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School of Health Sciences

Department of Occupational Therapy

# Effectiveness of Traditional Handwriting Instruction Supplemented With App-Based Instruction on Handwriting Legibility

An Evidence-Based Capstone Project In Occupational Therapy

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Submitted in Partial Fulfillment of the Requirements for the Degree of Occupational Therapy Doctorate

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#### Abstract

The task of handwriting is a necessary skill that elementary school students use each school day. Students who struggle with the skill are often referred for occupational therapy services for remediation. Currently, there is a lack of consistent handwriting instruction implemented within the kindergarten classroom, leaving teachers to provide instruction on this pertinent skill with little to no training and no curriculum to follow. This evidence-based practice project combines traditional instruction supplemented with tablet-based instruction in lowercase letter writing to one class of kindergarten students (n=16). Pre-and post-testing utilizing the Handwriting Without Tears® Print Tool® indicated 94% of students made gains in their overall handwriting skills. A similar percentage of student showed improvement with their ability to correctly sequence the strokes to form the letters. Additionally, 81% of students demonstrated improvement in the areas of placement of letters appropriately on the baseline and their ability to form lowercase letters from memory. These project results support the effectiveness of traditional handwriting instruction supplemented with tablet-based instruction to improve handwriting legibility of kindergarten students.

*Keywords:* occupational therapy, handwriting, LetterSchool™, Handwriting Without Tears®, kindergarten, education, teachers

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## Dedication

This project is dedicated to my dad, who left us to soon and did not get to firsthand witness this process. I know you would be proud.

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#### Chapter 1

#### Introduction and Overview of the Problem of Interest

This chapter provides an overview of the setting and lays the groundwork for the evidence-based project. A description of the setting, problem to be addressed, and the rationale are included. The project focuses on improving handwriting legibility of kindergarten students through the use of a tablet-based application which provides letter formation instruction to supplement traditional handwriting instruction methods. Also included are supports for the project, barriers that may arise, and the significance to the profession of occupational therapy.

#### **Description of the EBOT Project Setting**

The evidence-based occupational therapy project setting was a public-school system in the Metropolitan area of Atlanta, Georgia. This project took place within a kindergarten classroom in an elementary school that teaches kindergarten through fifth grade. The Henry County School system consists of 50 schools including 28 elementary schools, 11 middle schools, and 11 high schools. In addition, there are two educational programs of choice available, including an advanced studies/dual enrollment program and online learning program combined with classroom support. The school district serves approximately 42,000 students with 52% identified as African American, 32% Caucasian, 9% Hispanic, 4% Multi-racial, and 3% Asian. The school district is the county's largest employer, employing over 5,000 personnel, with 84% being teachers, 10% being Support Staff, and 6% being administrators (HCS, 2017, p. 1).

Henry County Public Schools believes "all learners will excel in an environment centered on rigor, relevance and relationships" to meet the mission statement of "ensuring success for EACH student" through the vision of "building a culture of personalized learning" (HCBOE,

n.d.). The majority of the schools have been renovated or are in the process of renovation to be updated with the latest technology, including promethean boards or smart boards. In addition, the Henry County Public Schools has over 45,000 computers or devices, meeting the one to one technology initiative. Students enrolled in kindergarten through second grade are issued an iPad which remains at school while students above third grade are each issued a Chromebook to utilize between home and school (HCS, 2017).

Occupational therapists fall under the purview of Exceptional Student Education, a component of the Family and Student Support division. The Office of Family and Student Supports provides support for students through many services including but not limited to vision services, occupational therapy, physical therapy, speech therapy, and assistive technology. This is also the umbrella under which special education services fall.

Currently, nine occupational therapists serve students in the district. Students with variety of disabilities receive their education within the county under the guidelines of the Individuals with Disabilities Education Act, Section 504 of the Rehabilitation Act, and the Americans with Disabilities Act. Eligibility areas include significant developmental delay, varying degrees of intellectual disabilities, autism, orthopedic impairment, other health impairment, traumatic brain injury, emotional behavioral disorder, specific learning disability, visual impairment, deaf/hard of hearing, and speech impairment. Students receiving special education services can be referred for an occupational therapy evaluation by the individualized education plan (IEP) committee, parent request, or teacher request. The IEP committee consists of the special education teacher, general education teacher, parent(s), student, and other service providers, such as occupational, physical, or speech therapists. The teacher of the visually impaired or the deaf/hard of hearing teacher may also be involved in the student's educational

program planning. The American Occupational Therapy Association identifies participation in educational activities as one of the domains of practice for occupational therapists (AOTA, 2014).

The occupational therapists within the county maintain caseloads of 35-60 students and provide services in a variety of ways including direct, collaborative, and consultative services. Services can also be delivered in a variety of locations including a specific therapy room or sensory room, the classroom, the cafeteria, the media center, the playground, and in the community. Service time and delivery methods are identified on the student's IEP or 504 Accommodation Plan. Educationally relevant goals and objectives are identified by the IEP committee with occupational therapy services supporting the student's ability to make the necessary progress.

Currently, the Henry County School System does not utilize a handwriting curriculum that is consistently taught throughout the district. An informal interview of kindergarten teachers across five elementary schools in the metro area school district indicated that the method for teaching handwriting skills ranged from non-continuous strokes such as "ball and stick" (i.e. vertical line written next to a circle to form "b" or "d") to the D'nealian style of handwriting, with teachers encouraging the formation style which is most legible. As occupational therapists in the school system, packets of strategies can be provided to teachers for implementation with struggling students. If the student requires further interventions, they are referred for an evaluation and may receive direct or collaborative services with remediation activities to target deficit areas. This allows the student to receive focused instruction on the needed skills to be successful within the classroom. Instruction may focus on the aspects of handwriting legibility or the underlying deficits which impact the ability to perform these specific tasks.

#### Description/Background of the Problem & Rationale for EBOT Project

Within school systems, a large number of referrals generated for occupational therapy services are due to difficulties with handwriting legibility and the related fine motor skills (Asher, 2006). Asher (2006) also indicated that many of the students referred for occupational therapy services do not have deficits in visual motor or fine motor skills which would explain the difficulties with handwriting skills. With the increase in technology use, many students are not engaging in fine motor play activities, choosing to play games on tablets or gaming systems instead. This can negatively impact the acquisition of the necessary fine motor skills to complete handwriting activities (Lin, Cherng, & Chen, 2017). Also, the demands presented for our youngest students are higher than ever. A few decades ago, kindergarten students participated in center time, including art, dramatic play, science, and water/sand table centers with less demands on academia. Now, these same age students are expected to be able to write two to three sentence responses by the end of the school year, as well participate in standardized testing throughout the year (Bassok, Latham, & Rorem, 2016). With the lack of formalized instruction and the increased demands for kindergarten students, difficulty with handwriting skills is becoming more prevalent (Asher, 2006).

Even though tablet use appears to have a mixed impact on the development of fine motor skills, the use of electronic devices is highly motivating for students (Butler, Pimenta, Tommerdahl, Fuchs, & Cacola, 2019; Karlsdottir & Stefansson, 2002; Lin et al., 2017). Children are struggling more and more with the ability to produce legible writing and often dislike practicing skills such as letter formation, but they may be willing to engage in this task if the practice is app-based. While technology is often blamed for the decrease in fine motor skills,

research supports that it can result in improved handwriting legibility, especially when paired with more traditional instruction (Jordan, Michaud, & Kaiser, 2016).

Poor handwriting impacts many areas of education. According to Bassok et al. (2016), the expectation is for kindergarten students to be able to compose and write complete sentences as well as compose responses with a beginning, middle, and end by the end of kindergarten. One study indicates approximately 10% to 30% of students have dysfunctional handwriting which requires remediation (Karlsdottir & Stefansson, 2002, p. 623). With the increase in technology available, one might speculate as to the importance of handwriting skills. Handwriting skills continue to be an important occupational task for students within their school day (Randall, 2018). Randall (2018) also indicates that handwriting skills are an important method utilized for children to demonstrate knowledge and also reinforce early literacy skills making the development of legible handwriting of utmost importance.

Given the increase in referrals for occupational therapy evaluations related to handwriting, occupational therapists are typically viewed as the experts on handwriting remediation. Occupational therapists have the unique ability to analyze the performance task to locate the source of dysfunction. With occupational therapists playing a key role in the area of handwriting remediation, it is important to identify the most effective and client-centered way to address this issue. Providing traditional handwriting instruction supplemented with the use of an application which teaches letter formation may provide the necessary skills for students to increase success in this area. Therefore, the purpose of this project is to apply the existing evidence related to effective handwriting instruction and technology use to promote improved legibility in handwriting of kindergarten students.

#### **Identification of Supports & Barriers**

**Supports**. Completion of this project required many physical and emotional supports. The support of the coordinator of the occupational therapy department as well as the support of the volunteer classroom teachers who will implement the program has been verbalized. Parental support was also required as consent needed to be obtained for the students to participate. The school system has resources such as computers, iPads, space for training, copy paper, and multiple handwriting curriculum materials which were required.

Barriers. There were several possible barriers to the completion of this project. Some applications that were used have a charge associated with them and this was a barrier. Time within the school day for implementation of the program was a barrier to completion of the project. Schedule changes and unplanned events, such as school closures due to weather could have impacted consistency of implementation. Student illness and absence may have negatively impacted the amount of intervention the student received leading to another barrier to successful completion of the project.

