriting Intervention contained these key practices of handwriting and critical feature analysis, and students gained foundational literacy skills.

The Critical Feature Handwriting Intervention results support the correlation between letter-naming and letter-writing fluency found in other studies (Reutzel et al., 2019). Findings suggest that awareness of critical features could be a part of early literacy instruction. Overall, this serves as a call for researchers to continue examining the role of handwriting in the early education and development of young children and for practitioners to develop and implement interventions for teaching early handwriting or handwriting 'readiness' skills in early childhood (Dinehart &Manfra, 2013).

Like the Critical Feature Handwriting Intervention in which results demonstrated improved quality and fluency in writing, the children in Graham et al. (2000), also improved. This included students with handwriting difficulties that participated in 27 fifteen-minute in comparison to their peers in a contact control condition receiving instruction in phonological awareness only. The students in the handwriting condition made greater gains in handwriting as well as compositional fluency immediately following instruction and 6 months later. The effects of instruction were similar for students with and without an identified disability. These findings indicate that handwriting is causally related to writing and that explicit and supplemental handwriting

instruction is an important element in preventing writing difficulties in the primary grades.

The Critical Feature Handwriting Intervention experimental group improved over time in pencil grip as well as writing quality. The Critical Feature Handwriting students' quality in the experimental group improved specifically in directionality and writing letters in the correctly. The other four quality indicators included line position how close the letters were to the line, circle closure and confirming that letters containing circles were closed. This correlates with Graham et al. (2000) findings as well.

Study Limitations and Future Research

The Critical Feature Handwriting instruction should be expanded for more diverse group of writers. Students in this study were from two private pre-schools and generalizations cannot be made to other types of programs (e.g., public pre-school) or the demographics of the students who participated in this study. Future studies with the intervention should be conducted in more schools with a larger diversity of children.

Future experimental research should include the same Critical Feature Handwriting Intervention model with scripted and explicit instruction in writing of letters implemented by a pre-school teacher. This would demonstrate whether the intervention can be conducted by teachers of record. Another limitation of the study design was the control group used. The control group had no handwriting or phonemic awareness instruction as identified in the Frog Street curriculum during this time frame as a closer comparison of groups. Researchers should compare the Critical Feature Handwriting intervention to a pre-k curriculum with a stronger phonemic awareness component. In addition, an analysis of the control group's current curriculum would give a better lens

into the comparison by understanding the scope and sequence of Frog Street or current curriculum. It would be informative to know the scope and sequence of the Frog System Curriculum and what letters are taught over what length of time, when and how they introduce handwriting. This would give researchers better insight into the comparison of instructional practices, when compared to the Critical Feature Handwriting intervention.

Conclusion

Santangelo and Graham (2016) concluded when specific skills in writing are taught, reading improves and that writing needs to be explicitly taught. Graham et al. (2021) also found that forming letters by hand while learning sounds activates reading circuits in the brain that promote literacy. The best solution for reading results is early intervention (Lopez-Escribano et al., 2022). The Critical Feature Handwriting Intervention started with children as young as three years old, expecting them to learn to identify letters, write letters, identify sounds, and write fluently. This high expectation for young learners may have contributed to the success of the intervention. English is an opaque orthography, and the development of decoding requires knowledge of graphemes and phonemes. This approach when working with young children should be a comprehensive approach considering the written structure of words.

Gough and Hillinger (1980) and Mason (1980) concluded that when developing the pre-reading skills of young children, the introduction to phonology should be the starting point. The Critical Feature Handwriting intervention implemented a phonological protocol in the daily instruction by chanting letter sounds. Knowledge of phoneme, vocabulary, and letter fluency is the foundation. The Report of National Reading Panel (2000) found that phonemic awareness helped all types of children improve in their

reading, including disabled readers, preschoolers, kindergarteners, and student's 1st thru 6th grade. Nichols et al. (2004) found that powerful predictors of children beginning reading is the development of phonemic awareness and concepts of print. Because phonemic awareness is so important and there were no studies identified in the literature on preschool students, the Critical Feature Handwriting Intervention was developed and examined in a pre-K setting. This allowed for phonemic awareness to be integrated in the Critical Feature Handwriting Intervention in the early stages of children foundation literacy skills and pre-reading ability.

