IMPACT OF DIRECT FINE MOTOR INTERVENTION ON HANDWRITING

A Thesis

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by

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I dedicate this work to my beautiful, creative and insightful 2019 – 2020 Pre-K class, without whom I would not have completed this thesis and who will always hold a special place in my heart as our time together was cut short during this trying time of global pandemic.

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ABSTRACT

Structured fine motor lessons consisting of regulated fine motor materials and feedback is documented in the literature as a strategy for strengthening fine motor skills (Hamilton & Liu, 2017). The purpose of the present study was to determine (1) the mean duration of child engagement with fine motor materials within the classroom during free play, and (2) if direct intervention with fine motor materials, which promote pinch and grip strength, would impact handwriting performance. Children were observed during free play, interacting with materials. The hypothesis suggested interacting with fine motor materials, specifically promoting pinch and grip strength, would result in better handwriting. Data from pre-intervention writing samples and baseline observations were collected using a single case, multiple baseline, with interval recording. The Pinch and Grip Strength Intervention (PGSI) consisted of 10-minutes with 14 pinch and grip strength promoting choices. Results demonstrated that all children increased their engaged time with fine motor materials during the PGSI and increased name writing performance in all three children and increased compositional writing for two of the three children. This study demonstrates the effectiveness of developmentally appropriate interventions within the context of naturally occurring classroom routines to increase emergent writing in young children. Future research should focus on the intentional teaching of writing in young children using developmentally appropriate strategies.
CHAPTER 1. INTRODUCTION

**Justification**

Early childhood education provides young children’s first introductions to formal education. One goal of early childhood education is to develop foundational skills across all domains, aiming to establish a love of learning. Traditional letter and number recognition hold the focus in many early childhood classrooms, with fine motor skills and writing falling short in the scaffolding and support provided (Bingham, Quinn & Gerde, 2017; Bingham & Wasik, 2012; Quinn, et al., 2016). Despite this, teachers could easily incorporate fine motor activities that develop foundational skills for handwriting within the context of naturally occurring routines and activities of the school day, thus providing an advantage for children for future learning. Without opportunities for fine motor strengthening and writing for young children, there exists a fundamental disadvantage for those children upon entrance to kindergarten.

As the writing development process evolves, Fountas and Pinnell (2018) argue that writing has expanded from a focus on conventions, the mastery of physical fine motor skills, and has begun to combine with the true craft of the cognitive emergent literacy skills within writing as a genre. Writing instruction requires early emergent writers to engage in a number of processes, including the manual act of producing physical marks, the meaning students associate with these marks, and further, the students’ understanding of how written language is used (Berninger & Chanquoy, 2012; Emerson & Hall, 2018). These skills benefit young children’s transition into elementary education, allowing for compliance with the expectations of performing challenging writing tasks of spelling and composing, beginning as young as kindergarten, making a foundation of early writing prior to school entry paramount (Zhang & Quinn, 2018). Wells Rowe agrees that early childhood writing experiences in both preschool and
kindergarten positively relate to “literacy subskills such as letter identification, phonological awareness, and letter–sound correspondence, and to better overall outcomes in reading, writing, and spelling in first grade and beyond” (Wells Rowe, 2017, p. 31). Creating a life-long path of success for learning begins with early childhood writing experiences.

In fact, handwriting skills in the early childhood classroom predicted academic successes of these young learners (Connelly, et al., 2005; Grissmer et al., 2010; McCarney et al., 2013; McMaster & Roberts, 2016; Medwell et al., 2009; Peverly, 2006). Providing writing experiences is a valuable investment for children; as young as kindergarten 46% of categorized classroom activities are spent engaged in fine motor activities, with 42% of their fine motor time being in paper and pencil activities (Marr et al., 2003). As children begin advancing from second through sixth grade, they “spend 31 to 60% of their school time in writing…and 85% of their activities are based on paper-and pencil tasks” (McHale & Cermak, 1992; McMaster & Roberts, 2016, p. 287; Rodger & Ziviani, 2006). Practice and repetition of specific handwriting tasks leads to increased handwriting proficiency (McMaster & Roberts, 2016).

Opportunity and experience with fine motor skills, including handwriting practice, remain the most effective methods for educating young children on writing. Specifically, fine motor interventions that support young children in their hand and finger strength dexterity, may be the most effective course of action in developing the foundational skills young children need for handwriting. The present study examines the impact on fine motor play, focused on hand and finer strength and dexterity (specifically, pinch and grip strength) to determine if this will increase young children’s mastery of handwriting as measured by the Stages of Emergent Writing (Byington & Kim, 2017) and Teaching Strategies Gold Objective 19a: Writes name (Heroman & Tabors, 2010).
Best Practices for Fine Motor Skill Development

The National Association for the Education of Young Children (NAEYC) recommends programs to foster physical fine motor development by providing young children many different opportunities to use their hands and fingers to act on their environment (NAEYC Early Learning Accreditation, 2018, p. 23). Several environmental rating scales provide guidance on the inclusion of fine motor skills and writing within the classroom environment. Fine motor movements associated with the development of handwriting include those movements requiring the use of the small muscles within the fingers, hands and arms. For the purposes of this study, definitions were extrapolated from Teaching Strategies Gold Objective 7a: Uses fingers and hands and 7b: Uses writing and drawing tools (Heroman & Tabors, 2017) (see Appendix A) to specify that materials requiring the use of finger skills would increase children’s pinch strength, and materials requiring the use of the whole hand or arm would increase children’s grip strength. Pinch and grip strength fine motor materials are part of the recommended materials found in environmental rating scales. The Early Childhood Environmental Rating Scale – Revised, (ECERS-R) (Harms, et al., 2005), recommends that the classroom environment include a variety of materials to maintain child interest. These materials consist of pegs with pegboards, building toy sets, regular and knobbed puzzles, beads for stringing, sewing cards and art materials (i.e., crayons, scissors, pencils, markers). The NAEYC Class Observation Tool (2019) suggests that art materials such as cutting, gluing, painting, sculpting, and drawing should be available to preschool aged children in centers such as blocks/construction, writing table, woodworking, library, creative arts, manipulatives, science and collections. The Early Literacy and Language Classroom Observation tool (ELLCO) (Smith, et al., 2008), suggests that children should be offered opportunities to include writing in their play through writing letters and words with adult
assistance or modeling. Developmentally Appropriate Practice recommends including hands-on interactions with materials (Copple & Bredekamp, 2009); while other leading organizations have encouraged limiting the use of technology with young children (American Academy of Pediatrics, 2016) and/or ensuring that technology supports developmental goals (National Association for the Education of Young Children & Fred Rogers Institute for Early Learning and Children’s Media, 2012).

However, much of children’s first experience with fine motor skills in today’s society occur on smart devices, often using a finger, which removes opportunity for the development of more refined fine motor movement. Lack of exposure to writing instruments (e.g., a stylus) may both positively and negatively affect fine motor development in children. Moon, et al., (2019) worked to determine the specific effects of smart devices on young children, finding that language development was negatively impacted, while young children (up to age 3) had a positive correlation between smart devices usage time and appropriate usage and fine motor skills, specifically "early touch screen scrolling… [and] frequent use of the index finger could facilitate fine motor development in young children” (Moon, et al., 2019, p. 908). However, this research also found that once reaching preschool age (age 4-5), children needed more diverse experiences than finger isolation, the ability to move each finger one at a time, to further develop fine motor skills as the positive correlation disappeared. These findings suggest the need for further research on how to address young children’s development of fine motor skills that support handwriting in consideration of the predominant use of smart devices.

**Purpose**

The purpose of the present study was to improve handwriting through increased engagement in fine motor pinch and grip strength lessons in three pre-kindergarten aged
children. Specifically, the present study sought to determine (1) the mean duration of child engagement with fine motor materials within the classroom during free play, and (2) if direct intervention with fine motor materials, which promote pinch and grip strength, would impact handwriting performance as measured by the *Stages of Emergent Writing* (Byington & Kim, 2017) and the *Teaching Strategies Gold Assessment* (Heroman & Tabors, 2010).

Anticipated results include increased percentage of engaged interactions with fine motor materials, and an increase in the quality of writing via improved pinch and grip strength for all three children who were identified for participation in the present study based on the results of a classroom wide assessment of a handwriting sample.

**Conceptual Framework**

Developmentally appropriate practices (DAP) provided the framework for this study (Copple & Bredekamp, 2009). When contemplating interventions to address handwriting in young children, consideration was given to the ways in which children learn in order to maximize child attention and learning opportunities. DAP recommend play-based learning with materials that support skill development across domains – in this case, fine motor skills. Another significant consideration was the component of child-directed learning: the intervention was designed to allow for child choice of play materials (DiCarlo, et al., 2016). Within this study, the teacher remained diligent in her adherence to DAP, through the provision of child choice of intervention materials and honoring children’s play with uninterrupted free choice and independence unless assistance was requested. The teacher’s behavior was “… shaped by the children’s active engagement” (Epstein, 2007, as cited in Copple & Bredekamp, 2009, p. 17); meaning that the teacher’s followed the child’s lead and assisted only as needed. Furthermore, DAP suggests that classrooms must provide a “rich variety of materials, challenges, and ideas
that are worthy of children’s attention” (Copple & Bredekamp, 2009, p. 18). Fine motor materials were selected that were both interesting and novel, provided specific pinch and grip strength skill development practice, and presented as a child choice within a play-based format.

**Research Question**

The purpose of the present study was to improve handwriting through increased engagement in fine motor pinch and grip strength lessons in three pre-kindergarten aged children. Specifically, the present study sought to determine (1) the mean duration of child engagement with fine motor materials within the classroom during free play, and (2) if direct intervention with fine motor materials, which promote pinch and grip strength, would impact handwriting performance as measured by the *Stages of Emergent Writing* (Byington & Kim, 2017) and the *Teaching Strategies Gold Assessment* (Heroman & Tabors, 2010).

**Research Design**

In this study, data were collected using a single case, multiple baseline design across children to measure engaged time with fine motor materials. Single case research designs allow comparison of an individuals’ behavior prior to and following the introduction of an intervention. A multiple baseline design allows for treatment to be introduced across subjects at different times (Kazdin, 2011). Data were collected in accordance with standards set forth in the *Single Case Technical Document* (Kratochwill, et al., 2010) and included a minimum of five data points per phase.