While issues such as weather days and student sickness could not be prevented, discussing the importance of consistency with the implementation of the intervention helped to alleviate lack of follow through within the classroom. This was addressed with collaboration with the teachers to determine the best time to implement the intervention within the already established class schedule. In addition, education provided to the parents of the participating students may have lessened the number of unnecessary absences. Make-up sessions were provided to alleviate missed instruction due to absences. Also, by providing evidence to the school system supporting the problem and proposed intervention, the school district may be willing to purchase the application, which may offset the financial burden and access barrier.

#### Significance of the EBOT Project to the Field of Occupational Therapy

This project sought to identify effective ways to address deficits in handwriting legibility in kindergarten students. It was designed to determine the effectiveness of supplementing traditional handwriting instruction with practice utilizing a tablet-based application for letter formation. This will aid to increase the knowledge of school-based occupational therapists on evidenced based interventions to improve handwriting legibility. Utilizing a collaborative approach with teachers, occupational therapists can support whole classrooms of students in their natural environments within the school day. This will also improve the perception of the value of occupational therapy services within the school setting. By implementing this program within the general education kindergarten classroom, students who are struggling with handwriting skills may benefit from this collaborative approach, resulting in a decrease in occupational therapy referrals. The results of this project may provide sound information to support the use of technology as a supplement to traditional handwriting programs. Providing this evidence would be a benefit for the profession as it would indicate additional intervention methods for handwriting instruction.

#### Chapter 2

#### Review of the Literature/Evidence

This chapter serves to review the information related to the evidence-based practice question and the synthesis of the Critically Appraised Topic Portfolio. The methodology of the literature search and a description of the portfolio are included. The evidence that directly supports the proposed intervention is reviewed as are the subthemes which indirectly support the intervention, provide background information, and provide information on outcome measures for data collection.

#### **The Evidence-Based Practice Question**

The evidence-based practice question was created after considering the need for successful, motivating interventions for handwriting deficits for school-based therapists. With a vast majority of occupational therapy referrals generated in the schools relating to handwriting, successful interventions are imperative (Asher, 2006). Many of these students have not received explicit handwriting instruction in their classrooms as there is not an adopted handwriting curriculum in the school district at this time, leaving teachers to provide instruction without training. With technology becoming utilized more frequently within the educational setting, using this medium as way to practice letter formation in addition to the traditional methods implemented within the classrooms could be beneficial, leading to the development of the following evidence-based practice question:

Population: kindergarten students

Intervention: traditional handwriting instruction supplemented with a tablet-based

application which teaches letter formation

Outcome: improved legibility

PIO Question: Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

#### Narrative Synthesis of CAT Portfolio

**Methodology of literature search**. The literature search of multiple databases was conducted between February and April of 2019. The library services of Chatham University were utilized during the literature search. Databases searched included the following: CINAHL, ERIC, Discovery, EBSCO, PEDro, Google Scholar, Medline, as well as the American Journal of Occupational Therapy, British Journal of Occupational Therapy and the Canadian Journal of Occupational Therapy. Key search terms included the following: handwriting instruction, kindergarten, technology, application, iPad, handwriting intervention, tablet, and traditional handwriting. The search utilized various combinations of the previous search terms. Results from the initial searches led to the terms LetterSchool<sup>TM</sup> and Handwriting Without Tears® being added in combination with other search terms listed. LetterSchool<sup>TM</sup> is a specific application which provides instruction on letter formation. Handwriting Without Tears® is a multisensory handwriting curriculum that focuses on the developmental progression of letter formation. Additional articles were located utilizing reference mining. Inclusion criteria included peerreviewed articles published in English and available as full text which discussed traditional instruction or technology-based instruction in handwriting, outcome measures, or typical handwriting instruction within a similar population as the proposed project. The search was limited to articles published within the last 15 years, although one article located through reference mining was included due to the relevant information it provided. Articles were excluded which did not meet the inclusion criteria. The search resulted in 13 articles being

chosen for the Critically Appraised Topic Portfolio as best evidence based on the relevancy of the information, research, and results related to the proposed intervention of the evidence-based capstone project. Chosen articles were published between 2002 and 2019 to maintain the most current and relevant information.

Description of the portfolio. The Critically Appraised Topic Portfolio includes a variety of articles from scholarly and peer reviewed professional journals including the *American Journal of Occupational Therapy, Australian Occupational Therapy Journal, AERA Open, Frontiers in Psychology, Journal of Early Childhood Literacy, OTJR: Occupation, Participation, and Health, Developmental Medicine & Child Neurology, Journal of Occupational Therapy, Schools, & Early Intervention, Perceptual and Motor Skills, Physical & Occupational Therapy in Pediatrics, and Journal of Developmental & Physical Disabilities. The portfolio consists of 11 articles published between the years of 2014 to 2019, one article published in 2006, and one article published in 2002. The articles published in 2002 and 2006 are older publications but provided background information regarding the development of handwriting skills and the need for a consistent handwriting curriculum for increased legibility. The Critically Appraised Topic Portfolio contains studies conducted in the United States, Australia, Switzerland, Norway, and Taiwan.* 

The Critically Appraised Topic Portfolio (see Appendix A: Literature Matrix and CAT Portfolio, p. 70) contains qualitative and quantitative studies ranging in levels of evidence from level II to level IV. It consists of six level II studies which were small scale randomized control studies, cohort studies with a control, or two-group non-randomized pre-test-post-test studies. The one level III study was a longitudinal study. There were three level IV studies which included a survey study, a correlational study, and a single case design study. In addition, one

study was a mixed method which included a qualitative portion and level III evidence. Lastly, two studies were phenomenological qualitative studies. Each study was carefully chosen for content and quality to address the PIO question. After careful review of the literature, several articles were found to directly support the effectiveness of the proposed intervention. In addition to direct evidence, the following themes emerged: handwriting instruction in early education, perceptions of teachers related to handwriting instruction, occupational therapist collaboration with teachers, use of technology, and evaluation and outcome measures.

Synopsis of evidence that directly supports the intervention. Within the school setting, handwriting is an important occupation in which students engage for a large percentage of the day. When students have difficulty mastering this skill, they are often referred for occupational therapy services (Asher, 2006; Nye & Sood, 2018). Several studies point to the need for consistency with handwriting instruction, regardless of the program, as imperative for acquisition of this essential skill (Asher, 2006; Hape et al., 2014; Randall, 2018). While there is little evidence to support the use of a specific handwriting program for teaching letter formation, a key component in handwriting legibility, (Asher, 2006), the Handwriting Without Tears® curriculum has been utilized to successfully teach this skill in research (Hape et al., 2014; Randall, 2018). The study completed by Randall (2018) demonstrated that 70% of students showed improvement with lower case letter formation, the letters which were addressed, from memory and for proper alignment (p. 381). Proper formation and alignment are key components to handwriting legibility.

While implementation of a consistent handwriting curriculum is necessary, the utilization of technology to address fine motor skills including handwriting skills has also shown promise.

According to Butler et al. (2019), the use of technology within the classroom can be motivating

for students to practice skills, leading to additional repetitions. One study which replaced tabletop activities with play on tablet-based applications designed to improve fine motor skills showed improvements in the formation of capital letters and scissor skills as well as statistically significant improved scores for motor coordination (Axford, Joosten, & Harris, 2018).

Other studies looked more specifically at letter formation, which impacts the ability to produce legible handwriting. Wells, Sulak, Saxon, and Howell (2016) completed a study which compared letter formation instruction completed on an iPad to traditional paper/pencil handwriting instruction. The results indicated that both the iPad mediated instruction group and the traditional instruction group both increased in letter formation by the same median amount, but letter production, or the quantity of letters produced, showed a statistically significant increase for the iPad group over the traditional group as assessed on the pencil/paper outcome measure utilized for the study (Wells et al., 2016). This study concluded that both groups increased in handwriting quality including legibility. Lorah and Parnell (2014) looked at the acquisition of letter writing using the application LetterSchool<sup>TM</sup> and iPod Touch® devices in students with developmental disabilities. Students utilized a stylus to complete learning tasks on the device followed by completing pencil/paper letter writing. Results indicated that students mastered letter formation of the presented letters and generalized this to paper/pencil tasks increasing the rate of mastery with each letter (Lorah & Parnell, 2014).

Studies have shown that both traditional instruction with pencil and paper as well as tablet-based instruction shows effectiveness in improving letter formation, a key component in handwriting legibility (Asher, 2006; Axford et al., 2018; Butler et al., 2019; Hape et al., 2014; Lorah & Parnell, 2014; Randall, 2018; Wells et al., 2016). Jordan et al. (2016) and Butler et al. (2019) both completed studies combining traditional instruction with app-based instruction

utilizing the application LetterSchool<sup>TM</sup>. Results indicated that the combination of instruction methods led to an increase in handwriting legibility (Butler et al., 2019; Jordan et al., 2016).

These studies support the proposed intervention of the use of traditional paper/pencil handwriting instruction supplemented with app-based instruction as an effective approach to improving legibility. By utilizing both pencil/paper instruction and app-based instruction, improvement in handwriting legibility may be achieved. Based on literature findings, paper/pencil instruction utilizing the Handwriting Without Tears® curriculum combined with the application LetterSchool<sup>TM</sup> may provide a successful instruction method for letter formation as the proposed intervention.