REFERENCES

Adams, M. J. (1990). *Beginning to read*. Cambridge, MA: Massachusetts Institute of Technology.

Asher, A. V. (2006). Handwriting instruction in elementary schools. *The American Journal of Occupational Therapy, 60(4),* 461-471. https://doi.org/10.5014/ajot.60.4.461

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling?. *Reading research quarterly*, 49-66.

Blachman, B. A. (1994). What we have learned from longitudinal studies of phonological processing and reading, *and* some unanswered questions: A response to Torgesen, Wagner, and Roshotte. *Journal of Learning Disabilities, 27*(5), 287–291. https://doi.org/10.1177/002221949402700504

Bradley, L. & Bryant, P.E. (1983). Categorizing sounds and learning to read: A casual Nature, 301(5899), 419 -421. https://psycnet.apa.org/doi/10.1038/301419a0

Brigance, A. H. (2008). *Brigance diagnostic inventory of early development II*. Curriculum Associates.

Badian, N. A. (1995). Predicting reading ability over the long term: The changing roles of letter naming, phonological awareness, and orthographic processing. *Annals of Dyslexia, 45(1),* 79-96. https://www.jstor.org/stable/23765369

Berninger, V., & Fuller, F. (1992). Gender differences in orthographic, verbal, and compositional fluency: implications for assessing writing disabilities in primary grade children. *Journal of School Psychology,30(3),*363-382. New York: Sage

Publications

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read a causal connection. *Nature*, *301*(5899), 419-421.

Bruner, J. S. (2010). *The process of education*. Harvard University Press

Case-Smith, J. (2002). Effectiveness of school-based occupational therapy intervention on handwriting. *The American Journal of Occupational Therapy, 56(1*), 17–25. https://doi.org/10.5014/ajot.56.1.17

Chall, J. S. (1999). Commentary: Some thoughts on reading research: revisiting the First-Grade Studies. *Reading Research Quarterly* 34(1), 64-77.

Children, G., Perfetti, C. A., Beck, I., Bell, L. C., & Hughes, C. (1982). Invitational Issue: *Children's Reading and the Development of Phonological Awareness 33(3*, 16-24. https://doi.org/10.1093%2Fdeafed%2Fenr043

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284–290. https://doi.org/10.1037/1040-3590.6.4.284

Dinehart, L. H. (2015). Handwriting in early childhood education: Current research and future implications. *Journal of Early Childhood Literacy 15(1)* 97–118. https://doi.org/10.1177/1468798414522825

Dinehart, L., & Manfra, L. (2013). Associations between low-income children's fine motor skills in preschool and academic performance in second grade. *Early Education and Development, 24(2)* 138–161. https://doi.org/10.1080/10409289.2011.63672

Durrell, D. D. (1980). Commentary: Letter-name values in reading and spelling. *Reading*

Research Quarterly, 16(1), 159-163. https://doi.org/10.2307/747753

Ehri, L. C., Satlow, E., & Gaskins, I. (2009). Grapho-phonemic enrichment strengthens keyword analogy instruction for struggling young readers. *Reading and Writing Quarterly, 25(2–3),* 162–191. https://doi.org/10.1080/10573560802683549

FastBridge (2018). Letter name, letter sound & phonemic awareness. https://fastbridge.illuminateed.com/hc/en-us

Fiset, D., Blais, C., Thier-Majcher, C. E., Arguin, M., Bub, D., & Gosselin, F. (2008). Features for Identification of Uppercase and Lowercase Letters. Florida Department of Education. (2009). *Florida Assessments for Instruction in Reading (FAIR).*

Foorman, B. R., Francis, D. J., Fletcher, J. M., Schatschneider, C., & Mehta, P. (1997). The role of instruction in learning to read: Preventing reading failure in at-risk children. *Journal of Educational Psychology, 90(1),* 37–55. https://psycnet.apa.org/doi/10.1037/0022-0663.90.1.37

Freyd, J. J. (1983). The mental representation of movement when static stimuli are viewed. *Perception & Psychophysics, 33(6),* 575-581. https://doi.org/10.3758/BF03202940

George, D., & Mallery, P. (2021). *IBM SPSS statistics 27 step by step: A simple guide and reference*. Routledge.