**Benefits and Limitations**

This study contributes to the literature on interventions to support handwriting pre-kindergarten aged children within the context of DAP. Benefits of a single case multiple baseline design include the clear causal relationships between the intervention and the behavior change
(Nock, et al., 2007) and that the intervention does not have to be withdrawn to establish experimental control, as other factors are ruled out through the systematic replication of the effects across subjects (Dallery & Raiff, 2014). As with all single case designs, one limitation is lack of generalizability (Kazdin, 2011). This study was limited to one regular education pre-kindergarten classroom in a Title I elementary school. The three children who performed the lowest on a classroom-wide handwriting sample assessment, were selected as the participants, as they exhibited the highest need for an increase in fine motor pinch and grip strength. Therefore, all children were operating on a need basis, and were exposed to all conditions of the intervention, supporting the internal validity of this study (Kratochwill, et al., 2010). Within the present study, there were low threats to history as the data were collected within a multiple baseline design, which involved repetition of the intervention phase (Kratochwill, et al., 2010). Maturation did not limit this study, as data were collected over a short course of time, lowering the likelihood of naturally occurring change throughout the intervention (Kratochwill, et al., 2010). The handwriting sample assessment data were collected through natural name writing, therefore, the children were not engaged in testing in a way that would have interfered with the intervention effect (Kratochwill, et al., 2010). While there was a potential for bias as the lead researcher for this study was the lead teacher within the pre-kindergarten classroom in which this study took place, the methods for data collection in both baseline and intervention were precisely repeated and did not change over time to confuse the intervention effects (Kratochwill, et al., 2010). In addition, this study was considered socially valid due to relevancy for the “peer group of persons considered to be functioning adequately with respect to the target behavior” as fine motor skills greatly impact pre-writing, writing and other early literacy development (Kazdin, 2011, p. 53).
Assumptions

1. Children were functioning within normal limits for their age and their performance on handwriting was not due to developmental delay.
2. The teacher held developmentally appropriate expectations for pre-kindergarten aged children.
3. Handwriting instruction in pre-kindergarten is a foundational skill for future learning.

Definitions

For this study, the behavior of interest was *engagement* with items designated as fine motor materials.

**Fine Motor Materials**

Fine motor materials were defined as any material that required fine motor movements, such as building toy sets, regular or knobbed puzzles, art materials (crayons, scissors, pencils, markers, gluing, painting, etc.), computer mouse, and a smartboard pen. For the purposes of this study, definitions were extrapolated from *Teaching Strategies Gold Objective 7a: Uses fingers and hands* and *7b: Uses writing and drawing tools* (Heroman & Tabors, 2017) (Appendix A) to specify that materials requiring the use of finger skills would increase children’s pinch strength, and materials requiring the use of the whole hand or arm would increase children’s grip strength.

**Pinch strength.** Pinch strength materials were defined as any material requiring the use of finger skills. Examples include tweezers, picking up small items using a pincer grip, or writing instruments.

**Grip strength.** Grip strength materials were defined as any materials requiring the use of the whole hand. Examples include ripping and tearing a variety of resistive materials, hole punches, and child safe cardboard slicers.
**Engagement**

Engagement was defined as interaction with a toy, designated as a fine motor material.

**Non-Engagement**

Non-engagement was recorded when the child was engaged in play that did not require the use of fine motor skills (running, jumping, skipping, walking, engaging in a conversation without playing with materials) or engaged in no play at all.
CHAPTER 2. REVIEW OF LITERATURE

The impact of technology on society continues to evolve, and with each advancement comes new strategies and tools which find their way into the classroom. Young children’s access to technology raises societal awareness to the ways it may in fact be reframing their lives, including: physical changes (i.e., obesity from lack of exercise; increased neck and back pain from poor posture while utilizing smart devices); rewiring of the brain (i.e., reward loops, supported by addictive design of gaming and auto play functions on videos); spatial reasoning and timing (i.e., improved spatial reasoning; lower attention spans for extended periods of time; increase hand-eye coordination); definition of childhood (i.e., early entry to social media; exposure to riskier behavior and a individuals from a variety of age groups), and mental health (i.e., increase risk of suicide, feelings of inadequacy and loneliness due to social media) (Bruce-Lockhart, 2018).

In relation to schooling, an increase in the use of technology, specifically smart devices, impacts fine motor skills, and the ways that children now engage with literacy. This can both positively and negatively affect fine motor development in children. Of children aged 3 to 4 years old, at the end of 2017, 1% had their own smartphone; 10% had their own tablet 96% watched TV, on average for 14 hours a week; 52% went online, for nearly 9 hours a week; 1% had a social media profile; and 36% played games for 6.5 hours a week (Organisation for Economic Co-operation and Development, 2019). By 2018, 21% of children aged three and four had their own tablet (Bruce-Lockhart, 2018). As young children increasingly utilize smart devices in the home, alternate opportunities must exist to provide fine motor development for pre-kindergarten aged children outside of the ever-present smart devices.
Recent research has examined (Moon, et al., 2019) the specific effects of smart devices on young children and had mixed findings. While language development was negatively impacted by use of devices, young children (up to age 3) who used smart devise more frequently exhibited more advanced fine motor development, specifically in their usage of index fingers through scrolling. However, once reaching preschool age (age 4-5), children needed more diverse experience to further develop fine motor skills, in order to develop a foundation for future writing. In order to accommodate this need, this study was designed to provide direct instruction through intervention for the desired, fine motor pinch and grip strength. The intervention was modified from Hamilton & Liu, 2018. Hamilton and Liu conducted intervention research illustrating that both gross and fine motor skills benefited from direct and targeted lesson planning. Results suggested that children in the treatment group benefited from a planned motor intervention program on their gross and fine motor skills, having positive implications for this method of instructional delivery for motor skills for young children. Thus, this study provided structured lessons with feedback to promote the development of pinch and grip strength.

The review of the literature is organized into major areas informing the research study including, the importance of selecting materials that specifically target age appropriate fine motor skills for purposes of intentional fine motor instruction, integrating fine motor opportunities into the classroom and home environments, and teacher scaffolded fine motor-based writing experiences.

**Intentional Fine Motor Instruction**

One of the many jobs of the preschool teacher is designing an environment which includes a selection of age-appropriate materials that elicit targeted skills, including fine motor
skills. Children learn through hands-on play, meaning the materials available in a preschool classroom impact the opportunities for children’s skill development during the school day. To increase intentional instruction for young children, the research of Auerbach (2012) and Karadimitriou (2019) suggest respecting the importance of each toy and consulting a series of criteria to determine the most appropriate and meaningful toys. These include: child safety, interests and abilities of the child, patterns of behavior (i.e., positive humanitarian, social and ecological responses), and design features (i.e., manufacturing quality and cost). Fine motor experiences should include activity, creativity, and learning toys to develop muscle skills, self-expression, and acquisition of knowledge respectively (Auerbach, 2012; Karadimitriou, 2019). Even further, special deliberation should be taken when choosing electronic materials for children. In particular, electronics should never be utilized in place of hands-on materials (i.e., books, blocks, painting) and the impact of the portrayal of characters, their behaviors, and quests impact social behavior patterns (Auerbach, 2012; Karadimitriou, 2019). These considerations when choosing toys increases the levels of both fun and educational meaning, maximizing learning outcomes. In addition to appropriate toy selection, meaningful instruction methods are necessary to maximize learning opportunity.

A teacher’s instruction methods largely impact the development of children’s fine motor skills, even within mathematics. Based on a lack of specificity in this area, Suggate, Stoeger, et al., (2017) tested whether fine motor skills (FMS), had a direct impact on early numerical skill development, finding that there was in fact, a significant impact. To accomplish this, fine motor tasks (i.e., pegboard, bead threading, and block turning) were assessed to determine fine motor abilities in the participants. In addition, specific mathematics tasks were assessed with both finger-based numerical skills (counting to 10 with fingers, showing fingers in the quantities of 3,
1, 5, 6, and 9, and arithmetic operations of simple addition and subtraction with fingers) and non-finger-based numerical skills (counting to 10 verbally, counting out beads in the quantities of 3, 1, 5, 6, and 9, and arithmetic operations of simple addition and subtraction using beads). In doing so, the link between FMS and numerical skills showed the involvement of finger representations in early mathematics finger movements (and number representations) in grasping finger-based numerical concepts and later mathematical skills, therefore aiding the acquisition of mathematical mental representations. Research from Pitchford, et al. (2016) agrees that the influence of fine motor skills on math ability emerges within the early schooling in the preschool classroom and is linked with the numeracy skills children procure through the practice of writing numbers and carrying out other math-based activities which require fine motor skills. Thus, solidifying that fine motor skills act as a foundational skill for a multitude of content areas. An impact on foundational math skills couples with the influence of fine motor development on reading and writing skills.

Similar to how Suggate, et al. (2017) explored the relationship between fine motor skills and math, reading and writing also offer meaningful instructional opportunities to embed fine motor skills. Writing is particularly predictive of later school achievement, making early intervention in fine motor development important for children’s foundational writing skills. Quinn, et al., (2016) found writing was often overlooked in early childhood classrooms due to limited scaffolding that would otherwise foster children’s writing. Due to the impact of early writing experiences on later reading and writing, classroom teachers should provide a variety of scaffolding including: *modeling, reducing choices, and guiding* across the three component skills of early writing: *composing, spelling, and forming letters*. For example, modeling could include writing the letter R while escribing its form (forming letters); modeling spelling a word by
saying the letters or sounds (spelling); thinking aloud while writing a story to demonstrates how
to make decisions about writing (composing). In addition to modeling, teachers can reduce
choices by asking, “while writing the letter ‘T’, does the line across go on the bottom or the
top?” (forming letters); limiting options while spelling a word: “what letter begins ‘/c/ cat’? Is it
‘C’ or ‘B’? (spelling); asking about particular words: “should we begin our letter with ‘Hello’ or
‘Dear _____’?”, (composing). Scaffolding through guiding could include offering feedback
while a child writes her name: “An ‘E’ and two ‘M’s, for Emma. Now you just need the last
letter. Remember how it is one of our circle and stick letters?” (forming letters); offering support
while child sounds out a word: “You sounded out the word hat. I heard the /h/ sound too. What
comes next?” (spelling); supporting children’s story construction: “What do you remember next
from your trip? You could write about that.” (composing). Although, despite professional
recommendations for use of scaffolding and writing instruction, usage of each is still limited in
pre-school classrooms (Gerde, Bingham, & Pendergast, 2015; Quinn, et al., 2016).