Inconsistency in handwriting instruction in early education. Handwriting skills continue to be an important method of communication throughout the school day. With the increased demands placed on kindergarten students, the expectation is that these students will be able to write in complete sentences by the end of kindergarten (Bassok et al., 2016). Methods for teaching handwriting skills to students, even within the same school systems, are inconsistent. Asher (2006) discovered through a survey of kindergarten through sixth grade teachers, different programs were utilized to teach this skill with little indication that one program was more effective than the others. These included both formal handwriting programs such as "D'nealian, Daily Oral Language spelling, Handwriting Without Tears®, Land of Letter People®, and the Zaner-Bloser handwriting program" and informal programs which were developed by the individual teachers (Asher, 2006, p. 466). This is further supported by Nye and Sood (2018) and Randall (2018) who found through teacher interviews that a consistent handwriting program was needed for effective instruction of letter legibility. Integrating a consistent handwriting program into the general education kindergarten classroom utilizing traditional instruction combined with

app-based instruction may lead to improved legibility which would positively impact the ability of the students to meet the demands of the curriculum.

**Perceptions of teachers related to handwriting instruction.** The task of teaching handwriting skills including proper letter formation and legibility is the responsibility of the kindergarten teachers. Their perceptions regarding this task are important as this can impact the success of a program. One study completed by Nye and Sood (2018) found that teachers felt the lack of a specific curriculum and training impacted their ability to effectively teach handwriting skills. They also found that teachers felt they lacked time within the day to address handwriting instruction and lacked resources and guidance (Nye & Sood, 2018). Another study indicated teachers felt they needed additional training or modeling on the best way to present instruction within the classroom to make sure they were "teaching it correctly" (Randall, 2018, p. 380). Even with the increased demands for handwriting skills, implementation of a consistent, effective method of handwriting instructions continues to be a challenge due to limited time available to teach this skill, limited access to handwriting curricula, or limited training in the implementation of curricula (Asher, 2006; Nye & Sood, 2018; Randall, 2018). Providing a coaching or collaborative model to handwriting instruction through a traditional method combined with an app-based intervention may improve the perceptions of teachers and their ability to implement the program into their instructional day.

Occupational therapist collaboration with teachers. Several studies have indicated the positive influence on handwriting instruction when collaboration between the teacher and the occupational therapist occurs. Randall (2018) interviewed teachers participating in a study addressing collaboration and instruction with the Handwriting Without Tears® program. Results showed that teachers valued the occupational therapist being present during instruction. This led

to early identification of children with concerns and allowed for immediate remediation (Randall, 2018). Another study utilized occupational therapist collaboration for instruction and teacher support throughout the duration of the protocol (Jordan et al., 2016). This collaboration allowed for consistent instruction and ensured the teacher understood the protocol. Increased consistency leads to improved success of the program implemented. Nye and Sood (2018) found that teachers believed access to an occupational therapist for training inside or outside of the classroom would improve handwriting instruction. In addition, another study completed by Hape et al. (2014) utilized occupational therapist collaboration throughout its duration for instruction as well as additional support to problem-solve issues as they arose. This collaboration was received with positive results and added to the consistency of handwriting instruction within the classroom (Hape et al., 2014). As teachers often feel inadequately prepared to provide handwriting instruction, occupational therapist collaboration with the teachers can improve the instruction provided leading to more consistency and may produce the result of increased legibility. This project will incorporate collaboration with the teacher for in-classroom instruction to ensure consistency throughout the implementation period.

Use of technology. Technology has become ever-present in the education system. With many schools having moved to a one-to-one technology initiative, this is another medium available to address handwriting (Wells et al., 2016). Butler et al. (2019) addressed the use of technology within the classroom indicating that technology use can be motivating for children and can be used to reinforce instruction. Other studies utilized the applications iTrace and LetterSchool™ installed on touchscreen devices in combination with a stylus to practice letter formation with good success for improved legibility (Butler et al., 2019; Jordan et al., 2016; Lorah & Parnell, 2014; Wells et al., 2016). Axford et al. (2018) also found positive results with

improvement of fine motor skills when students engaged with applications specifically chosen for this purpose. The use of technology within the educational setting is prolific and it can be used in positive ways to facilitate increased skill. Overall, technology has been shown to be motivating for students to practice skills which may be difficult for them. Utilizing a supplemental technology-based handwriting instruction program combined with traditional instruction may facilitate increased handwriting legibility. Incorporating a stylus into the program when practicing on the tablet may increase generalizability to pencil/paper tasks.

**Evaluation and outcome measures.** Several outcome measures to assess the many aspects of handwriting legibility were utilized or discussed in the studies included in the Critically Appraised Topic Portfolio (See Appendix A: Literature Matrix and Critically Appraised Topic Portfolio, p. 70). These include the Print Tool®, the Test of Handwriting Skills-Revised, and the Evaluation Tool of Children's Handwriting (ETCH). The Print Tool® was utilized in studies to successfully determine changes in handwriting skills including legibility following intervention implementation (Hape et al., 2014; Randall, 2018). The Print Tool® is a non-standardized assessment that evaluates eight specific components of handwriting including memory, orientation, placement, size, sequence, start, control, and spacing, all of which can impact legibility (Olsen & Knapton, 2016). The Print Tool® was evaluated for validity by Donica and Holt (2018) and was determined to have concurrent validity with the Test of Handwriting Skills-Revised. The Test of Handwriting Skills-Revised (THS-R) was discussed by Donica and Holt (2018). The THS-R is a norm-referenced test to evaluate handwriting skills on 10 subtests with scoring based on legibility and is considered both reliable and valid (Donica & Holt, 2018). Butler et al. (2019) used the ETCH to assess handwriting speed and legibility. The ETCH is a criterion-referenced, standardized test composed of seven tasks to assess

handwriting skills and is validated for grades one through six, but the first three sections have been used to assess students as young as age five (Butler et al., 2019). The Print Tool® has been utilized to show change in handwriting skill, including aspects necessary for legibility in kindergarten age children, whereas the ETCH and the THS-R are standardized for children beginning at age six. Given that some participants within the project may still be five years old, the Print Tool® is the proposed outcome measure for this project.

#### Chapter 3

#### **Additional Supports for the Project**

This chapter discusses additional supports for the evidence-based occupational therapy project. The occupation-based conceptual model guiding the project is described. In addition, the relationship between the project and the American Occupational Therapy Association's Occupational Therapy Practice Framework: Domain and Process, 3<sup>rd</sup> edition and the Vision 2025 is explained. The sustainability of the project in relation to practice and health is presented. This chapter also discusses the qualifications, skills, and knowledge of the practitioner conducting the project which is focused on traditional handwriting instruction supplemented by app-based instruction.

#### Occupation-based Conceptual Model Guiding the Project

When looking for a guiding model for the project of implementing traditional handwriting instruction supplemented with app-based instruction for the outcome of improved legibility, the components of the Ecology of Human Performance align well. The Ecology of Human Performance model focuses on the role of context related to task performance. The Ecology of Human Performance specifically addresses the person-context-task relationship (Cole & Tufano, 2008; Dunn, Brown, & McGuigan, 1994).

In this project, the persons involved are the kindergarten students and the task is learning to produce legible handwriting. The context is the environment of the school and the developmental level of the kindergarten students. This also encompasses the social contexts which guide the expectations for what a kindergarten student should be doing by the end of the school year. The person-context-task transaction is the interaction between the students and the

expectations placed on them by the standards they are required to meet in relation to the production of legible penmanship.

The intervention strategies utilized within the Ecology of Human Performance include establish and restore, alter, adapt and modify, prevent, and create (Cole & Tufano, 2008, Dunn et al., 1994). Related to the project the proposed intervention seeks to establish a new skill or remediate a skill which may not be the most functional for the task of handwriting. In addition, the intervention sought to alter the instruction which was already in place to facilitate increased success. When needed, the intervention provided modifications to the environment to increase success using adaptive equipment, such as pencil grips, slant boards, etc. By implementing the intervention early in the educational career of these students, difficulties with the task of handwriting may be prevented. A successful outcome of the proposed intervention could create opportunities to advocate for the intervention program to be implemented on a broader scale, allowing more students to benefit from the program. See figure 3.1 for a visual description of the model related to the project.

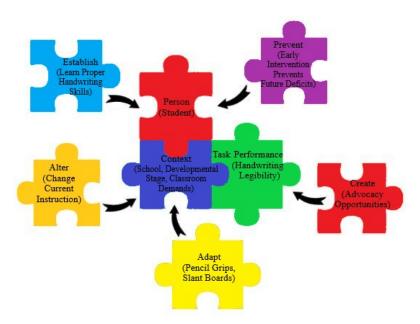


Figure 3.1: Model of the Ecology of Human Performance created by the author

#### Correlation Between the Project & the OTPF/Vision 2025

Based on the AOTA's (2014) Occupational Therapy Practice Framework: Domain and Process, 3rd Ed., occupational therapy services should be client-centered and evidence-based. This document also identifies education, including participation in both formal and informal educational experiences such as academics, extracurricular activities, and non-academic endeavors such as recess and lunch as areas of occupation which can be addressed through occupational therapy services. According to these guidelines, occupational therapists within the school need to obtain the best evidence to support the recommended interventions. This project sought to utilize evidence-based interventions to implement a traditional handwriting program supplemented by app-based instruction to improve handwriting legibility of kindergarten students. Handwriting is a primary occupation of kindergarten students and this project served to facilitate increased occupational performance with this task.