Gibson, E. J., & Levin, H. (1975). *The psychology of reading*. The MIT press.

Gough, P. B., & Hillinger, M. L. (1980). Learning to read: An unnatural act. *Bulletin of the Orton Society, 30,* 179–196. https://doi.org/10.1007/BF02653717

Graham, S., Hebert, M., & Harris, K. R. (2015). Formative assessment and writing: A meta-analysis. *The Elementary School Journal, 115(4),* 523-547. https://doi.org/10.1086/680460

Graham, S., & Sandmel, K. (2011). The process writing approach: A meta-analysis. *The Journal of Educational Research*, *104*(6), 396-407.

Graham, S., Harris, K. R., & Fink, B. (2000). Is handwriting causally related to learning to write? Treatment of handwriting problems in beginning writers. *Journal of Educational Psychology, 92*(4), 620–633. https://doi.org/10.1037/0022-0663.92.4.620

Graham, S., & Weintraub, N. (1996). A Review of Handwriting Research: Progress and Prospects from 1980 to 1994. *Educational Psychology Review, 8(1),* 33-42. https://www.jstor.org/stable/23359270

Graham, S., Skar, G. B. U., & Huebner, A. (2021). Learning loss during the COVID-19 pandemic and the impact of emergency remote instruction on first grade students' writing: A natural experiment. *Journal of Educational Psychology*. https://doi.org/10.1037/edu0000701

Graham, S. & Santangelo, T. (2011). A comprehensive meta-analysis of handwriting. *Educational Psychology Review*, *28*, 225–265. DOI: 10.1007/s10648-015-9335-1

Granger, J. (2008). Cracking the orthographic code: An introduction. *Language, Cognition and Neuroscience. 23:1,* 1-35.

Har-Zvi, S. & Lifshitz, N. (2015). A comparison between students who receive and who do not receive a writing readiness intervention on handwriting quality, speed and

positive reactions. *Early Childhood Education Journal*, *43*, 47-55.

Hardy, M., Stennett, R. G., & Smythe, P. C. (1974). Development of auditory and visual language concepts and relationship to instructional strategies in kindergarten. *Elementary English, 51(4)*, 525-532.

Heilman, A. W., Blair, T. R., Rupley, W. H. (2002). Principles and Practices of Teaching Reading. United Kingdom: Prentice Hall.

Heilman, A. W., Blair, T. R., & Rupley, W. H. (1990). *Principles and practices of teaching reading*. Prentice Hall.

Heilman, A.W. et al. (2020). Assessing functional language. ASHA journals. Media. https://doi.org/10.23641/asha.12456719.v1

Huot, B. & Perry, J. (2009). *Toward a new understanding of classroom writing assessment.* In Beard, R. & Mayhill, D. (Eds.), The sage book of writing development. (pp. 422-531). Sage

James, K. H., & Engelhardt, L. (2012). The effects of handwriting experience on functional brain development in pre-literate children. *Trends in Neuroscience and Education, 1(1),* 32-42. https://doi.org/10.1016/j.tine.2012.08.001

Jones, D., & Christensen, C. A. (1999). Relationship between automaticity in handwriting and students' ability to generate written text. *Journal of Educational Psychology, 91(1),* 44-49. https://doi.org/10.1037/0022-0663.91.1.44

Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first-grade math achievement from developmental number sense trajectories. *Learning Disabilities Research & Practice, 22(1*), 36-46.

https://psycnet.apa.org/doi/10.1111/j.1540-5826.2007.00229.x

Juel, C. (1991). Beginning reading. *Handbook of reading research, 2*, 759-788.

Karl, J. M., & Whishaw, I. Q. (2014). The contribution of the reach and the grasp to shaping brain and behaviors. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *68*(4), 223.

Kim, H. S., Kil, H. J., & Shin, A. (2014). An analysis of variables affecting the ICT literacy level of Korean elementary school students. *Computers & Education*, *77*, 29-38.