In agreement with Quinn et al. (2016), letter formation and the fine motor skills required
for such a task impact early writing. Seeing a gap in the research on the direct impact of fine
motor skills on early writing, Suggate, Pufke, et al., (2018) conducted a study to delineate the
difference between fine motor skills (FMS) and grapho-motor skills, small muscle control
required to hold a writing instrument to form letters, and the impact of each on early literacy
development. Essentially, fine motor skills are “small muscle movements requiring close eye–
hand coordination” (Luo et al., 2007, p. 596). While grapho-motor skills are a subgroup of skills
that directly involve pencil operation skills required for writing, without the ability to produce
letters from memory (Stachelhaus & Strauß, 2005; Suggate, Pufke, et al., 2018). This distinction
defines the difference between using fine motor skills as a developmental foundation for writing
to compose a message, while grapho-motor skills are necessary for basic pre-writing strokes of linear and circular motions. This study found that the isolation of skills indicated that FMS related less strongly than grapho-motor skills to emergent literacy skills. Therefore, for early writing development, specific fine motor activities (those grounded in grapho-motor skills), rather than more generalized fine motor skills, aid in the development of handwriting by tying the production of letter forms and strokes into the classroom opportunities and experiences. Hence, specified fine motor experiences to build small muscle control will provide the foundational skills needed to coincide with knowledge of letters symbols and their formation to scaffold further writing development.

**Integrating Fine Motor Opportunities**

**In the Classroom**

Bingham, Quinn, McRoy, et al., (2018) found that integrating writing experience across early childhood curriculum brought writing to the foreground in order to provide greater attention to children’s early writing attempts and experiences. The metaphor of painting aides in understanding what educators may consider the background and foreground of learning experiences within the classroom. The term *backgrounding* describes the portion of a lesson which provides the meaning and foundation for a lesson and *foregrounding* describes the finished product the lesson aims to achieve. Educators establish the background during planning, through anticipation of what children might discuss and write about and can more easily integrate writing with other curricular experiences, allowing writing to push to the foreground when appropriate (Bingham, Quinn, McRoy, et al., 2018). Their research illustrate methods educators can utilize to set writing rich environments, like backgrounding, by embedding writing materials into dramatic play centers for grocery lists or doctors’ prescriptions, graph paper and
stickers for blueprints in the block center, post-it notes, journals, or graphs for observation documentation in sciences centers, and loose paper and writing instruments for child authored books into the book center. Through meaningful integration, writing will rise to the foreground, allowing teachers to provide writing experiences into everyday learning opportunities. Educators should acquire a planning framework highlighting which skills will be in the background or foreground, increasing practical incorporation into existing activities and play settings. By drawing attention to writing materials, making natural connections with children’s interest and play, and scaffolding children’s early writing attempts and experiences educators will actively support children’s writing development in preschool classrooms.

Intentional planning of background and foreground materials supports effective lessons and learning activities which produce higher academic achievement. In the same fashion, Gerde, Goetsch, et al., 2016 found that intentional engagement with print in the early learning environment between both teachers and students supports writing in the classroom. In order for high levels of engagement with print to take place, educators must provide environmental print of quality, including: print that is related to children’s interests; print that is aligned with current classroom content; print that is co-created with children (i.e., children participate in composing, drawing, or writing parts of the posted print); and print that is referred to often. While print in the environment is typically posted in early childhood classrooms, it is often not meaningful to children because teachers are rarely referring to it, nor incorporating environmental print into their interactions with children. This is a missed opportunity to integrate children's opportunities to interact with or produce meaningful print, which should be posted in locations students spend important portions of their day (i.e., cubbies, name tags for play centers, attendance chart, job charts, routine charts, class books, class-made graphs, journals, name cards within the writing
center, reflection charts, etc.). In addition to this, students should be invited to create and use these print materials. When children and teachers purposefully engage with print by pointing to print, thinking-aloud to explain the use of print, and using print as a resource for letter names, sounds and forms in the classroom, their writing is supported and their interests drive further engagement with classroom content and learning. Child engagement with print in the environment, is adaptable and should be utilized within schools, the community, and within the home to promote emergent writing and early literacy.

**In the Home**

Developmentally appropriate teaching calls for teacher and child collaboration in learning experiences in the classroom. Bindman, et al., 2014 contributes a similar call for the importance of collective learning experiences between parents and their child, particularly through shared writing tasks. To determine how parents best support children’s early writing skills, Bindman, et al., 2014 analyzed videotaped interactions between mothers and children during a joint writing activity creating a party invitation. They were focusing on isolating sounds within words to match them with corresponding letters, and producing letter forms on paper, where parents were gauged on their efforts to “involve the child in actively producing writing using the same techniques as expert writers, including segmenting the words into sounds, connecting those sounds with the appropriate letters, and forming letters and words on the page” (Bindman, et al., 2014; Ehri et al., 2001). Specifically, parents were measured on: writing support (through analyzing and coding each letter that parents or children wrote on the invitation); graphophonemic support (the process the parent used to help the child to isolate each sound in a word and determine which letters should be written); print support (how the parent helped the child to draw the letter forms on paper); and demand for precision (examining whether and how
the parent pointed out errors in the child's writing and asked the child to correct the errors) (Bindman, et al., 2014). Results found when parents provided graphophonemic support to their children, they were most likely to say the word as a whole or to spell the word out as a complete sequence of letters. In fact, results demonstrated that parents who provided higher levels of graphophonemic support had children with higher decoding and fine motor skills. For print support, approximately 24% of parents wrote the letters themselves, while parents' level of demand for precision was not related to children's vocabulary, literacy, or fine motor skills (Bindman, et al., 2014). Therefore, parents need assistance in integrating writing within the home through direct instruction of the four components assessed: writing support, graphophonemic support, print support, and precision. In addition to this, an understanding of how children’s writing develops and an understanding of where their child falls in its progression is essential for parental involvement. Joint writing activities can continue to support at home writing integration with coaching and modeling from teachers on how to participate through scaffolding instead of parent-based completion.

Parents can also integrate fine motor development opportunities with their children in the home. Colker (2010) provides skill building activities for us in the home to increase muscle strength and coordination, preparing children for more advanced handwriting skills. Opportunities are available through everyday routine and activities to support the development of fine motor skills through many self-help and managerial tasks. These tasks can occur within routines, such as setting the table, eating using utensils, getting dressed independently using fasteners (i.e., zippers, buttons, snaps) and various play activities.

In addition to daily routine opportunities for independent practice of fine motor skills, parents can provide children with independent writing activities as well. Aram and Besser-Biron,
2016 found that children preferred writing experiences that allowed for more independent completion, without parental assistance. In fact, through their research, Aram and Besser-Biron, 2016 found that when comparing mother-child interactions between a pencil and paper or computer-based writing task, mothers gave their children more independence in printing the letters when using the computer than when using the pencil. In turn, the children preferred to writing on their computer, as “children did not like their mothers to enter into their space and clearly asked for independence” (Aram & Besser-Biron, 2016, p. 16). These fine motor tasks and children’s desire to perform them independently carry into the classroom, integrating home and school development together.

**Teacher Scaffolded Fine Motor Based Writing Experiences**

When children are given opportunities and guidance in any type of writing, such as forming straight lines, they develop refined muscles in their hands which provide the foundations for sophisticated writing. Lin et al., (2015) determined that fine motor ability relates to both age and *kinematic parameters*, the movements and force required to create writing. This highlights the importance of educators’ knowledge and understanding of child developmental. Lin et al., analyzed children’s fine motor development through drawing trajectories, kinematics and kinetics. Straight lines drawing tasks and circles drawing tasks were performed by using a force sensitive tablet to measure drawing duration (i.e., time spent engaged in drawing), mean drawing velocity (i.e., average drawing speed), and number of peaks in stroke velocity profile (NPV) (i.e., a straight line extracted from the starting point to the ending point is recognized as a stroke; a half circle corresponds to an up and down movement; Considering circles were drawn from up to down first and then from down to up, a circle was segmented into to two strokes; therefore for all drawings the values of NPV per stroke were measured) were used to derived as kinematic
parameters. Compared with kinematic parameters, findings revealed that kinetics is another important perspective in the analysis of fine motor movement. Therefore, it remains important for educators to intervene in writing when children need support in their grip as it relates to formations and force used to produce a stroke.

Puranik and Lonigan (2012) examined length of name, as a predictor of writing proficiency. The research sought to determine whether children with longer names had any advantage over children with shorter names in their name writing proficiency. First, they examined whether preschool children’s name-writing proficiency differed on other emergent reading and writing tasks, and second, they examined the effect of name length on preschool children’s emergent literacy skills, including alphabet knowledge and spelling. They found that the more advanced name writers outperformed the less advanced name writers on all emergent literacy measures, though children with longer names did not show superior performance compared to children with shorter names. For young children, having longer names did not translate into an advantage on alphabet knowledge or spelling tasks. In fact, as a foundation for compositional writing, name writing reflects knowledge of some letters rather than a broader knowledge of letters that may be needed to support early spelling. Therefore, name writing proficiency, not length of name, were associated with preschool children’s developing emergent literacy skills. Educators should utilize both name writing and compositional writing as means to foster fine motor skills and emergent writing skills.