This project also aligned with the American Occupational Therapy Association's (AOTA, 2017) Vision 2025. The Vision 2025 challenges practitioners to follow the guideposts of being accessible, collaborative, effective, and to become leaders (AOTA, 2017). This project aligns with the Vision 2025 by increasing occupational therapist collaboration with teachers within the classroom, as well as increasing accessibility to services by helping an entire class of students, rather than one student within the class. This project also positioned the occupational therapist within the school to be a leader by demonstrating expertise in the much-needed area of handwriting instruction, an area where teachers often feel lacking (Nye & Sood, 2018). This could also demonstrate the need for a handwriting curriculum for kindergarten students within the district and allow the occupational therapist to have input in this decision.

#### **Sustainability of Practice & Health**

The World Federation of Occupational Therapists (2012) Position Statement on sustainability implores therapists to develop a global perspective of sustainability, focusing on interdependence, independence, and rights. Interdependence establishes the connection and equality between all people with each possessing the ability to learn from one another respectfully. Independence allows for a person to lead his or her preferred life whereas rights refers to the concept that health is a human right involving "justice, transparency, and accountability" (WFOT, 2012, p. 1). The project addressed the three global health values of interdependence, independence, and equality. The project facilitated interdependence, as students learned the skills and learned mutually from each other as well. Interdependence was also fostered as the teachers and therapists learned from each other. Independence was encouraged to increase the students' ability to effectively fill the learner role through improvement of the occupation of handwriting. The students had equal rights to access the necessary information to become successful, lifelong learners. According to the Swedish Association of Occupational Therapists, reprinted in Occupational Therapy Now "occupational therapists support a person's ability to achieve sustainable development through individualised interventions" (Bressler, 2013, p. 6). In addition, instruction in handwriting skills should be individualized to meet the specific needs of each student.

The sustainability of this project beyond the six-week intervention period is imperative for the continuation of improved handwriting legibility, which is a necessary occupation of students. Materials for this project offer some sustainability. The application, which can be reused from year to year, is a one-time purchase fee. The stylus to be used with the application can reused as well. The kindergarten students currently have iPad devices supplied by the school

system which are reissued each school year. Student workbooks are single use but could be recycled after they are finished. To implement this program, financial resources are needed from year to year to replace items such as workbooks, paper, chalk, pencils, and paper towels. The cost associated with this would be minimal per child with some materials already available within the classroom. After completion of this program, a specific handwriting instruction protocol will be available for implementation in other classrooms within the district. The teachers involved will be better prepared to provide instruction in handwriting skills which impact legibility. This knowledge can be used to train other teachers implementing the program as well. As a result, increased awareness of effective handwriting instruction and how to implement this in the classroom will lead to the sustainability of this project. Success of the project will also demonstrate a need for a district adopted handwriting curriculum to further sustain the evidence-based occupational therapy project. The results of the evidence-based occupational therapy project will be submitted for publication, also sustaining the project, as the results could be used by school systems nationwide.

#### **Practitioner Professional Skills & Knowledge**

As an occupational therapy practitioner, I have worked within the school system setting for 17 years. Having worked in this setting, I have gained extensive knowledge and experience. The majority of my caseload has focused on students having difficulties with handwriting tasks. Handwriting instruction for students I serve is provided in a one on one setting with teacher collaboration to focus on follow through within the classroom. In my current position, I am responsible for providing services for students in the age range 3-21 years, who receive services in both the general education setting, as well as the special education setting. However, most of the students I serve fall in the age range of 3-12 years. These services can be provided in a

variety of settings including the classroom, the therapy room, the library, or the cafeteria, depending on the student's needs and availability of space within the school.

Throughout my tenure, I have received training in the use of the Print Tool®, the Handwriting Without Tears® Screener of Handwriting Proficiency, the Test of Handwriting Skills, the Beery-Buktenica Test of Visual Motor Integration, and the Wide Range Assessment of Visual Motor Abilities. Handwriting Assessments consist of formal testing with outcome measures based on the needs of the students as well as informal assessment including observation of the student and his or her performance of skills and teacher interviews.

During my 17 years employed in the school system setting, I have experience, through courses or readings, with several different handwriting programs. These include Handwriting Without Tears®, Loops and Other Groups, Size Matters, D'Nealian, and Zaner-Bloser. To further my training, I am also a Handwriting Without Tears® certified instructor (See Appendix B: Handwriting Without Tears® Certificate, p. 108). Also, in recent years, with the increase of technology use, I have observed that the students I serve are motivated by using apps to practice skills. I have utilized various applications for reinforcing handwriting skills. These include LetterSchool<sup>TM</sup>, Ready to Write, Writing Wizard, and School Writing. In addition, I have completed extensive research and literature reviews related to the topic of handwriting instruction supplemented with application-based instruction. For this project, Handwriting Without Tears® was chosen as it is an evidence-based traditional handwriting curriculum. The application LetterSchool<sup>TM</sup> was also chosen to supplement traditional handwriting as the evidence supports its use combined with traditional instruction.

#### Chapter 4

#### **Project Plan**

This chapter examines the activities of the project including participant selection and recruitment criteria and the materials and equipment required for the intervention. The project plan is detailed from preliminary steps through project implementation followed by project evaluation. Outcome measures used with the project are reviewed. Next, assumptions and limitations of the project are outlined. Finally, the project's approach to client-centeredness is discussed.

#### **Activities of the Project**

Participant selection and recruitment. For the evidence-based occupational therapy project, one kindergarten teacher and paraprofessional were recruited as volunteers. In order to be included, the teacher/paraprofessional team had to have students receiving occupational therapy services enrolled in their classroom and have at least one year of teaching experience. The team had to be willing to volunteer approximately two and a half hours over the six-week period during implementation of the project. Teacher/paraprofessional teams were excluded if there were no students receiving occupational therapy services within their classroom or if they were in their first year of teaching experience. Recruitment of the teacher/paraprofessional team took place through an email detailing the project and the requirements of the project including the inclusion and exclusion criteria composed by the project coordinator. Contact information of the project coordinator was included for questions from the teachers/paraprofessionals. This was sent to kindergarten teachers at the implementing school by a teacher in a different grade requesting volunteers (See Appendix C: Volunteer Recruitment Email, p. 109). The first teacher

which responded and met all the inclusion criteria was chosen to participate and a volunteer consent form was obtained (See Appendix D: Volunteer Consent Form, p. 110).

All students enrolled within the volunteer teacher's classroom participated in the intervention; however, only those meeting the inclusion criteria participated in data collection. In order to be included in the data collection, the students met the following criteria: enrolled in the participating classroom, parental consent was obtained, and the student was between 5-7 years old. The age range of 5-7 years old was chosen to be sure to include all students who may be enrolled in kindergarten, including those who may be repeating the grade. The students invested a time commitment of approximately seven hours over a six-week intervention period. Students were excluded if they were not enrolled in the classroom, parental consent was not granted, or if they had limited English proficiency and are unable to comprehend the instructions provided during the intervention. This criterion was determined through a conversation with the English to Speakers of Other Languages teacher on a case by case basis.

Students were recruited through an introductory letter sent via email detailing the project and providing contact information for the project coordinator in the event questions arose from the students' parents. This letter was constructed by the primary investigator and forwarded by the teacher to the parental distribution list of the class (See Appendix E: Participant Recruitment Email, p. 116). Following the email, a hard copy of the letter with the informed consent form was sent home by the following day in the students' weekly folders (See Appendix F: Informed Consent Form, p. 118). A second copy of the email with a copy of the informed consent form attached was distributed by the teacher one week later to those who had not returned the forms as a reminder to return the consent forms. Distribution of materials

by other individuals in place of the project coordinator aided in the reduction of coercion of participants.

**Materials and equipment required**. In order for this evidence-based project to be implemented, certain materials and supplies were necessary. The following equipment and materials were required for implementation of this project:

- Volunteer recruitment email (See Appendix C: Volunteer Recruitment Email, p. 109)
- Volunteer agreement form (See Appendix D: Volunteer Consent Form, p. 110)
- Participant recruitment email (See Appendix E: Participant Recruitment Email, p. 116)
- Informed consent form (See Appendix F: Informed Consent Form, p. 118)
- The Print Tool® Assessment and Evaluation Forms (See Appendix G: Print Tool® Forms, p. 123)
- Letters and Numbers for Me workbooks and Teachers Manual
- Small golf-size pencils
- Double line Notebook paper
- Chalkboard with double lines (for students in the group, approximately 5)
- Chalk
- Small square sponges
- Small cups for water
- Paper towels
- Rock, Rap, Tap & Learn CD
- CD Player
- iPads
- LetterSchool<sup>TM</sup> app

- Child-friendly stylus
- Calculator
- Pencil grips
- Slant boards
- Storage container for supplies to be used for implementation
- Computer and Software such as Excel
- Access to a copier and printer
- Standard office supplies such as paper, pencils, pens, stapler

**Procedures**. This section discusses the procedures needed for implementation of the evidence-based project. It includes preliminary steps which needed to occur prior to implementation. Project implementation is discussed with an outline of the schedule for implementation. Finally, the ways in which the project was evaluated for success are detailed.