Learning (Handwriting) Without Tears (2023). https://www.lwtears.com/sites/default/files/2022-12/header-lwt-logo.svg

López-Escribano, C., Martín-Babarro, J., & Pérez-López, R. (2022). Promoting handwriting fluency for preschool and elementary-age students: Meta-analysis and meta-synthesis of research from 2000 to 2020. *Frontiers in Psychology, 13,* 1-16. https://doi.org/10.3389/fpsyg.2022.841573x.

Mason, J. M. (1980). Intervention procedures for increasing preschool children's interest in and knowledge about reading. *Center for the Study of Reading Technical Report; no. 312*.

Molfese, V. J., Beswick, J. L., Jacobi-Vessels, J. L., Armstrong, N. E., Culver, B. L., White, J. M., Ferguson, M. C., Rudasill, K. M., & Molfese, D. L. (2011). Evidence of alphabetic knowledge in writing: Connections to letter and word identification skills in preschool and kindergarten. *Reading and Writing, 24(2),* 133–150. https://doi.org/10.1007/s11145-010-9265-8

Müller-Steinhardt & Weidmann, C. (2012). Characteristics of lapsed German whole blood donors and barriers to return four years after the initial donation. *Transfusion medicine and hemotherapy*, *39*(1), 9-15.

National Writing Project. (2010). *Analytic Writing Continuum*. Berkely, CA: National Writing Project.

Naus, M. J. (1976). Why a Y Is Not a V: A New Look at the Distinctive Features of Letters. *Journal of Experimental Psychology: Human Perception and Performance, 2(3),* 45-51.

Naus, M. J., & Shillman, R. J. (1976). Why a Y is not a V: A new look at the distinctive features of letters. *Journal of Experimental Psychology: Human Perception and Performance, 2(3*), 394. https://psycnet.apa.org/doi/10.1037/0096-1523.2.3.394

Neisser, U., & Weene, P. (1960). A note on human recognition of hand-printed characters. *Information and Control, 3,* 46-52.

Nichols, S. et al. (2004). Semantics, cross-cultural style. *Cognition, 92(3),* B1-B12. https://doi.org/10.1016/j.cognition.2003.10.003

National Association for the Education of Young Children. (1998). *Learning to read and write: Developmentally appropriate practices for young children*. International Reading Association.

National Commission on Writing in America's Schools and Colleges. (2003). *The neglected "R": The need for a writing revolution. The report of the National Commission on Writing in America's Schools and Colleges*

National Governors' Association. Center for Policy Research, & United States. Defense

Civil Preparedness Agency. (2012). *Comprehensive emergency management: A governor's guide*. [Department of Defense], Defense Civil Preparedness Agency.

.

Paige, D. D., Rupley, W. H., Smith, G. S., Olinger, C., & Leslie, M. (2018). Acquisition of letter naming knowledge, phonological awareness, and spelling knowledge of kindergarten children at risk for learning to read. *Child Development*. https://doi.org/10.1155/2018/2142894

Pelli, M. D., et al. (2006). Processing emotional tone from speech in Parkinson's disease: A role for the basal ganglia. *Cognitive, Affective, & Behavioral Neuroscience, 3(4),* 275-288. https://doi.org/10.3758/CABN.3.4.275

Petscher, Y., Kim, Y. S., & Foorman, B. R. (2011). The importance of predictive power in early screening assessments: Implications for placement in the response to intervention framework. *Assessment for Effective Intervention, 36(3)*, 158–166. https://doi.org/10.1177/1534508410396698

Peverly, S. T., Garner, J. K., & Vekaria, P. C. (2014). Both handwriting speed and selective attention are important to lecture notetaking. *Reading and Writing, 27(1),* 1–30. https://doi.org/10.1007/s11145-013-9431-x

Reid, T., & Parkinson, B. (2019). *Teaching literature in a second language*. Edinburgh University Press.