In addition to focusing on name writing models, teachers can intervene in the early development of fine motor skills through games and play that elicit fine motor skills. Through observation of fine motor skills, the researcher chose a class of children in a middle class, public kindergarten class, to collect data on the process of educational activities using folk games. The
games aimed to boost development of young children’s fine motor skills, by tracking and observing children, and physical analysis of their products at the end of each game. The folk game lessons occurred three times a week for 10 weeks (i.e., Flexible Fingers; Fingers’ change; Paper Folding Change; Cut Window; Paper Cutting-Lanterns; Noodle’s Making; Dumplings’ Making; Weaving Snails’ Houses, etc.) (Wei, 2016). Initially, each activity paid key attention to individual fine motor skills of pinching, drawing, and cutting and folding, with activities becoming more individualized as each student demonstrated their level of development. Wei (2016) found that these folk games had the ability to increase children’s fine motor development when such games were presented for specific learning experiences, as “the fine motor skills of children in the intervention class has gained overall improvement and its fine motor skills in “pinching”, “touching”, “drawing” and “cutting” exceeded children in the control class” (Wei, 2016, p. 116). Educators can foster fine motor development to improve early writing skills in such simple and desirable interventions, allowing children to engage and thrive in endeavors, which are suited to their own level of development and aligned with age-appropriate expectations.

Educators must continuously abide by the stages of children’s writing development in order to encourage emergent writing for each student individually. A multitude of research (Bingham, Quinn & Gerde, 2017; Bingham, Quinn, McRoy, et al., 2018; Gerde, Goetsch, et al., 2016; Quinn, et al., 2016), has found that many early childhood programs offer children materials and tools for engaging in writing activities but lack teacher modeled writing for children to scaffold children’s writing attempts. Gerde, Bingham, et al., (2012) provide research-based guidelines of best practices for writing within the early childhood classroom (i.e., Building writing into your daily schedule; Explicitly model writing; Scaffold’s children’s writing;
Encouraging child to read what they write; Encouraging invented spelling; Make writing opportunities meaningful; Have writing materials in all centers; Display them-related words in the writing center; Engage in group writing experiences; Make writing a way to connect with families; and Using technology to support writing). It is not only important to provide children with access to fine motor materials, but also to provide multiple opportunities for children to observe teachers’ modeling of writing. Teachers should provide support and scaffolding for children’s writing attempts and to engage children in meaningful writing in their play. Research-based evidence indicates that modeling writing supports children’s literacy development in early childhood classrooms, even as simplistically as name writing and game play.

Just as teachers should consider both child development and child interest when planning activities to support fine motor skills and writing, they must understand the progression of emergent writing and its impact on young children’s emergent writing experiences. Byington and Kim (2017) present a three-part framework of children’s knowledge of writing, including: conceptual knowledge (learning that writing has a purpose and that print is meaningful (i.e., it communicates ideas, stories, and facts); procedural knowledge (learning the mechanics of letter and word writing (e.g., name writing), spelling and gaining alphabet knowledge); and generative knowledge (i.e., children’s abilities to write phrases and sentences that convey meaning) which encompasses the components of emergent writing and their natural progression of development. Teachers should set developmentally appropriate expectations for both emergent literacy and the function of writing, including the meaningful integration of fine motor manipulatives and writing within the routines and activities of the early childhood classroom. These practices have the potential to provide increased interest and opportunity to practice writing and other fine motor skills. Byington and Kim (2017) developed the Stages of Emergent Writing (see Handwriting
Sample Assessment) as a guide for educators to increase their understanding of the stages of development of emergent writing, beginning with the practice of scribbles. Increasing awareness of the stages of writing development provides teachers with a better understanding of how to support writing across each stage.

Lastly after teachers have provided intentional fine motor instruction through interventions and integrated lessons, and have acquired knowledge of the developmental stages of writing, they can take the next steps into compositional writing and further supports for emerging writing. Bingham, Quinn and Gerde (2017) determined that teachers’ methods may be limited in their support strategies for early writing. Despite a wide recognition on the importance of young children’s language and literacy environments to later achievement, Bingham, et al.’s research indicated that there was little was known about teachers’ supportive approaches to early writing in preschool classroom contexts and the ways in which these supportive approaches relate to children’s writing development as they progressed in their education. In their research, Bingham et al., found that of 270 related writing supports, handwriting-related support strategies accounted for a majority of the total (156 of 270), teachers also used spelling-related strategies (96 of 270), including alphabet knowledge, print concepts, and letter-sound knowledge. The smallest portion of writing support instances addressed composing (18 of 270), in only 16 of 41 observation classrooms. Of these 270 instances of writing support, 234 of them were deemed low level, shallow and less targeted support where teachers focused on writing in routine or repetitive ways. However, could utilize high level support, attuned more closely to the individual child’s understanding and development of a targeted skill, primarily focusing on extending learning past the child’s skill level or immediate context. This approach allows children to begin engaging in composing opportunities well before their developing motor skills and letter knowledge permit
them to write well-formed letters and generate invented spellings, acknowledging composing as a critical early gateway to writing for young children (Bingham et al., 2017). Examinations of teachers’ supportive writing practices revealed that teachers were much more likely to focus on children’s handwriting and spelling skills, with less attention to composing. However, associations between teachers’ pedagogical practice and children’s writing skills indicated that children from classrooms with teachers who supported composing exhibited more advanced writing capacities. Educators must intervene by teaching foundational writing skills of letter forms and strokes, within handwriting and spelling to support more composition-based writing for broader foundational development in their students.

Summary

This review of literature highlighted the importance of selecting materials that specifically target age-appropriate fine motor skills for purposes of intentional fine motor instruction, integrating fine motor opportunities into the classroom and home environments, and teacher scaffolded fine motor-based writing experiences. As recognized by literature, structured fine motor lessons consisting of regulated fine motor materials and feedback have been documented as a strategy for strengthening children’s fine motor skills (Hamilton & Liu, 2017). In addition to teacher-led intervention, opportunities for fine motor development can be incorporated across classroom activities and within home environments and routine activities. Additionally, research also advocates for providing children with scaffolding and following children’s choice and natural interest (Bingham, Quinn, McRoy, et al., 2018), including teacher facilitated opportunities to observe modeled writing (Gerde, Bingham, et al., 2012). Handwriting is a foundational skill that supports future learning, and educators must consider the development of foundational skills that support fine motor development, continuing through the stages of
emergent writing (Byington & Kim, 2017; Quinn, Gerde, et al., 2016). These approaches aide in the development of emergent writing, which develops in stages and can be supported through access to play materials that foster the development of fine motor skills.
CHAPTER 3. METHODOLOGY

Setting

The study took place in a pre-kindergarten classroom in an urban Title 1 elementary school, located in a major city in a southern state. This state requires all children enrolled in public pre-kindergarten programs turn four years old by September 30th of their preschool year. The targeted classroom served 20 (11 boys and 9 girls) regular education children, no children in the classroom had Individualized Education Plans (IEP) nor any other academic restrictions. The classroom was staffed by two adults, a lead teacher, who held a Bachelor’s degree and PK-3 teacher certification; having four years’ experience, and a paraprofessional. The paraprofessional had an Associate’s degree in early childhood education and had 14 years’ experience. The lead teacher served as the researcher and data collector for the purposes of this study; while the lead teacher collected baseline or intervention data, the paraprofessional facilitated classroom flow and management. The classroom was divided into activity specific areas called centers similar to those found in Early Childhood Environmental Rating Scale – Revised (ECERS-R; Harms, et al., 2003), where small groups of children were able to play freely. These centers operate under a free-play structure where children may choose with what or where they would like to play, with whom, and for how long within the 60-minute center time. The classroom had writing materials (i.e., crayons, pencils and paper) accessible in all learning centers. The classroom included a variety of other opportunities allowing a child to experience fine motor opportunities embedded in free play centers (see Table 1).
Table 1. *Embedded Fine Motor Opportunities*

<table>
<thead>
<tr>
<th>Dramatic Play</th>
<th>Embedded Fine Motor Opportunity: Zippers, Snaps &amp; Buttons for Dress Up; Drill; Phone; Cash Register; Egg Beaters; Screw on Lids on Plastic Jars; Paper, Pencil &amp; Crayons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book Center</td>
<td>Embedded Fine Motor Opportunity: Paper &amp; Wooden Page Turning; Re-Telling Materials (Dolls; Puppets; Felt Pieces; Magnet Pieces, etc.); Magnetic Letter Easel; Paper, Pencil &amp; Crayons</td>
</tr>
<tr>
<td>Computer</td>
<td>Embedded Fine Motor Opportunity: Mouse (Click; Scroll; Drag, etc.); Headphones; Manipulation of Volume Knob</td>
</tr>
<tr>
<td>ActivBoard (Interactive White Board)</td>
<td>Embedded Fine Motor Opportunity: Interactive Pen (requires traditional pencil grip to operate games)</td>
</tr>
<tr>
<td>Art</td>
<td>Embedded Fine Motor Opportunity: Glue, Scissors, Paintbrushes; Collage Materials; Paper and Tissue Paper for tearing; Variety of Writing Utensils (Pencils; Colored Pencils; Markers; Thin Crayons; Thick Crayons)</td>
</tr>
<tr>
<td>Paint Easel</td>
<td>Embedded Fine Motor Opportunity: Paintbrushes; Clothespins to Hold Paper; Marker (to write name on work)</td>
</tr>
<tr>
<td>Tinker Toys; Blocks</td>
<td>Embedded Fine Motor Opportunity: Magnetic Train and Track Pieces; Plastic Connecting Shapes; Lacing cards; Stacking and Aligning Blocks; Paper, Pencil &amp; Crayons</td>
</tr>
<tr>
<td>Writing</td>
<td>Embedded Fine Motor Opportunity: Variety of Paper (Copy Paper; Lined Paper; Graph Paper; Colored Paper; Index Cards; Post-It Notes); Variety of Writing Utensils (Pencils; Colored Pencils; Markers; Thin Crayons; Thick Crayons); Name Cards/Content Word Cards</td>
</tr>
<tr>
<td>Sensory Table</td>
<td>Embedded Fine Motor Opportunity: Sand and Rice Finger Tracing; Tweezers; Toothbrush for scrubbing; Sponge for squeezing; Measuring Cups and Sifters for Pouring; Paper, Pencil &amp; Crayons</td>
</tr>
<tr>
<td>Science</td>
<td>Embedded Fine Motor Opportunity: Magnifying Glass; Bar &amp; U Magnets; Balance Scale; Paper, Pencil &amp; Crayons</td>
</tr>
<tr>
<td>Self-Help; Managerial Tasks</td>
<td>Embedded Fine Motor Opportunity: Opening and Closing Classroom Door; Placing Work Product in Backpack (Un-Zip &amp; Zip); Turning On and Off Water Faucet; Clothing Tasks (I.E., Zippers, Buttons, Velcro Straps, etc.)</td>
</tr>
</tbody>
</table>

**Subjects**

Three children were targeted for participation in the present study based on the results of a classroom-wide assessment of handwriting sample (see *Handwriting Sample Assessment*, below). Even though all three children were operating within the norms of the four-year-old
development range on the *Teaching Strategies Gold* assessments (Heroman & Tabors, 2010); their performance results were the lowest of the class. Pseudonyms were used to protect the identity of the participants. Kaleb was a 4 year and 1-month old African American male; Maleek was a 4 year and 3-month African American male; Cali was a 4 year and 7-month old African American female. Institutional Review Board approval (Appendix B) was obtained from the researcher’s university; administrative consent, parent consent, and child assent were obtained prior to the start of the study.