Preliminary steps. Prior to implementation of the project, site permission from the school district was obtained (See Appendix H: Permission Letter from Site, p. 126). Additionally, permission from the principal of the school of implementation was granted (See Appendix I: Permission Letter from Principal, p. 127). Permission for use of the application LetterSchool<sup>TM</sup>, the Handwriting Without Tears® Program, and The Print Tool® was obtained (See Appendix J: Permission to Use Materials, p. 128). CITI training was completed by the project coordinator (See Appendix K: CITI Training Certificates, p. 130) A proposal was submitted to the Institutional Review Board of Chatham University (See Appendix L: Chatham IRB Proposal, p. 133). The Institutional Review Board of Chatham University approved the evidence-based project on October 28, 2019 (See Appendix M: Chatham IRB Approval, p. 179). The implementing school district also approved implementation of the evidence-based project on

January 27, 2020. (See Appendix N: Henry County Schools Project Approval, p. 181).

Necessary materials for implementation were obtained. Furthermore, a one-hour training session for the volunteer teacher and paraprofessional regarding the program and the requirements for implementation was held. Training utilized the Handwriting Without Tears® Letters and Numbers for Me Teacher's Manual and a hands-on demonstration of the usage of the application LetterSchool<sup>TM</sup>.

**Project implementation**. The following table outlines the intervention of the evidence-based project by week. Prior to beginning the intervention, student assent was obtained for any students over age 7 (See Appendix O: Student Verbal Assent, p. 183). Participants completed an individually administered pre-test to obtain baseline data. Basic demographic information including gender, age, and special education status was collected from the student's record following obtainment of parental consent. This information was included on the scoring form for the Print Tool<sup>®</sup>. Participants engaged in traditional handwriting instruction utilizing the Handwriting Without Tears® program followed by supplementary instruction provided via the application LetterSchool<sup>TM</sup>. The therapist led the traditional instruction a minimum of two days per week and supervised the app-based instruction two additional days per week to ensure students stayed on task and practiced the correct letters. The fifth day of the week was used for makeup sessions or review as needed. The traditional instruction time and application practice was approximately 15 minutes per day per participant. This time period was based on the amount of time the students are engaged in each session of small group instruction time during the English/Language Arts instructional block. At the end of each week, the therapist met with the volunteers to discuss progress or concerns noted during the intervention week. (See table 4.1: Outline of the Plan for Intervention Implementation.)

Week	Intervention	Assessment	Time Commitment for Participants	Time Commitment for Volunteer
Pre	Pre-intervention: Individually Pre- test Students Teacher/paraprofessional training	The Print Tool® (See Appendix G: Print Tool Forms, p. 123)	20 minutes	1 hour
1	Day 1: traditional instruction c, o, s Day 2: traditional instruction v, w, t Day 3: app-based instruction using LetterSchool <sup>TM</sup> for c, o, s, v, w, t- Volunteer/therapist collaboration		45 minutes	15 minutes
2	Day 1: traditional instruction a, d, g Day 2: app-based instruction using LetterSchool <sup>TM</sup> for a, d, g (previous letters as needed) Day 3: traditional instruction u, i Day 4: app-based instruction using LetterSchool <sup>TM</sup> for u, i- (previous letters as needed) Day 5: Review of letters/Make up sessions Volunteer/therapist collaboration		1.25 hours	15 minutes
3	Day 1: traditional instruction e, l, Day 2: app-based instruction using LetterSchool <sup>TM</sup> for e, l, - (previous letters as needed) Day 3: traditional instruction k, y Day 4: app-based instruction using LetterSchool <sup>TM</sup> for k, y- (previous letters as needed) Volunteer/therapist collaboration		1 hour	15 minutes
4	Day 1: traditional instruction j, p Day 2: app-based instruction using LetterSchool <sup>TM</sup> for j, p- (previous letters as needed) Day 3: traditional instruction r, n Day 4: app-based instruction using LetterSchool <sup>TM</sup> for r, n (previous letters as needed)		1.25 hours	15 minutes

	Day 5: Review of letters/Make up sessions			
	Volunteer/therapist collaboration			
5	Day 1: traditional instruction m, h Day 2: app-based instruction using		1.25 hours	15 minutes
	LetterSchool <sup>TM</sup> for m, h (previous			
	letters as needed)			
	Day 3: traditional instruction b, f			
	Day 4: app-based instruction using			
	LetterSchool <sup>TM</sup> for b, f (previous			
	letters as needed)			
	Day 5: Review of letters/Make up			
	sessions			
	Volunteer/therapist collaboration			
6	Day 1: traditional instruction q, x, z	The Print	1 hour	15 minutes
	Day 2: app-based instruction using	Tool® (See		
	LetterSchool <sup>TM</sup> for q, x, z (previous	Appendix		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed)	Appendix G: Print		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up	Appendix G: Print Tool		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions	Appendix G: Print Tool Forms, p.		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration	Appendix G: Print Tool		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration Day 4: Post-Testing	Appendix G: Print Tool Forms, p.		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration	Appendix G: Print Tool Forms, p.		
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration Day 4: Post-Testing	Appendix G: Print Tool Forms, p.	Total Time	Total Time
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration Day 4: Post-Testing	Appendix G: Print Tool Forms, p.	Commitment	Commitment
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration Day 4: Post-Testing	Appendix G: Print Tool Forms, p.	Commitment for each	Commitment for each
	LetterSchool <sup>TM</sup> for q, x, z (previous letters as needed) Day 3: Review of letters/Make up sessions Volunteer/therapist collaboration Day 4: Post-Testing	Appendix G: Print Tool Forms, p.	Commitment	Commitment

Table 4.1: Outline of the plan for intervention implementation

Project evaluation. Upon completion of the intervention period, the students were individually re-assessed using the Print Tool®. Comparison was made with the established baseline obtained from pre-testing using the Print Tool®. The data was analyzed using descriptive statistics with the percentage change in each area of the Print Tool® calculated per student. An overall legibility score for lower case letters was also obtained from the assessment and the percentage change for this score was calculated. The mean percentage scores of the total participants was determined for each area and the overall legibility score. The percentage change for each area and the total score was calculated. These results were depicted in a series of bar

graphs comparing the change per student pre-test and post-test in each area. A bar graph was also used to depict the comparison of the class means scores from pre-test to post-test. Comparisons were further made based on demographic information such as gender or special education status. Demographic information was depicted with the use of pie charts with each piece representing a percentage of the information portrayed in the chart (i.e. for gender, one piece represented the females and the other the males with the size proportional to the percentage.)

The project was deemed successful by the students demonstrating improvement in handwriting legibility as assessed by the Print Tool®. This included the components of memory, orientation, placement, size, sequence, and starting point, all of which impact legibility. This improvement was determined by improved scores on the post-assessment.

Outcome measures. The results of this evidence-based occupational therapy project were assessed utilizing the Print Tool® (See Appendix G: Print Tool® Forms, p. 123) as an outcome measure. Permission to utilize The Print Tool® was obtained on June 24, 2019 (See Appendix J: Permission for Programs, p. 128). A pre-assessment/post-assessment design was chosen based on the evidence supporting this project (Axford et al., 2018; Butler et al., 2019; Hape et al., 2014; Jordan et al., 2016; Wells et al., 2016). The students completed the Print Tool® assessment both pre- and post-intervention to determine changes in their handwriting skills. The Print Tool® aligns with the components of the Handwriting Without Tears® program as it was developed by the makers of the handwriting program. The Print Tool® demonstrates reliability and validity to measure components of handwriting skills (Donica, 2018). With each component, the student receives a percentage score based on the number of letters which meet the criteria for accuracy. In addition, basic demographic information was collected from the student's record following obtainment of parental consent for participation. This allowed

quantitative data to be compared to various factors, including age, gender, and special education status to determine the impact these areas have on performance. This information was included on the scoring form of the Print Tool®. Confidentiality with this project was addressed by using number identifiers for the students' pre-test and post-test forms. The students had the same number, assigned by the project coordinator, on both tests so that they could be matched for comparison and data analysis. Numbers were assigned based on the order of return of the parental consent forms.

# **Assumptions and Limitations of Project Design**

This evidence-based project was based on a sequence of assumptions regarding handwriting instruction within the Henry County Public School district. Initially, this project was born from the project coordinator's concern related to the expectation placed on kindergarten students regarding handwriting skills with a lack of instruction due to the district not having a system-wide handwriting curriculum and the students' interest in electronic devices. An additional concern was the increase in referrals for occupational therapy services due to poor handwriting skills (Asher, 2006; Nye & Sood, 2018). Other assumptions arose from those initial thoughts after an extensive literature review.

- Project coordinator's observations and literature review indicate that there are greater expectations to produce legible handwriting at younger ages to meet educational standards (Bassok et al., 2016).
- 2. Therapist observation and a review of the literature indicated that many teachers have not received adequate training in handwriting instruction (Nye & Sood, 2018).
- 3. The amount of handwriting instruction varies greatly among teachers (Asher, 2006).