Reilly, D., Neumann, D. L., & Andrews, G. (2019). Gender differences in reading and writing achievement: Evidence from the National Assessment of Educational Progress (NAEP). *American Psychologist, 74(4),* 445–458. https://doi.org/10.1037/amp0000356

Reiter, B. (2017). Theory and methodology of exploratory social science research. https://ijsrm.humanjournals.com/2017/02/

Olinghouse, N. G. (2008). Student- and instruction-level predictors of narrative writing in third-grade students. *Reading and Writing, 21(1-2*), 3-26. https://doi.org/10.1007/s11145-007-9062-1

Piasta, S. B. (2018). Assessment of young children's letter-sound knowledge: Initial validity evidence for letter-sound short forms. *Assessment for Effective Intervention, 43(4),* 249–255. http://doi.org/10.117/1534508417737514

Paige, D. D., Rupley, W. H., Smith, G. S., Olinger, C., & Leslie, M. (2018). Acquisition of letter naming knowledge, phonological awareness, and spelling knowledge of kindergarten children at risk for learning to read. *Child Development*. https://doi.org/10.1155/2018/2142894

Pelli, D. G., Burns, C. W., Farell, B., & Moore-Page, D. C. (2006). Feature detection and letter identification. *Vision research*, *46*(28), 4646-4674.

Perfetti, C. A., Beck, I., Bell, L. C., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. *Merrill-Palmer Quarterly, 33(3),* 283-319.

Phillips, B. M., & Piasta, S. B. (2013). Phonological awareness and print knowledge: Key precursors and instructional targets to promote reading success. *Early childhood literacy: The national early literacy panel and beyond*, 95-116.

Piasta, S. B., & Wagner, R. K. (2010). Developing early literacy skills: A meta-analysis of alphabet learning and instruction. *Reading Research Quarterly, 45(1),* 8-38. https://doi.org/10.1598/rrq.45.1.2

Powell, D. R., Diamond, K. E., Bojczyk, K. E., & Gerde, H. K. (2008). Head start teachers' perspectives on early literacy. *Journal of Literacy Research, 40(4),* 422–460. https://doi.org/10.1080/10862960802637612

Rachmani, R. (2020). The effects of a phonological awareness and alphabet knowledge intervention on four-year-old children in an early childhood setting. *Australasian Journal of Early Childhood, 45(3),* 254–265. https://doi.org/10.1177/1836939120944634

Rosenblum, L. D. (2008). Speech perception as a multimodal phenomenon. *Current Directions in Psychological Science, 17(6),* 405–409. https://doi.org/10.1111/j.1467-8721.2008.00615.x

Reutzel, D. R., Jones, C., & Mohr, K. (2019). Exploring the relationship between letter recognition and handwriting in early literacy development. *Journal of Early Childhood Literacy, 19 (3)* 349-374. https://doi.org/10.1177/1468798417728099

Seidenberg, M. S., & McClelland, J. L. (1990). More words but still no lexicon: Reply to Besner et al.(1990).

Sensible Pencil (1985). Different rods to learning. http://difflearn.com

Shaw, D. M. (2011). The effect of two handwriting approaches, D'Nealian and sun form, on kindergartners' letter formations. *Early Childhood Education Journal, 39(2),* 125–132. https://doi.org/10.1007/s10643-011-0444-2

Terepocki, M., Kruk, R. S., & Willows, D. M. (n.d.). *The coincidence and nature of letter orientation errors in reading disability.* (Unpublished manuscript). Department of Educational Psychology, University of Alberta, Edmonton, AB,

Canada.

Tseng, M. H., & Chow, S. M. K. (2000). Perceptual-motor function of school-age children with slow handwriting speed. *American Journal of Occupational Therapy, 54(1*), 83–88. https://doi.org/10.5014/ajot.54.1.83

U.S. Department of Health & Human Services, Administration for Children and Families,(2003). The effectiveness of early childhood development programs: A systematic review. *American journal of preventive medicine, 24*(3), 32-46. *Therapy, 54(1*), 83–88. https://doi.org/10.5014/ajot.54.1.83

Vadasy, P. F., & Sanders, E. A. (2021). Introducing grapheme-phoneme correspondences (GPCs): exploring rate and complexity in phonics instruction for kindergarteners with limited literacy skills. *Reading and Writing, 34*, 109-138.