**Handwriting Sample Assessment**

The handwriting sample assessment was conducted at the end of October for all 20 children within the targeted classroom. This sample was scored using *Stages of Emergent Writing* (Byington & Kim, 2017) and the *Teaching Strategies Gold Objective 19a: Writes name* (Heroman & Tabors, 2010). Both tools were used, as the *Stages of Emergent Writing* relates to overall compositional writing, whereas the *TS Gold Assessment* is focused on the child writing their own name. The three lowest performing children were chosen to participate in this study.

The *Stages of Emergent Writing* (Appendix C), ranging from drawing to conventional spelling and sentence writing, were converted into quantitative values of one-nine respectively (Byington & Kim, 2017). *Drawing* (1) was defined as drawings that represent writing; *scribbling* (2) was defined as marks or scribbles the child intends to be writing; *wavy scribbles or mock handwriting* (3) was defined as wavy scribbles that imitate cursive writing, with a left-to-right progression; child pretends to write words; *letter-like forms or mock letters* (4) was defined a letters and marks that resemble letter-like shapes; *letter strings* (5) was defined as strings of letters not creating words, written left to right, including uppercase and lowercase letters; *transitional writing* (6) was defined as letters with spaces in between to resemble words;
letters/words copied from environmental print; letters often reversed; invented or phonetic spelling (7) was defined as different ways to represent the sounds in words; the first letter of the word or beginning and ending sounds represent the entire word; beginning word and phrase writing (8) was defined as words with beginning, middle, and ending letter sounds; short phrases; and conventional spelling and sentence writing (9) was defined as correct spelling of words, generally the child’s name and words such as mom and dad; sentences with punctuation and correct use of uppercase and lowercase letters (see Appendix C).

Additionally, Teaching Strategies GOLD: Objective 19a: Writes Name (Heroman & Tabors, 2010) (Appendix D) ranges in scores from zero (not yet) to fourteen in order to determine the developmental level of a child’s writing product. Definitions are provided for even-numbered scores; mid-range scores are given if the child’s product falls in between two even number descriptions. Not Yet (no score) was defined as the skill being too developmentally advanced for a child’s age (not applicable in the study, as all children were 4-years-old); Makes scribbles or marks (2) was defined as scribble writes deliberately; makes marks that appear to adults to be in random order; Makes controlled linear scribbles (4) was defined as scribbles lines, circles, or zigzags in rows; often repeats action and forms; Writes mock letters or letter-like forms (6) was defined as writes segments of letter forms, e.g., lines, curves; may use too many segments to create a letter, e.g., five horizontal line on the letter E; may not orient letter segments correctly; Makes letter strings (8) was defined as writes some letters correctly, writes letters in unconventional order; Writes partially accurate first name (10) was defined as writes all the letters of own name, although some may not be sequenced correctly; writes all the letters of own name, but some of the letters are not formed or oriented correctly; Writes accurate first name (12) was defined as writes all the letters of own name in the correct sequence, form, and
orientation; uses uppercase or lowercase letters (or a combination of both) when writing name; 

_Writes accurate first and last name_ (14) was defined as encompassing all of the prior stipulations or level 12 for both first and last name (see Appendix D). An example of a mid-range score would be a 7, credited for a representation of both _Writes mock letters or letter-like forms_ (6), and _Makes letter strings_ (8) represented in a writing product using a combination of both mock letters or letter-like forms and properly formed letters resembling a letter string.

**Behavior Definitions**

For this study, the behavior of interest was _engagement_ with items designated as fine motor materials.

**Fine Motor Materials**

Fine motor materials were defined as any material that required fine motor movements, such as building toy sets, regular or knobbed puzzles, art materials (crayons, scissors, pencils, markers, gluing, painting, etc.), computer mouse, and a smartboard pen. Fine motor movements associated with the development of handwriting include those movements requiring the use of the small muscles within the fingers, hands and arms. For the purposes of this study, definitions were extrapolated from *Teaching Strategies Gold Objective 7a: Uses fingers and hands* and *7b: Uses writing and drawing tools* (Heroman & Tabors, 2017) (see Appendix A) to specify that materials requiring the use of finger skills would increase children’s pinch strength, and materials requiring the use of the whole hand or arm would increase children’s grip strength. 

_Pinch strength_ materials include tweezers, picking up small items using a pincer grip, or writing instruments; _grip strength_ materials include ripping and tearing a variety of resistive materials, hole punches, and child safe cardboard slicers. There were several materials across baseline and
intervention that elicited both pinch and grip strength. Examples include stringing activities, lacing activities, and hammer and nails.

**Engagement**

Engagement was defined as interaction with a toy, designated as a fine motor material. A modified version of the Martens and Hiralall (1997) definition of toy play was used to define engagement as the child’s manipulation of fine motor toys in the manner the toy or material was intended to be manipulated. Looking at a fine motor toy or item or talking about the fine motor toy or item in the absence of manipulation was considered engagement (once the child initially manipulated the fine motor toy). Only interactions with materials designated as fine motor toys or items were recorded as engagement, this consists of purposeful and intended play with pegs with pegboards, building toy sets, regular or knobbed puzzles, beads for stringing, sewing cards, art materials (crayons, scissors, pencils, markers, gluing, painting, sculpting, etc.). This also includes engaging in self-help related fine motor tasks (e.g., tying shoes, zipping jacket, turning doorknobs). Any disruptive behavior (e.g., throwing toys that were not meant to be thrown) or aggressive behavior (e.g., hitting another child with a toy) was not considered engagement (DiCarlo, Baumgartner, et al., 2016; DiCarlo, Reid, et al., 2003).

**Non-Engagement**

Non-engagement was recorded when the child was engaged in play that did not require the use of fine motor skills (running, jumping, skipping, walking, engaging in a conversation without playing with materials) or engaged in no play at all. An example would include putting on dress up materials without the need of fine motor skills (e.g., a pull over the head cape).
Data Collection

Data were collected using interval recording in 15-second intervals for a period of 10-minutes during the children’s free choice center time daily to record engagement and non-engagement with fine motor materials and to record the material each child interacted with during the session (see Appendix E for data sheet). Engaged Fine Motor Interactions (EFMI) was collected on a partial interval basis; if the child engaged in an interaction with fine motor toy play at any part of the interval this behavior was recorded. No Fine Motor Engagement (No FMI) was recorded on a whole interval basis; meaning that the child had to refrain from fine motor engagement for the entire duration of the interval for this behavior to be recorded. Baseline data were collected until a stable pattern of behavior was observed, with a minimum of 5 data points per child per phase (Kratochwill et al., 2010). Data were summarized by counting all instances of engagement or non-engagement and dividing by the total number of observed intervals and multiplying by 100 to generate a percentage.

Observation Procedure

During free play the researcher stood in an unobtrusive position in close proximity to the target child in order to observe their hand use. As the target child circulated through centers, the researcher followed, ensuring a far enough distance to not distract the child or influence play. For each session, the researcher utilized a clipboard with the data sheet and a timer to record data for a 10-minute period. During baseline, the data were collected during the first ten minutes of free play centers by observing and shadowing the child during play. During the intervention, the teacher allowed the child choice among the 14 pinch and grip strength activities, provided a model of the appropriate use of each of the new materials, and provided praise, but no assistance, throughout the 10-minute session.
Experimental Conditions

Baseline

The pre-kindergarten classroom had a variety of fine motor materials within classroom centers to be chosen freely during center time. When a child engaged in free choice play, they were at their own liberty to decide where they played, with what materials, and for how long of a duration. The teacher did not intervene, nor provide feedback to encourage the continuation nor conclusion of play. The classroom also included a writing center; additionally, each center was stocked with paper and writing instruments. Once each week, the classroom had structured journal writing for a 15-minute period. The teacher allowed time for children to be independent with self-help skills, such as zipping school bags and opening zip top bags. The usual practice was for the teacher to observe and only assist when requested by the child. If requested, the teacher assisted children with fine motor tasks by providing a model; if this was not successful, she completed the task with, or for the child. Even though there were embedded fine motor opportunities in free play centers, it was possible for children to play in these areas of the classroom and still demonstrate a lower level of engagement, as they could work within a center without engaging with the fine motor materials present. Meaning, that the mere presence of fine motor materials within the centers did not guarantee that children would engage in fine motor opportunities within their play.