- 4. The method of handwriting instruction and the programs used is inconsistent (Asher, 2006; Nye & Sood, 2018).
- 5. Providing a consistent handwriting protocol improves handwriting legibility (Asher, 2006).
- 6. Project coordinator's observations that facilitating handwriting instruction and collaborating with teachers demonstrated improved effectiveness with carryover skills.
- 7. Project coordinator's observations and literature review indicated that tablet-based practice is highly motivating for students (Butler et al., 2019).
- 8. Utilizing tablet-based practice to increase repetition of appropriate formation improves handwriting legibility (Butler et al., 2019; Jordan et al., 2016).
- Project coordinator's observations indicate that teachers are willing to learn strategies to help their students improve handwriting legibility
- Project coordinator's observations indicate kindergarten teachers would like to implement a handwriting program.
- 11. Documented improvement with handwriting legibility using the Handwriting Without

  Tears® program supplemented with additional practice on the iPad application

  LetterSchool™ would increase the possibility of a district-wide, policy change related to handwriting instruction in the elementary schools.

The limitations associated with this project are related to the short, 6-week intervention period. Even though evidence supports using a shorter time frame, this may have produced less evident changes in handwriting legibility than when implemented over a longer timespan (Randall, 2018). In addition, the project only measured improvements in handwriting skills and not the impact this has on other areas of academic performance such as literacy. The project

coordinator may have brought bias to this evidence-based project due to the previously established relationships with the school staff. Additionally, due to the parameters of the time allowed for the project, qualitative characteristics were not explored. These areas included the volunteers' perspectives on the program, as well as the students' perspectives. This project also had limitations related to the small sample size limited to one geographic area in one school. This limitation impacts the ability to generalize the results to a larger population or populations in different regions.

#### **Approach to Client-Centeredness**

Providing interventions which are client-centered is at the core of the profession of occupational therapy. This concept of using a client-centered approach to determine what is meaningful to the client is discussed in the *Occupational Therapy Practice Framework: Domain and Process* (3<sup>rd</sup> ed.) (AOTA, 2014). Given a client-centered model of practice, interventions should be more community-based, with the clients undertaking more responsibility in their own treatment (Cole & Tufano, 2008). Based on these concepts, this evidence-based project was designed to meet the needs of the students and the teachers, both clients of school system practice. This project will be integrated into the daily schedule of a kindergarten classroom, providing the intervention to the entire class, not just one student. This aligns with the community-based concept preferred in client-centered practice (AOTA, 2014).

One tenet of client-centered practice is the clients' ability to be able to express areas in which they would like to improve (AOTA, 2014). While it is important to allow client input in the areas they feel they need to improve, kindergarten students may lack the ability to be able to state their needs due to their age. While they may be unable to determine areas which need improvement, the students do have opinions on activities. Based on this, the activities presented

need to be fun and engaging for the students. Integrating highly motivating tablet-use into the program will aid in keeping the students engaged through this activity. When looking at the preferences of the additional clients within this project, the teachers and paraprofessionals, the need for a handwriting program within the classroom has been articulated (Asher, 2006). This project is designed to meet that need by providing an evidence-based handwriting program within the kindergarten classroom.

Another aspect of client-centered practice is ensuring the client feels successful in the completion of the interventions (AOTA, 2018). While the intervention was implemented with every student within the class, each student is an individual with differing abilities and skill levels. Due to this, accommodations or modifications were made on an individual basis to ensure success. This included providing pencil grips, adapted paper, or scaffolding of the task to ensure success. Also, instructions provided were adjusted to ensure each student comprehended the expectations.

## Chapter 5

# **Project Implementation and Results**

This chapter provides a description of the participants enrolled in the evidence-based project. It also details modifications to the plan of implementation. Methodology of the analysis of the data obtained from pre-testing and post-testing is discussed. The results of the data analysis are presented.

## **Description of the Participants**

The participants recruited in this evidence-based project attended a kindergarten class in an elementary school located in Henry County, Georgia. Teachers who expressed an interest in the project were evaluated to determine if they met eligibility criteria. After this evaluation, one teacher/paraprofessional team met the criteria and was selected. The teacher and paraprofessional provided informed consent as discussed in Chapter 4.

The selected teacher has obtained a bachelor's degree in early childhood education, master's degree in media technology, and specialist degree in leadership. She reported having 19 years of teaching experience ranging from grades kindergarten through fifth grade. She was completing her 13<sup>th</sup> year of teaching kindergarten at the time of this evidence-based project. She also spent seven years as a media specialist. The teacher reported having a background of working with students of varying abilities, including those with individualized education plans, 504 plans, response to intervention, early intervention plan services, and English to speakers of other languages support services. The paraprofessional was in her second year in kindergarten and had previously provided support for two years in a special education classroom serving students with an emotional behavioral disorder eligibility. This general education kindergarten classroom included students receiving special education support, such as occupational therapy

services, speech-language services, behavioral intervention services, and response to intervention support for behavior.

After the teacher/paraprofessional team were recruited as volunteers, students in the class were recruited. There were a total of 20 students in the selected teacher's classroom. Of the 20 students, one student was excluded as he was receiving services outside of the classroom during the scheduled implementation period. Of the 19 remaining students, 18 students returned parental consent. During the project, two participants, a set of twins, were withdrawn from school to be homeschooled, bringing the total participants to 16. Of the 16 participants, nine were boys, and seven were girls, with ages ranging from 5 years, 5 months to 6 years, 10 months in age (Mean age = 5 years, 10.7 months). One student received response to intervention services for behavior, four students received special education services and had individualized education plans. One additional student had an individualized education plan for speech and language services only. Additionally, one of the students with an individualized education plan also received occupational therapy support services. This project did not interfere with the provision of the individualized education plan mandated services. If the intervention was provided during the provision of educational services, the student was excluded. Table 5.1 displays the students' demographic information.

Table 5.1

Demographic Data of Participants

	Age in				
Student	months	Gender	IEP	MTSS	Speech
01	65	M	X		X
02	75	M	X		X
03	72	F			
04	65	F			
05	65	F			
06	65	M	X		X

07	75	M	X	
08	67	M		
09	68	M		
10	65	F		
11	76	F		
12	74	F		
13	73	M		
14	75	M		X
15	82	M	Tier 2	
16	69	F		

*Note*. IEP=Individualized Education Plan; MTSS=Multi-tiered System of Support and encompasses Student Support Team and Response to Intervention services

The following graph visually represents the gender of the participants. (See figure 5.1)

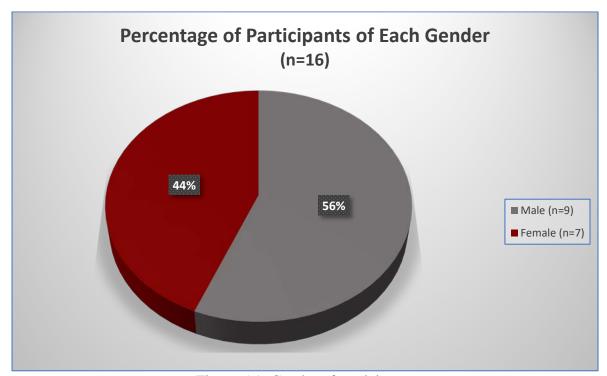


Figure 5.1: Gender of participants

## Modifications to the Evidence-Based Occupational Therapy Project Plan

After implementation began, modifications to the intervention were necessary. Rather than completing all four small groups of each type of instruction each day—all traditional instruction one day and all app-based instruction the next day—the groups were broken into two groups completing traditional instruction while the other two groups completed tablet-based

instruction. This allowed all four groups to complete their instruction in a shorter amount of time per day and better aligned with the schedule of the classroom. In addition, the time of day of implementation was altered to take place during morning work time as the school site had students from multiple classrooms in the volunteer teacher's room during the English and Language Arts Block. The kindergarten grade level divided students from various classrooms based on performance so they could receive instruction appropriate to the students' performance level. This instruction may not occur in the same classroom, making this time of day for providing implementation of the project less desirable, as the students participating in the project were scattered into multiple classrooms.

The type of tablet was also modified to allow more access to the app. While iPads were the most used device, Droid based tablets were also used to provide additional devices for application-based instruction within the classroom. Since the application has a fee associated with the full version, the app was unable to be installed on the student iPads which were issued through the school district. Because of this, additional types of devices were procured to broaden the number of students who could access the application. The application functioned identically on both the iPad devices and the Droid devices.

Makeup sessions were held during the class's scheduled computer lab time. As there is not new material introduced during this class, students who missed the intervention due to absences or tardiness could use this time to receive the instruction missed. A total of six make up sessions were held for the individual students who missed instruction. This allowed instruction to take place each day of the week rather than completing a make-up day on the final day of the week. A review was provided at the end of the intervention, prior to post-testing to help solidify the instruction of handwriting skills.

## **Data Analysis**

The data was analyzed using descriptive statistics within Microsoft Excel for Office 365 MSO. A spreadsheet was created and each student and their corresponding subtest scores on the Handwriting Without Tears® Print Tool® were listed. The percentage score for each subtest was calculated. The students' total percentage score for the overall legibility was also calculated using Microsoft Excel for Office 365 MSO. This was completed for both pre-test and post-test scores. In addition, the mean score for the total class was calculated for each subtest as well as the overall legibility score for both pre-test and post-test. After the average scores were calculated, the percentage of change between each subtest and total score from pre-test to posttest was calculated for each student. Also, the aggregate mean percentage of change between pretest and post-test was determined for each subtest and the overall score. Pre-test and post-test results were also compared by gender and by educational program status. Mean scores for the overall score and each subtest were calculated for each gender as well as based on the services the students were receiving. Two-tailed paired t-tests for dependent samples were calculated within Microsoft Excel for Office 365 MSO to identify the impact of the evidence-based occupational therapy project.