Washington, D.C.: U.S. Department of Educational, National Reading Panel (2000). Report of the National Reading Panel - Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading Instruction: Reports. *National Institute of Child Health and Human Development.*

Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *Child development, 69*(3), 848-872.

Yopp, H. K., & Yopp, R. H. (2000). Supporting phonemic awareness development in the classroom. *The Reading Teacher, 54(2),* 130-143. http://dx.doi.org/10.1598/RT.54.2.2

Zaner-Bloser (2023) Zaner-Bloser shop. Designed and built by supadu.

http://zaner-bloser.com

APPENDIX A

LESSON PLANS

Weekly Lesson Plans

Week 1: *Critical Feature Letters Intervention*

Day 1:

Letters with a critical feature of short line and dot will be introduced on poster board on the first day of the intervention. The letters will be l, x, j, w, z, and v. The instruction will explain the process as follows. "Today we are going to learn letters that have short lines and dot features in them" (script). The features will be shown to the students. "I am going to say a chant (song) and you will repeat after me the letter name and sound. Once we have learned the name and sound, we will paint the letters on paper. Do you understand? Hopefully, the students will say yes. At this time, I will introduce the letter "I" and say

When I say "I" you say I, say I, say i, i, i, when I say "x" you say "x", say x, say x, x, x. When I say "j" you say "j", say j, j. j. When I say "w" you say "w" say w, w, w. When I say "z" you say "z", say z, z, z. When I say "v" you say "v", say v, v, v. After the letter names are introduced then begin with the sounds. "When I say /i/ you say /i/, say /i/, /i/, /i/. When I say /x/, you say /x/, /x/, /x/. When I say /j/, you say /j/, say /j/, /j/./j/. When I say /w/, you say /w/, say /w/, /w/, /w/. When I say /z/, you say /z/, say /z/, /z/, /z/. When I say /v/, say /v/, /v/, /v/. The instructor will say "Good job!" then, continue, "Now we are going to write the letters with [markers, sand]". The students will be given large sheets of paper and, the letters will be placed where the students can view them as they write the

letters. The students will be instructed to start with the first letter "I" and they will go through the same order as they learned the letters. All students will be allowed to write the letters and will be assisted with pencil grip and writing as needed.

Day 2:

The students will be told that they are reviewing the letters from the previous day. Again, the interventionist will go through the chants of when I say 'i" you say "i", "i", "i". After reviewing the letter name then the students review the letter sounds. When I say /i/, you say /i/m /i/, /i/, /i/. This will continue until all short line and dot letters have been reviewed. After reviewing the name and sounds, students will write the letters with gel pads or the medium of the day. The letters reviewed will be placed in front of students as they use them as a model to write the letters of the day.

Day 3

The students have already written the letter twice but will receive guidance, if needed, to get started or to make sure they write all the letters we know they can write. The writing medium is still unlined paper, this time it will be a standard 8 x 11" sheet of paper.

Day 4:

The same process of letter review will take place. After the letter and sound activity, students will be given lined tablet paper and asked to write the letters with a pencil. We will let the students begin to write and direct them as needed if they forget or skip a letter.

Week two

Day 1:

The letters this week will include critical features letters with long lines such as l, t, y, and k. We will review last week's letters first by simply repeating the letter name and sound at the same time. The process of chanting names and sounds will not be the same, however, as we will combine the letter and sounds together. Teachers will remind students of last week's letters i, x, j, w, z, and v. They will quickly review the letters by chanting the letter 'i', 'i', 'i', then the sound /i/, /i/, /i/. After the Week 1 review, we introduce the new letters for this week, which are l, t, y, and k. Because these letters all include a long line, the teacher holds up an example of a long line. "This time we will introduce the letter 'l' and say when I say 'l', you say l, say l, say 1, /l, /l. When I say 't', you say t, say 't', say t, /t/, /t/, /t/, say t, t, t. When I say 'y', you say 'y', say y, y, y; now say /k/ /k/, /k/, say 'k', 'k', 'k'." After the names are introduced, we begin with the sounds: "When I say /l/ you say /l/, say /l/, /l/, /l/. When I say /t/, you say /t/, say /t/, /t/, /t/. When I say /y/, you say /y/, say /y/, /y/, /y/. When I say /k/, you say /k/, say /k/, /k/, /k/.