Pinch and Grip Strength Intervention

Fourteen pre-set pinch and grip strength promoting activities, ranging in different hand capacities and performances were available for the children’s choice during each intervention session (see Table 2). During intervention, the targeted child was given a choice among these activities and received direct instruction on how to interact with these materials (Hamilton &
Liu, 2018). Each of the 14 activities were housed on a rolling cart near the teacher’s desk. Prior to the start of each session, the child was invited to choose three of the 14, targeted fine motor activities, independently. These materials remained out of reach from all children except the targeted child during his intervention sessions. These 14 activities utilized pinch strength, grip strength, or both, and selected one activity of each type per session. In contrast to baseline, prior to beginning the 10-minute session, the teacher modeled the use of each of the three activities chosen by the child, lessening transition time between activities. If the child completed or seemed to lose interest with an activity during the 10-minute intervention period, the teacher offered a new choice in order to maintain child engagement within the session. The teacher remained with the child throughout the 10-minute period, and if necessary, provided positive feedback, but no assistance. Allowing the children choice was paramount to maintaining autonomous play, and as “children are more likely to play with their chosen material for a longer duration, because children selected a material they found appealing” (DiCarlo, Baumgartner, et al., 2016, p. 144). All Pinch and Grip Strength Intervention activities were new to the classroom in relation to availability to the children (e.g., hole punch and pipe cleaners and other art materials were previously available for teacher use, but never before available for child use) in order to increase the appeal to the children. Upon completion of the intervention phase, these 14 activities were distributed throughout the classroom for free choice use during center time for all classroom children, providing the classroom with a variety of more focused fine motor choices.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Fine Motor Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed-the-Bunny Fine Motor Game</td>
<td>Objective: The child will use child-safe, elongated, plastic tweezers to pick up carrots from a basket and place them in the mouth of a rabbit.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Rubber Band Geo-Board</td>
<td>Objective: The child will use rubber bands to form shapes on a geo-board from their own cognition or from a cue card.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Eye Dropper</td>
<td>Objective: The child will use an eye dropper to transfer drops of dye-colored water from one bowl to another bowl with non-dyed water.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Scoop – A – Bug Sorting Kit Lakeshore ©</td>
<td>Objective: The child will use a pair of scooping tongs (similar to a scissor mechanism with plastic, half-circle collectors in place of blades) to pick up bugs and sort them into their appropriate beakers.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Mini Muffin Match Up Math Activity Set</td>
<td>Objective: The child will use a pair of squeezable scooping tongs (similar to a tweezer mechanism with plastic, half-circle collectors on ends) to pick up muffins and sort them into a color-coded muffin tin.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Buckle Book</td>
<td>Objective: The child will use three belt-like fasteners to open and close the rectangular buckle book.</td>
<td>Pinch Strength</td>
</tr>
<tr>
<td>Roll &amp; Tear Model Magic</td>
<td>Objective: The child will roll out, manipulate, and tear model magic with their fingers and hands.</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>Cardboard Slicing</td>
<td>Objective: The child will use child-safe box cutters to slice various sizes and thicknesses of cardboard.</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>Paper Hole Punch</td>
<td>Objective: The child will use a standard hole punch to punch holes in various configurations on a variety of papers (printer paper, construction paper, cardstock).</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>Cardboard Hole Punch</td>
<td>Objective: The child will use a heavy-duty hole punch with the ability to punch holes in a variety of configurations through various sizes and thickness of cardboard.</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>Slice Modeling Clay</td>
<td>Objective: The child will use a child-safe, plastic pizza cutter to slice through modeling clay after manipulating in various ways.</td>
<td>Grip Strength</td>
</tr>
<tr>
<td>String – A – Bead (Large)</td>
<td>Objective: The child will use oversized wooden beads and shoe strings to lace a variety of patterns.</td>
<td>Pinch and Grip Strength</td>
</tr>
<tr>
<td>String – A – Bead (Small)</td>
<td>Objective: The child will use pony beads and pipe cleaners to lace a variety of patterns.</td>
<td>Pinch and Grip Strength</td>
</tr>
<tr>
<td>Hammer &amp; Nail Board</td>
<td>Objective: The child will use a plastic, child-safe hammer to insert plastic, child-safe nails into a fabric covered Styrofoam rectangle.</td>
<td>Pinch and Grip Strength</td>
</tr>
</tbody>
</table>
Experimental Design

In this study, data were collected using a single case, multiple baseline design across children to measure engaged time with fine motor materials. A multiple baseline design allows for treatment to be introduced across subjects at different time phases (Kazdin, 2011). Data were collected in accordance with standards set forth from the *Single Case Technical Document* (Kratochwill, et al., 2010) and included a minimum of five data points per phase.

Interobserver Agreement

The reliability observer was a certified pre-kindergarten teacher with a bachelor’s degree in early childhood education. The reliability observer was trained by reviewing the behavior definitions, and through discussion with the researcher who answered any questions and explained examples and non-examples of the behaviors. All reliability data were scored from pre-recorded videos of sessions. The two observers then scored the videos simultaneously until they demonstrated at least 80% reliability. Interobserver reliability was calculated for 20% of all observations across baseline and the Pinch and Grip Strength Intervention conditions (Kratochwill, et al., 2010). Reliability was calculated using the point-by-point reliability formula, by taking the number of agreements and dividing by the agreements plus disagreements and then multiplying by one hundred to generate a percentage (Kazdin, 2011). For *engagement* the average reliability for occurrence was 95% (range, 81-100%), nonoccurrence was 87% (range, 50-100%), and overall reliability was 97% (range, 90-100%). The range for nonoccurrence reaching as low as 50% was reflective of the small window of nonoccurrence present in the intervention data, implying a large decline in reliability when in actuality there was only one disagreement present.
CHAPTER 4. FINDINGS

The purpose of the present study was to improve handwriting through increased engagement in fine motor pinch and grip strength lessons in three pre-kindergarten aged children. Specifically, the present study sought to determine (1) the mean duration of child engagement with fine motor materials within the classroom during free play, and (2) if direct intervention with fine motor materials, which promote pinch and grip strength, would impact handwriting performance as measured by the Stages of Emergent Writing (Byington & Kim, 2017) and the Teaching Strategies Gold Assessment (Heroman & Tabors, 2010).

Results indicated that the pinch and grip strength intervention increased children’s time spent engaging in fine motor play across all three children. A post-intervention handwriting sample also indicated that the pinch and grip strength intervention contributed to an increase in name writing performance (Teaching Strategies Gold) in all three children and an increase in compositional writing (Stages of Emergent Writing) for two of the three children.

Pinch and Grip Strength Intervention
Figure 1. *Percentage of observed intervals with engagement in fine motor activities*
**Kaleb**

During baseline, Kaleb engaged in fine motor play on average 50% (40-70%) of the observed intervals; when the *Pinch and Grip Strength Intervention* was used, Kaleb engaged in fine motor play on average 93% (range, 85-98%). This represents a 43-percentage point increase in fine motor play.

**Maleek**

During baseline, Maleek engaged in fine motor play on average 58% (50-65%) of the observed intervals; when the *Pinch and Grip Strength Intervention* was used, Maleek engaged in fine motor play on average 98% (range, 95 - 100%). This represents a 40-percentage point increase in fine motor play.

**Cali**

During baseline, Cali engaged in fine motor play on average 56% (25-83%) of the observed intervals; when the *Pinch and Grip Strength Intervention* was used, Cali engaged in fine motor play on average 99% (range, 98 - 100%). This represents a 43-percentage point increase in fine motor play.

**Handwriting Sample Assessment**
Figure 2. Child writing level by assessment across baseline and the Pinch & Grip Strength Intervention
**Kaleb**

During the pre-assessment handwriting assessment, Kaleb produced his name at a level 4, *Letter Like Forms or Mock Letters*, on the *Stages of Emergent Writing* (Byington & Kim, 2017) quantitative measure. This correlates to a level 6, *Writes Mock Letters or Letter-Like Forms*, in *Teaching Strategies GOLD 19a Writes Name*. After completion of the *Pinch and Grip Strength Intervention*, Kaleb produced his name in the post-assessment handwriting assessment at a level 4, *Letter Like Forms or Mock Letters*, on the *Stages of Emergent Writing* quantitative measure. This correlates to a level 7 in *Teaching Strategies GOLD 19a Writes Name*, which falls between 6, *Writes Mock Letters or Letter-Like Forms*, and 8, *Writes Letter Strings*. This represents no increase on the *Stages of Emergent Writing* quantitative measure, but a 1-level increase on *Teaching Strategies GOLD*. The mid-range scores on the *Teaching Strategies GOLD* assessment tool allowed the progress in Kaleb’s name writing product to reflect as a mid-range score, resulting in an increase, even though the *Stages of Emergent Writing* tool’s broader definitions did not illustrate his product growth.

**Maleek**

During the pre-assessment handwriting assessment, Maleek produced his name at a level 2, *Scribbling*, on the *Stages of Emergent Writing* (Byington & Kim, 2017) quantitative measure. This correlates to a level 4, *Makes Controlled Linear Scribbles*, in *Teaching Strategies GOLD 19a Writes Name*. After completion of the *Pinch and Grip Strength Intervention*, Maleek produced his name in the post-assessment handwriting assessment at a level 5, *Letter Strings*, on the *Stages of Emergent Writing* quantitative measure. This correlates to a level 8, *Writes Letter Strings*, in *Teaching Strategies GOLD 19a Writes Name*. This represents a 3-level increase on
the *Stages of Emergent Writing* quantitative measure, and a 4-level increase on *Teaching Strategies GOLD*.

**Cali**

During the pre-assessment handwriting assessment, Cali produced her name at a level 3, *Wavy Scribbles*, on the *Stages of Emergent Writing* (Byington & Kim, 2017) quantitative measure. This correlates to a level 5, between 4, *Makes Controlled Linear Scribbles*, and 6, *Writes Mock Letters or Letter-Like Forms*, in *Teaching Strategies GOLD 19a Writes Name*. After completion of the *Pinch and Grip Strength Intervention*, Cali produced her name in the post-assessment handwriting assessment at a level 4, *Letter Like Forms or Mock Letters*, on the *Stages of Emergent Writing* quantitative measure. This correlates to a level 7 in *Teaching Strategies GOLD 19a Writes Name*, which falls between 6, *Writes Mock Letters or Letter-Like Forms*, and 8, *Writes Letter Strings*. This represents a 1-level increase on the *Stages of Emergent Writing* quantitative measure, and a 2-level increase on *Teaching Strategies GOLD*. The mid-range scores on the *Teaching Strategies GOLD* assessment tool allowed the progress in Cali’s name writing product to reflect as a mid-range score, resulting in an larger increase, than on the *Stages of Emergent Writing* quantitative measure.
CHAPTER 5. DISCUSSION

The purpose of the present study was to improve handwriting through increased engagement in fine motor grip and strength lessons in three pre-kindergarten aged children. Specifically, the present study sought to determine (1) the mean duration of child engagement with fine motor materials within the classroom during free play, and (2) if direct intervention with fine motor materials, which promote pinch and grip strength, would impact handwriting performance. This study suggests that the Pinch and Grip Strength Intervention both increased the mean duration that children engaged in fine motor activity and also demonstrated an improvement in participating children’s handwriting as measured by the Stages of Emergent Writing (Byington & Kim, 2017) and Teaching Strategies Gold (Heroman & Tabors 2010).