#### Results

Quantitative data was collected from The Print Tool®. Pre-test and post-test results of the subtests and the overall score were compared both as a group and also individually. Scores were also compared by gender as well as by the type of educational program the student received — either general education or additional education services such as special education services.

Percentages of change and two-tailed paired t-tests for dependent samples were calculated to determine the progress made related to the evidence-based project.

The Print Tool®. The Print Tool® was utilized to yield quantitative data to be analyzed for the purpose of this evidence-based project. Lowercase letters were assessed using the subtests of memory, orientation, placement, size, start, and sequence. Start refers to the beginning point of the letter and sequence indicates the order in which the letter strokes are made, and a total score was obtained based on the subtest scores. With this assessment, subtest scores are directly correlated to the score received on the memory subtest. If students did not remember the letter, that letter was excluded from the remainder of the subtests. Therefore, a student who scored nine out of 26 correct on the memory subtest would only be scored on those nine letters for the other subtests, which could impact the percentage score for the remaining subtests as well as the overall percentage scores. The assessment is comprised of the activities of writing various words spelled by the project coordinator and each letter being scored based on the criteria given from the administration instructions. Additionally, scoring of letters was discussed with another Handwriting Without Tears® certified handwriting instructor to increase reliability of scoring. If a discrepancy occurred, discussion was held until a consensus was reached.

At pre-test, the whole class' overall mean handwriting percentage score was 70 percent (standard deviation = 13.16) and at post-test the whole class' overall mean handwriting percentage score was 80 percent (standard deviation = 9.67). This indicates that the class averaged a 10 percent increase from pre-test to post-test which was deemed statistically significant (t (15) = 5.24, p = 0.0001). Students showed the most percentage increase in the subtest of placement with an aggregate pre-test score of 52 percent and a post-test score of 70 percent. This was shown to be statistically significant (t(15) = 3.95, p = 0.001). Memory also showed an increase in score with a pre-test mean class score of 79 percent and a post-test score of 92 percent. A p-score of 0.001 (t(15) = 3.94) indicated this result was statistically significant.

Other subtests which demonstrated statistically significant improvement included orientation with a pre-test score of 89 percent and post-test score of 94 percent (t(15) = 2.31, p = 0.035), start with a pre-test score of 72 percent and a post-test score of 82 percent (t(15) = 3.12, p = 0.007), and sequence with a pre-test mean score of 50 percent and a post-test score of 65 percent (t(15) = 4.00, p = 0.001). The size subtest resulted in a decrease in skill with a pre-test mean score of 83 percent and a post-test score of 82 percent. This result was not statistically significant (t(15) = 0.23, p = 0.82). See figure 5.3 for comparison of mean whole class scores pre and post-test scores.

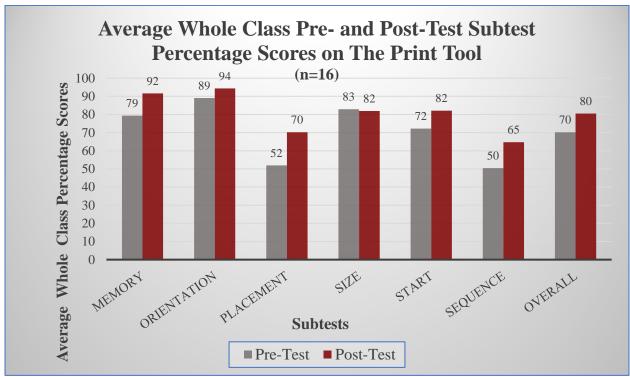


Figure 5.2: Comparison of aggregate subtest percentage scores and overall percentage scores. This figure represents the percentage scores of the student participants from pre-test to post-test on The Print Tool®. The higher the percentage the better the performance of the subtest.

When comparing individual scores, 94 percent of students improved with several that demonstrated more improvement than others. One student began with a low memory score at pre-test (35%) and improved to 85 percent at post-test. This was a 144 percentage of change

from pre-test to post-test. Students who began with lower pre-test scores had more room for improvement of post-test scores than those who began with higher scores. For example, student nine scored 100% on the memory, orientation, and size subtests during the pre-test and had no room to improve those subtest scores, whereas student six had lower subtest scores in all subtests leaving a wide range for improvement. Students (n=3) who scored overall less than 60 percent increased on average 18% from pre-test to post-test. Those (n=9) with overall scores between 61-79 percent averaged an 11 percent increase from pre-test to post-test with the remaining students (n=4) initially scoring above 80 percent overall increasing by an average of 4 percent.

Illustrations of the individual student data from each the pre-test and post-test regarding each subtest can be found in the individual data set from the Print Tool®. (See Appendix P: Individual Data Graphs for the Print Tool Subtests, p. 184). See figure 5.3 for a comparison of the pre-test and post-test scores of overall handwriting skills of individual students.

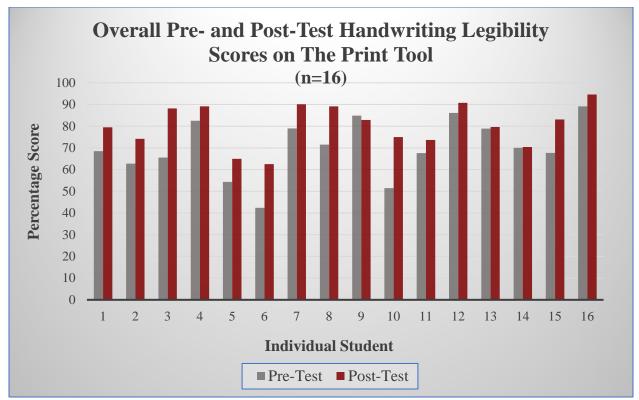


Figure 5.3: Comparison of individual students' pre-test and post-test overall handwriting percentage score on the Print Tool®. The higher the percentage score, the better the performance on the test.

Differences in gender were also calculated to determine if the intervention impacted both male and female students in the same way. At pre-test overall scores were equal with males and females scoring 71 percent on the overall legibility score on the Print Tool®. Females demonstrated strength in the subtests of size and start (82 percent and 78 percent respectively) compared to male students with a percentage of 74 percent in size and 68 percent in start. Male students exceeded female performance initially in the subtest of placement with a score of 55 percent compared to 48 percent for females. Male students showed improvement in overall test score going from a pre-test score of 70 percent to a post-test score of 79 percent (t(8) = 3.56), t(8) = 3.56), p = 0.007). Males showed the most improvement on the subtests of placement and start going from a pre-test score of 55 percent and 68 percent to a post-test score of 72 percent (t(8) = 2.63, t(8) = 2.63, t(8

in the subtests of memory (t(8) = 3.59. p = 0.007), orientation (t(8) = 1.64, p = 0.14), size (t(8) = 0.56, p = 0.58), and sequence (t(8) = 2.07, p = 0.07). Of these, only the subtest of memory demonstrated statistical significance.

Female students also demonstrated statistically significant improvements from pre-test to post-test in their overall handwriting score with a pre-test score of 71 percent and a post-test score of 82 percent (t(6) = 3.66, p = 0.01). Female students demonstrated the most improvement in the subtests of placement and sequence going from a pre-test score of 48 percent and 50 percent to a post-test score of 68 percent (t(6) = 2.82, p = 0.03) and 69 percent (t(6) = 4.23, p = 0.005) respectively. They also demonstrated improvements in the subtest of memory progressing from 76 percent at pre-test to 93 percent (t(6) = 2.74, t = 0.03) at post-test. Females demonstrated improvements in the subtests of orientation (t(6) = 1.59, t = 0.16) and start (t(6) = 1.71, t = 0.13) although scores were not deemed statistically significant. Females demonstrated a decrease in scores in the subtest of size (t(6) = 1.86, t = 0.11). See figure 5.4 for a comparison of Print Tool scores by gender.

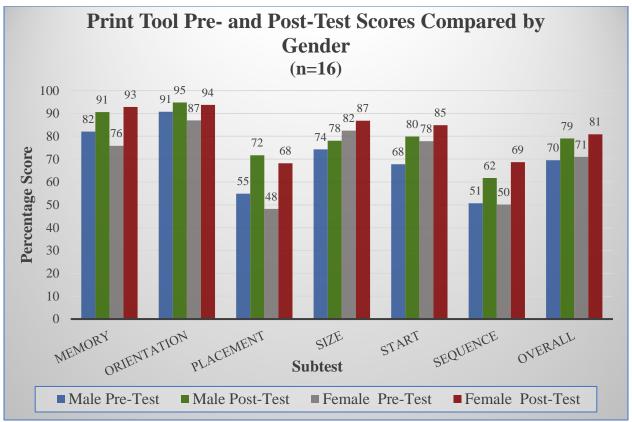


Figure 5.4: Scores on the Print Tool® compared by gender. The higher the percentage score on the better the performance on the test.