The writing medium for this will be sand or a large sheet of unlined paper with paint on Day 1, a large sheet of unlined paper with gel or markers on Day 2, a pencil, and a sheet of 8 x 11" size unlined paper on Day 3, and a pencil and lined tablet paper on Day 4.

Day 2:

Another quick revision of last week's letters and sounds should take 2–3 minutes. Next, the chants of letter names and sounds will begin again with the letters l, t, y, and k.

The objective is to keep the letters on display for the children to review while they are still working and learning new letters weekly.

Writing: Sand or Salt Writing

Day 3:

Review letters from Week 1 (i, x, j, w, z, and v), and work on Week 2 chants (l, t, y, and k).

Writing: Crayons

Day 4:

The same as Week 1, except for the final writing, which will be done using a pencil and lined paper.

Writing: Pencils

Week 3: Critical Features Letters Intervention

Critical feature letters U-turn/hump (h, n, m, u)

Day 1:

We will begin by reviewing last week's (Week 2) letters with the names and sounds (l, t, y, k). Then, we will introduce Week 3 letters, which are the U-turn/hump letters, (h, n, m,

u). The letters will be introduced with the same process of chanting the letter name, then the letter sound of each letter. The students will then continue with the same writing media, going from large sheets of paper to smaller ones, and finally to lined paper with a pencil.

Test of Letter Names:

Materials: manual, scoring booklet, pencil, clipboard; Student materials: practice page and page 1 letters

Procedure: Place the practice letter-naming copy with letters f and s in front of the student. The remaining test page will be face-down beside the examiner. The instructor reads: “I will show you some letters on a page and you will tell me the name of each letter. If you do not know the name of a letter, that is ok. Just do your best. I will go first. This is an ‘f.’ What is the name of this letter?” Point to the ‘s.’ Correct (no score). “Good. That is the letter ‘s.’ Incorrect: Say the letter name. “The name of this letter is ‘s.’ Say it with me, ‘s’”. Make sure to prompt the student to say the letter. State whether it is correct or incorrect once this is done move to the test items.

Begin the test: “Here are more letters for you to read” (place the letter name page in front of the student and point to the first letter). “When I say ‘Begin,’ say the name of each letter. Read across the page then go to the next line (point to demonstrate) Try to say each letter's name. If you come to a letter name you do not know, I’ll tell you.” Put your finger on the first letter (guide the student to the first letter) and follow along with your finger as you say the names of the letters.

Begin, and if the student fails to say the letter in 4 seconds, say the letter name, mark it as incorrect and move on. If the student starts with a different task (e.g., reading letter sounds, reading words, or telling a story), remind the student to say only the letter name. Point to the next letter on the list and say “Ready? Begin.” Do not give any feedback about the students’ responses. Record all responses on the scoring sheet for letter names.

Types of Errors:

1. Incorrect task: Student says the sound of the letter and not the letter name.

2. Incorrect letter: Student says the wrong letter name.

3. Omission: Student omits or skips a letter name. If a whole row is missed, each item is counted as incorrect.

4. 4-second rule: If the student hesitates for 4 seconds, provide the letter name, and have the student continue with the next item.

Non-Errors:

1. Speech differences: The responses of students with speech impairments or dialect issues are not counted as incorrect. For example, if the letter is 'c' and a student who has a frontal lisp, says '/tph//e/,' that response is correct.

2. Self-corrections: If the student says the wrong letter name and then corrects it within 3 seconds. Do NOT count it as an error.

Test of Letter Sounds

Materials: manual, scoring form; Student materials: practice page, screening form 1 Procedure: Place the practice sound page in front of the student with the letters f, s, and a. READ: "I will show you some letters on a page, and you will tell me the sound of each letter. If you do not know the sound of a letter, that is okay. Just do your best" (point to the letter 'f,' at the top of the page). "I will go first. This is an /f/ sound. Now you try. What is the sound of this letter?" Point to the letter 's.' If the letter is correct, move to the vowel 'a' sound; if the sound is incorrect (such as the students saying the letter name, another sound, or no sound within 4 seconds). READ: "The sound of this letter is /s/. Say it with me: /s/" Then move to the vowel sound. "Now try another. What is the sound of this letter?" (Point to the 'a'). If correct, say "Good! That letter has an /a/ sound." Use

short vowel sounds during this activity. If the student gets it wrong, READ: “This sound of this letter is /a/. Say it with me /a/.”