As the literature has identified, structured fine motor lessons consisting of regulated fine motor materials and feedback have been documented as a strategy for strengthening children’s fine motor skills (Hamilton & Liu, 2017). Research literature recommends providing children with scaffolding and following children’s choice and natural interest (Bingham, Quinn, McRoy, et al., 2018), including teacher facilitated opportunities to observe modeled writing (Gerde, Bingham, et al., 2012), and considering the development of foundational skills that support fine motor, continuing through the stages of emergent writing (Byington & Kim, 2017; Quinn, Gerde, et al., 2016).

Name writing was chosen as the writing measure for this study as a means of creating a fair and developmentally appropriate assessment of pinch and grip strength abilities, which reflected increased performance. As identified by Puranik and Lonigan (2012), “name writing proficiency, not length of name is associated with preschool children’s developing emergent literacy skills” (Puranik & Lonigan, 2012, p. 284). This informed the structure of this study and
its assessment as a way to allow a nondiscriminatory strategy for tracking progress within handwriting through pinch and grip strength activities.

The intervention in the present study was designed to increase the time children spent engaging with fine motor materials with the intent of increasing handwriting performance. Initial data collection from the present study indicated that while children spend about half of their observed sessions engaged in fine motor play, when the intervention was introduced, there was an observed increase. This may have been due to the use of focused teacher modeling, support and feedback with materials that require the use of targeted fine motor skills. Previously, the children lacked a strong connection to the existing fine motor materials presented to them in the classroom. In contrast with the baseline conditions, the Pinch and Grip Strength Intervention provided access to interesting and meaningful activities, thus their duration of engagement showed an increase.

Auerbach (2012) advises that toy selection requires special consideration to ensure that materials eliciting age-appropriate development skills are selected. While children did interact in roughly half of the observed sessions with fine motor materials, the increased interaction following intervention could have been the novelty of the materials or the presence of choice. Materials that were present in the early childhood classroom prior to the intervention had been present in the classroom for three months and were an everyday part of the classroom. The lack of fine motor material rotation may have contributed to the novelty effect of the new materials. Materials for the Pinch and Grip Strength Intervention were carefully selected to elicit targeted skills and presented in a choice-driven, play-based fashion, which may have contributed to the increased duration of engagement in fine motor play.
Consistent with the recommendations of Moon et al. (2019), to expand fine motor experiences beyond technology for children 4 years and older, there were no technology choices provided in this intervention. This effort attempted to fill a gap left in the typical play of pre-kindergarten aged children. According to pre-assessment name writing data, all three children were able to hold and manipulate the pencil in a manner which mimicked name writing, therefore proving they were not in need of the basic fine motor engagement technology could provide. The results of the Pinch and Grip Strength Intervention indicate that more hands-on materials and teacher involved activities were more beneficial than independent technology play.

In addition to the increased appeal of the toys presented during the intervention, the teacher provided the children with a choice of 14 activities during each session. The value of choice has been established in the literature as being preferred by young children (Fenerty & Tiger, 2010) and also important for increasing duration of play (DiCarlo, et al., 2016). Similar to this research, this study also demonstrated that children seemed to prefer choice.

The increased awareness of the stages of writing through the use of the two writing assessments (Stages of Emergent Writing, Byington & Kim, 2017; Teaching Strategies Gold, Heroman & Tabors 2010) impacted the materials present in the classroom as well as the teacher’s facilitation strategies.

Similar to Bingham, et al., (2018) and Bingham and Wasik (2012) integrating fine motor intervention through play allowed the teacher opportunities for scaffolding children’s fine motor skills. The addition of new materials and increased teacher awareness shifted the teacher’s interactions.

The impact of teacher promoted activities is shown in the results of the Pinch and Grip Strength Intervention. During baseline, there was no interaction between the children and the
teacher, as solely child-led free play was being observed. Results from the present study are consistent with Gerde, et al. (2016) being that when teacher modeling and feedback were provided, child engagement increase.

**Limitations**

A limitation for the present study is the size of the population, as one regular education pre-kindergarten classroom was utilized to narrow down the participants to three children; each child exhibited a need for an increase in fine motor pinch and grip strength. However, the selected children were the lowest performing students, therefore, demonstrating their collective need for the intervention, controlling for the selection process and the internal validity of the study (Kratochwill, et al., 2010). Due to the single case subject design, the results were generalized which can cause potential conflict for the external validity, due to the limited number of participants involved (Kazdin, 2011). In addition, there was a potential for bias as the researcher for this study was the lead teacher within the pre-kindergarten classroom in which this study took place. However, these limitations did not impact the study as data were collected consistently throughout the baseline and intervention phases, including follow-up data collection, over a short period of time lessening the prospect of history and maturation impacting the validity of the study.

During the baseline data collection, the definition of fine motor toy play was broad in the acceptance of what fine motor toy play looked like, including any material that required fine motor movements. It could be said that while utilizing fine motor skills, the children were not solely utilizing materials which elicited pinch and grip strength, as they were directed to do within the intervention period. This could account for the relatively high duration of engagement in fine motor play during baseline. A more narrowly-focused definition of fine motor skills
specific to pinch and grip may have provided a more accurate depiction of the prewriting skills
play children engaged in prior to the intervention. The changes in available materials during
intervention were more focused on those fine motor skills that supported handwriting; the more
generalized definition likely inflated the baseline engagement scores.

The handwriting sample assessment data were collected in a naturally occurring
compilation, therefore they did not conflict with the intervention effects (Kratochwill, et al.,
2010). Due to the specific nature and purpose of the fine motor assessment utilized in the pre-
and post-writing assessment, a model of the child’s name was not provided during their name
writing assessment. This course of action was chosen, as correct name writing was not the main
goal of the intervention, and was not needed to show improvement in pinch and grip strength
through letter strokes or formation. However, in relation to the literature which promotes teacher
provided modeling and prompting (Bingham & Wasik, 2012) it is possible that a broader
representation of fine motor related writing skills could have been demonstrated in each child’s
product, had there been a name prompt present during both pre- and post- writing assessment.

In a similar fashion, a child progressing from scribbles to mock letters in terms of writing
development is impacted by handwriting or pinch and grip strength, but it is not necessarily the
only causative component. Cognitively, children are prompted to move from scribbling to letter
like forms based upon a naturally occurring progression within their comprehension of letters as
symbols, and an understanding that letters produce sounds and accompany oral language
(Fountas & Pinnell, 2017; Fountas & Pinnell, 2018). This study focused on the increased
duration of fine motor engagement through physical strengthening of pinch and grip strength and
the impact this direct intervention has on handwriting. Though, what this study did not track, was
the terms of exposure, from a cognitive sense, to the conceptual meaning of letters, recognition
of letters, pointing out of letters through shared reading and writing experiences, or awareness of environmental print and peer usage of writing. Therefore, even though the fine motor play engagement and pinch and grip strength interventions had a positive impact on handwriting, one cannot assume this was the sole contributing factor.

**Clinical Implications**

Results from the present study suggest that teachers should consider the stages of emergent writing in the selection of fine motor materials and offer enough variety so that children have choices between play materials. Teacher facilitation strategies, such as modeling, scaffolding and feedback should be used to support both children’s name writing and compositional writing within meaningful play routines and activities.

This study sets in motion the foundational steps for creating a strong writer throughout the course of education. Educators should foster an environment that facilitates meaningful writing in play, provides materials that specifically target age appropriate fine motor skills within instruction, and monitors and collects data which can inform instruction across all content areas including math, reading, and writing (Bingham & Wasik, 2012; Quinn, et al., 2016; Suggate, Stoeger, et al., 2017).

In contribution to intentional instruction, and with relevancy to smart devices and technology in today’s world and society, especially in the field of education, classrooms should design technology usage plans. This would allow for the new world of instruction, and also the ability to maintain developmentally appropriate expectations and instruction. It is relevant to consider the ratio of time spent interacting with devices, versus with writing instruments and other fine motor manipulation. As young children's use of digital devices can impact their experience and their abilities with handwriting. In fact, Moon, et al., (2019) encourages
educators to take caution about writing on a screen with a single finger, in comparison with the different physical handwriting tasks required of a writing implement. Classrooms should be aware of the foundational difference in the usage of fine motor practice via smart devices, versus traditional paper pencil lessons.

In order to strengthen fine motor pinch and grip strength, classrooms should provide designated materials and instruction time to activities that require the use of smalls muscle control. Next, classrooms can provide instructional time promoting grapho-motor skills (Suggate, Pufke, et al., 2018) which requires these newly developed muscles to begin using pre-writing strokes of linear and circular motions to extend emergent writing. This will allow educators to intervene and scaffold grip (Lin, et al., 2015) to encourage future letter formation for name writing and composing messages, as is the purpose of this study.

As this study has brought to the forefront, emergent writing develops in stages (Byington & Kim, 2017). This knowledge should be widespread across early childhood educators so that developmentally appropriate expectations may be set for each learner, and the next steps of writing may grow from fine motor development and name writing. Bridging simple strokes and letter formations to messages, where “young children learn that writing has a purpose and that print is meaningful (i.e., it communicates ideas, stories, and facts)” (Byington & Kim, 2017). With this, educators will help children to gain the ability to translate thoughts into writing that goes beyond the word level (Puranik & Lonigan, 2014) through scaffolding from letter formation to composition (Bingham, Quinn, Gerde, 2017; Quinn, et al., 2016).

**Future Research**

As early childhood education evolves in compliance with the relevancy of smart device usage and its impact on both cognitive and fine motor development (American Academy of
Pediatrics, 2016; Bruce-Lockhart, 2018; Moon, et al., 2019; Organisation for Economic Co-operation and Development, 2019), research needs to continue to collect data on what types of technology should be made available for young children both inside and outside of the classroom, including computers, tablets, or interactive white boards. Once a standard for device availability is determined, research could continue to delve deeper in the importance of specific applications and opportunities which encourage fine motor development, through the requirement of pinching and or motions of the wrist and index finger. In fact, research can work to determine if there is in fact, a negative impact of using technology in the absence of a stylus or if there should there be a combination of finger isolation and stylus use. A wider array of research will increase the acceptance of technology in the classroom, provided it is implemented in a way that maintains developmentally appropriate expectations and supports children’s development.