Begin test: “Here are more letters for you to read” (place the sound test page in front of the student and point to the first letter). “When I say ‘Begin,’ say the sound of each letter. Read across the page then go to the next line (point to demonstrate for the student). “Try to say each letter sound. If you come to a letter, you do not know, I will tell it to you.” Put your finger on the first letter (guide the student to the first letter) and follow along with your finger as you say the sounds of the letters. If the student fails to say the first letter sound after 3 seconds, give the correct letter sound, mark it incorrect, point to the next letter, and move on. If the student starts with a different task (e.g., reading letter names, reading words, or telling a story) pause and tell the student to just say the letter sound. Point to the next letter and prompt only once. Do not give feedback about the responses. Continue to give students all options to say the sounds for every letter within the 4 seconds before stopping.

Types of Errors

1. Incorrect task: Student says the name of the letter and not the letter sound.

2. Incorrect letter: Student gives the wrong letter sound.

3. Omission: Student omits a letter sound. If a whole row is skipped each item is counted as incorrect.

4. 4-second rule: If the student skips the entire line, each sound in that line is incorrect.

Non-errors

1. Speech differences: Responses from students with speech impairments or dialects are not counted as incorrect. For example, if the letter is ‘c’ and a student who has a frontal lisp, says ‘th-ee,’ that response is correct.

2. Self-Correction: If the student gives the wrong letter sound and then corrects it before the 4 seconds, do NOT count it as an error.

Data Collected: score: twenty-six.

For reliability, assessors will score approximately 30 percent of the completed pre- and post-assessments together. The data will be collected and submitted into SPSS for statistical analysis and multiple regression before the intervention.

Letter-Writing Fluency

Materials: Timer; Student materials: lined paper and pencil

Procedure: Students will have a pencil and a sheet of paper. They will be told that the object of this assessment is to write letters on the piece of paper given to them. The examiner/assessor can model by showing the students where and in which direction to write on the paper. The assessor can also model the procedure and direction by demonstrating it with their finger as if writing on the line. Students were asked to write all letters to the best of their ability on lined paper and can have two sheets if they need additional room to write. Students will then be given 2 minutes to write each set of letters. No other feedback given. The goal is to see how many letters students can write on their own in 2 minutes.

Types of Errors

1. The letter that cannot be determined

2. Omitted letters

Non- Errors

1. Not writing on the line

Data Collected: score: twenty-six.

Test of Letter-Writing Quality

Materials: Alphabet assessment sheet; Student materials: pencil and paper Procedure: Students will be given a pencil and a sheet of paper. They will be told that the object of this assessment is to write letters on the paper given to them. The examiner can model by showing the students where and in which direction to write on the paper. The assessor can demonstrate the procedure and directions by writing with their fingers to show one letter as if writing on the line. Students will be asked to write all the dictated letters to the best of their ability.

Types of Errors

3. The letter that cannot be determined

4. Omitted letters

Non- Errors

2. Not writing on the line

Data collected: score: 26.

APPENDIX B

Intervention Design The rotation of letters introduced and the features they represented is found below.

Lesson Structure

Week 1: short line letters and dots

i, x, j, w, z, v

Week 2: long line letters

l, t, y, k

Week 3: short hook

f, r

Week 4: long hook

g, q

Week 5: closed curve

o, p, a, b, d

Week 6: open curve

c, s, e

Week 7: U-turn hum

h, n, m, u. Week 8: Review

The five early literacy practices outlined by the National Association for the Education of Young Children (singing (chanting letters), talking (identifying letters), reading (identify letters), writing (weekly writing of feature letters), and playing (sand, markers, drawing of letters) were all integrated into the Critical Feature Handwriting Intervention daily instruction.