Though the present study contributes to the existing research about emergent writing and fine motor skills separately, there is a narrow field of literature that address fine motor interventions set forth to increase writing readiness in early childhood. Future research should work to build literature on how an understanding of fine motor development can impact early childhood teachings to create less need for intervention, and more room for scaffolding throughout effective instruction. The literature supporting this study reinforces the foundational skills and developmental stages of emergent writing (Byington & Kim, 2017), but there is a lack of existing studies which track a child’s development from initial muscle development of grapho-motor (Suggate, Pufke, et al., 2018) pre-writing strokes through composing with conventional spelling and sentence writing. Broader research into these topics would create more
awareness in educators and more intentional teaching so young children can gain a more encompassing, developmentally appropriate education.

The present study worked solely with name writing, with literature justifying that this, unlike writing for meaning, does not require alphabet knowledge nor spelling tasks, therefore serving as a more meaningful measure for the foundational fine motor skills of writing (Puranik & Lonigan, 2012). Consequently, it did not focus on when the shift from name writing to writing for meaning, or composition, should take place. Both of these skills are represented in Teaching Strategies GOLD Objective (Heroman & Tabors, 2010) in dimensions 19a: Writes Name and 19b: Writes to Convey Meaning, making this a question that is lucrative to all early childhood educators, especially those assessing utilizing this tool. Both of these skillsets require the foundational fine motor skills increased with the pinch and grip strength intervention, therefore, future research should seek to answer the issue of where in the developmental process should fine motor skills and the cognitive knowledge of letters merge to create emergent, composed writing.

In solving this question, future research could broaden the scope of the participating population to younger children who are functioning on, or above their developmental level for fine motor development. Subsequently, documenting their mastery of their kinematic parameters (Liu, et al., 2015), their movements and force with which they create their writing. Perhaps, in the exact opposite, it would be advantageous for research to collect data on older children, who are functioning below their developmental level for the same data. Through the analyzation of kinematic parameters, more direct writing interventions could pair with direct fine motor activities in order to build these developmental skills in unison. Understanding this range of development and what may be missing could be the next step to creating more effective
interventions to increase pinch and grip strength, with a direct impact on emergent writing readiness.
Appendix A. Teaching Strategies Gold 7a and 7b Dimensional Progression

**Objective 7** Demonstrates fine-motor strength and coordination

### a. Uses fingers and hands

<table>
<thead>
<tr>
<th>Not Yet</th>
<th>1</th>
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<th>3</th>
<th>4</th>
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<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaches for, touches, and holds objects purposefully • Eats or sipps at a toy • Transfers objects from one hand to another • Releases objects voluntarily • Rakes and scoops objects to pick them up • Picks up food with fingers and puts in mouth • Bangs two blocks together • Crumples paper</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Uses fingers and whole-arm movements to manipulate and explore objects • Places shape in shape sorter • Points at objects and pokes bubbles • Releases objects into containers • Uses spoon and sometimes fork to feed self • Dumps sand into containers • Unbuttons large buttons • Rotates knobs • Tears paper</td>
<td>✗</td>
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</tr>
<tr>
<td>Uses refined wrist and finger movements • Squeezes and releases longs, turkey baster, squirt toy • Snips with scissors • Strings large beads • Pours water into containers • Pounds, pokes, squeezes, rolls clay • Buttons, zips, buckles, laces • Uses hand motions for “I spy, It’sy Spider” • Turns knobs to open doors • Uses eating utensils • Sews facing cards • Cuts along straight line</td>
<td>✗</td>
<td>✗</td>
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<td>✗</td>
<td>✗</td>
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<td>✗</td>
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<td>✗</td>
</tr>
<tr>
<td>Uses small, precise finger and hand movements • Uses correct scissors grip • Attempts to tie shoes • Puts letters specific keys on a keyboard • Arranges small pegs in pegboard • Strings small beads • Cuts out simple pictures and shapes using smooth, even strokes • Pours liquid during science experiment into small opening without spilling</td>
<td>✗</td>
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</tr>
<tr>
<td>Uses smooth finger and hand movements • Stays within the lines while following a maze • Outlines/traces shapes using smooth, even strokes • Cuts food • Builds a structure using small plastic building bricks</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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</tr>
<tr>
<td>Manipulates grade-appropriate tools and intricate materials with control and precision • Cuts complex pictures and shapes, leaving edges smooth • Folds paper to make an origami creature • Uses try pieces to make a detailed miniature world for a social studies project • Uses keyboarding skills to compose a short story on the computer</td>
<td>✗</td>
<td>✗</td>
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</tbody>
</table>

### b. Uses writing and drawing tools

<table>
<thead>
<tr>
<th>Not Yet</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasps drawing and writing tools, jabbing at paper</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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</tr>
<tr>
<td>Grips drawing and writing tools with whole hand but may use whole-arm movements to make marks</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Holds drawing and writing tools by using a three-point finger grip but may hold the instrument too close to one end</td>
<td>✗</td>
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</tr>
<tr>
<td>Uses three-point finger grip and efficient hand placement when writing and drawing</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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</tr>
<tr>
<td>Demonstrates control and appropriate pressure when using writing and drawing tools; writes legibly</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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</tr>
<tr>
<td>Moves writing or drawing utensils fluidly across the page with increasing speed and accuracy; produces letters and number symbols having accurate formation, size, proportion, slant, and spacing; may use cursive writing</td>
<td>✗</td>
<td>✗</td>
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</tr>
</tbody>
</table>
TO: Cynthia Dicarlo  
Education

FROM: Dennis Landin  
Chair, Institutional Review Board

DATE: November 7, 2019

RE: IRB# E11968

TITLE: Impact of Direct Fine Motor Interactions on Handwriting


Review Date: 11/6/2019

Approved X Disapproved

Approval Date: 11/6/2019 Approval Expiration Date: 11/5/2022

Exemption Category/Paragraph: 1

Signed Consent Waived?: No

Re-review frequency: Three years

LSU Proposal Number (if applicable):

By: Dennis Landin, Chairman

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING – Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
8. SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.

* All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb
# Appendix C. Stages of Emergent Writing

<table>
<thead>
<tr>
<th>Point Value</th>
<th>Stages of Emergent Writing</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drawing</td>
<td>Drawings that represent writing</td>
<td>![Drawing Example]</td>
</tr>
<tr>
<td>2</td>
<td>Scribbling</td>
<td>Marks or scribbles the child intends to be writing</td>
<td>![Scribbling Example]</td>
</tr>
<tr>
<td>3</td>
<td>Wavy scribbles or mock handwriting</td>
<td>Wavy scribbles that imitate cursive writing and have a left-to-right progression; child pretends to write words</td>
<td>![Wavy Scribbles Example]</td>
</tr>
<tr>
<td>4</td>
<td>Letter-like forms or mock letters</td>
<td>Letters and marks that resemble letter-like shapes</td>
<td>![Letter-like Forms Example]</td>
</tr>
<tr>
<td>5</td>
<td>Letter strings</td>
<td>Strings of letters that do not create words, written left to right, including uppercase and lowercase letters</td>
<td>![Letter Strings Example]</td>
</tr>
<tr>
<td>6</td>
<td>Transitional writing</td>
<td>Letters with spaces in between to resemble words; letters/words copied from environmental print; letters often reversed</td>
<td>![Transitional Writing Example]</td>
</tr>
<tr>
<td>7</td>
<td>Invented or phonetic spelling</td>
<td>Different ways to represent the sounds in words; the first letter of the word or beginning and ending sounds represent the entire word</td>
<td>![Invented or Phonetic Example]</td>
</tr>
<tr>
<td>8</td>
<td>Beginning word and phrase writing</td>
<td>Words with beginning, middle, and ending letter sounds; short phrases</td>
<td>![Beginning Word and Phrase Example]</td>
</tr>
<tr>
<td>9</td>
<td>Conventional spelling and sentence writing</td>
<td>Correct spelling of words, generally the child's name and words such as mom and dad; sentences with punctuation and correct use of uppercase and lowercase letters</td>
<td>![Conventional Spelling Example]</td>
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</table>
# Appendix D. Teaching Strategies Gold 19a Dimensional Progression

## Objective 19: Demonstrates writing skills

**a. Writes name**

<table>
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<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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<tr>
<td>Makes scribbles or marks</td>
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</table>
- Scribble writes deliberately
- Makes marks that appear to adults to be in random order
| Makes controlled linear scribbles |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
- Scribbles lines, circles, or zigzags in rows
- Often repeats action and forms
| Writes mock letters or letter-like forms |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
- Writes segments of letter forms, e.g., lines, curves
- May use too many segments to create a letter, e.g., five horizontal lines on the letter E
- May not orient letter segments correctly
| Writes letter strings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
- Writes some letters correctly
- Writes letters in unconventional order
| Writes partially accurate first name |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
- Writes all the letters of own name, although some may not be sequenced correctly
- Writes all the letters of own name, but some of the letters are not formed or oriented correctly
| Writes accurate first name |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
- Writes all the letters of own name in the correct sequence, form, and orientation
- Uses uppercase or lowercase letters (or a combination of both) when writing name
| Writes accurate first and last name |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

- Carolyn
- Lilly
- Paula
- Emma
- Vicky
- Brooke
- Abraham
### Appendix E. Data Collection Sheet

Target Child:________________ Teacher:________________ School:_________________
Date:_______________ Observer:__________________ Reliability Observer:______________

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References


VITA

Carlye Breuhl was born in New Orleans, Louisiana. She resided in the state of Louisiana until she was 10 years-old then moved with her family to Texas. Upon completion of high school, she chose to attend Louisiana State University where in May 2016, she received her Bachelor of Science in Early Childhood Education and a teaching certification for pre-kindergarten through third grade. Since earning her degree, she has taught pre-kindergarten at Title I school in Baton Rouge for four years. After Carlye graduates with her Masters of Education in Curriculum and Instruction with a focus in early childhood, she plans to continue teaching in the early childhood classrooms in Louisiana.