Additionally, scores were analyzed based on educational program. Students who were identified as having an individual education plan or receiving multi-tiered systems of supports services were compared to those not receiving additional services. In this class, six students out of the 16 participants (31%) received some variety of extra support, either through an individualized education plan or through the multi-tiered system of support. Of those six, one student also received occupational therapy services. It was found that the majority of the students who received services scored lower initially, with the exception of one student, whose exceptionality was related to visual impairment. The exception to this was the subtests of orientation and start. Students with services scored slightly higher in the orientation subtest with a score of 91 percent compared to 90 percent for general education students and in the subtest of start with a score of 73 percent compared to 72 percent for general education students. Those

students receiving additional services demonstrated a mean percentage score of 65 percent at pre-test and 77 percent at post-test (t(5) = 4.33, p = 0.007) with a percentage of change of 18 percent on overall handwriting skills. Those who did not receive additional services received a mean pre-test score of 73 percent and a mean post-test score of 83 percent with a percentage of change of 13 percent (t(9) = 3.43, p = 0.08). Both groups demonstrated statistically significant overall improvement. See figure 5.5 for a comparison of scores by educational program.

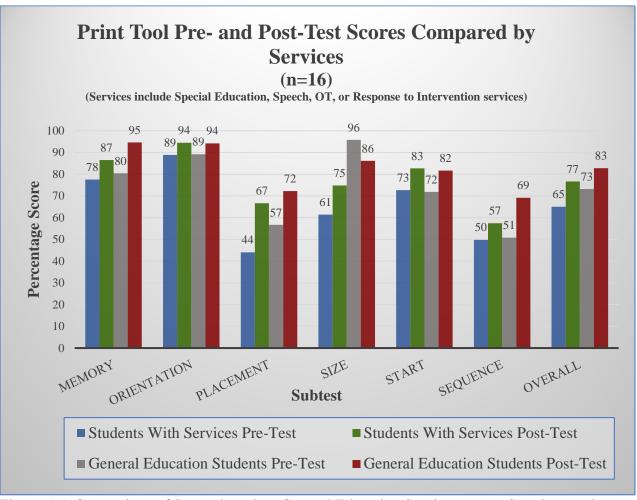


Figure 5.5: Comparison of Scores based on General Education Services versus Supplemental Services including IEP, RTI, Speech, and OT. The higher the percentage score, the better the performance on the test.

# Chapter 6

# **Evaluation of the Evidence-Based Occupational Therapy Project**

This chapter concludes the evidence-based project discussed in chapters one through five. It begins with an interpretation of the project results presented in chapter five and compares the outcomes to the current literature found in the CAT portfolio (See Appendix A: Literature Matrix and Critically Appraised Topic Portfolio, p. 70). This chapter also provides recommendations for future practice based on the findings of the project. This chapter concludes with an epilogue of the capstone journey from beginning to end.

# **Discussion and Interpretation of the Project Results**

The PIO question that guided this evidence-based occupational therapy project was as follows: Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)? The results of this project clearly indicate that traditional instruction supplemented with tablet-based instruction improved kindergarteners' ability to print lowercase letters legibly. As detailed in chapter five, approximately 81 percent of the students demonstrated improvement in the ability to print recognizable lowercase letters from memory from pre-test to post-test. Likewise, approximately 81 percent of students showed an increase in the ability to place letters appropriately on the line. This contrasts with the study by Jordan et al. (2016) which showed the least amount of improvement in the area of placement. This difference could be related to the traditional instruction provided during the intervention phase. The traditional instruction portion of the intervention provided demonstration and practice of placement of letters appropriately on the baseline in addition to letter formation practice. Additionally, approximately 94 percent of students in this project improved in the skill of sequencing the

strokes of the letters from pre-test to post-test. The one student who did not show an increase in his sequence percentage actually sequenced more letters correctly at post-test; however, due to his increased memory subtest score, which is used to calculate the percentage, his sequencing percentage decreased. Furthermore, approximately 94 percent of the students in this project showed an increase in their overall score on the Print Tool®, indicating improvement in the ability to legibly print lower case letters. For the group as a whole, a paired t-test for dependent means revealed a statistically significant gain from pre-test (mean = 70.15%, standard deviation = 13.16%) to post-test (mean = 80.48%, standard deviation = 9.67%); t(15) = 5.24, p = 0.0001). Overall, class scores increased in all subtests except for size with the subtests of memory, orientation, placement, start, and sequence showing statistical significance (p < 0.05) from pretest to post-test. These factors are key components of legible handwriting. The results of this project support the findings of Jordan et al. (2016) which combined paper and pencil activities with practice using the LetterSchool<sup>TM</sup> application and showed improvement in legibility. A study by Butler et al. (2019) which supplemented traditional instruction with tablet-based instruction using LetterSchool<sup>TM</sup> also resulted in improved outcomes. Additionally, the results of this project also reinforce the findings of several other studies which demonstrated effectiveness of either traditional instruction or app-based instruction related to handwriting skills (Asher, 2006; Axford et al., 2018; Hape et al., 2014; Lorah & Parnell, 2014; Randall, 2018; Wells et al., 2016).

Inconsistency in handwriting instruction in early education. The results of this evidence-based occupational therapy project echoed the findings by Nye and Sood (2018) and Randall (2018) which indicated that students needed a consistent handwriting program for effective instruction. Integrating this program within the kindergarten classroom allowed for an

increase in the class's overall handwriting legibility as evidenced by the increase in overall scores presented in chapter five. In addition, this project also indicated that those students who started with the lowest scores (below 60 percent overall), showed the most growth, improving 18 percent overall from pre-test to post-test (49% at pre-test to 67% at post-test) indicating that those who may be struggling with these skills benefit the most from a consistent program. These findings are consistent with the findings of Randall (2018) who also found greater improvement in those students who started with the lowest scores.

Perceptions of teachers related to handwriting instruction. Opinions of the volunteer teacher/paraprofessional team were initially consistent with literature, with thoughts of lack of time, lack of training and a lack of curriculum impacting the ability to effectively teach handwriting skills (Asher, 2006; Nye & Sood, 2018; Randall, 2018). As the evidence-based project continued and commenced, the teacher volunteer indicated during a debriefing session that having the therapist available was helpful to her and her students. She felt that using both the traditional method of instruction as well as the app-based instruction was beneficial for improvement of skill. She especially enjoyed the app-based instruction, as it allowed for independent practice, but did not allow incorrect formation. She continues to feel that increased training is needed, and time should be allotted for a program to be implemented within the kindergarten curriculum.

Occupational therapist collaboration with teachers. As this project was completed within the confines of a general education classroom, collaboration occurred between the therapist and the teacher/paraprofessional team. By completing this project within the general education classroom, the teacher/paraprofessional team could be involved in the instruction and collaboration could take place to ensure that reinforcement of the skills was consistent

the frequent collaboration with the occupational therapist during the course of the evidence-based project. They explained that the collaboration improved their understanding of how to best teach handwriting skills and helped to ensure that they were reinforcing the skills in the same way the students were instructed. This aligns with the findings of other studies conducted incorporating teacher collaboration (Hape et al., 2014; Jordan et al., 2016; Randall, 2018).

Use of technology. The use of technology within the classroom is pervasive. Outcomes of this project are indicative of the results obtained in multiple studies that demonstrate that using a touchscreen device with a stylus to supplement instruction is an effective way to improve legibility (Butler et al., 2019; Jordan et al, 2016; Lorah & Parnell, 2014; Wells et al., 2016). In addition, students would frequently ask if it was their day to practice on the iPad, indicating that this was motivating for the students and they enjoyed engaging in learning in this manner. While Butler et al. (2019) indicated that utilization of tablet-based instruction was as effective as traditional instruction with improving handwriting, this project demonstrated that the combination of the two mediums resulted in statistically significant improvement in overall legibility scores (t (15) = 5.24, p = 0.0001). Findings from the study completed by Jordan et al. (2016) contrasted the results of this project as the area of most improvement in that study was related to letter size, which demonstrated a decrease in skill in the evidence-based project. This decrease in skill could have been attributed to the younger age of the participants of the evidence-based project (kindergarteners vs. first graders). Also, given the short time frame of the evidence-based project, the participants may have been concentrating on the starting point and strokes of the letters for accurate formation, rather than accurately sizing the letters. In addition, practice in the small groups for both traditional and tablet-based instruction had the students

practice writing on a larger scale; therefore, making the letters larger than would be typical when writing on paper. This could have influenced the transfer of skill to pencil and paper, impacting the size of the letters.

Limitations. The limitations associated with this evidence-based project are related to the short, 6-week intervention period, small sample size, and lack of control group for comparison purposes. Even though evidence supports using a shorter time frame, this may have produced less evident changes in handwriting legibility than when implemented over a longer timespan (Randall, 2018). Due to this shorter time frame, the project was implemented with only lowercase letters. Also, due to the timing of the project within the school year, late January-early March, students had already received instruction on some letters that may have resulted in the acquisition of poor letter formation habits. The evidence-based project was implemented in a single elementary school in a suburban area of the southeast; therefore, the results are not necessarily generalizable to other populations in different areas. The project population was small, involving a teacher/paraprofessional team and 16 students. Both the intervention and evaluation were completed by the same therapist, eliminating the possibility of blinding procedures. The project coordinator may have brought bias to this project due to the previously established relationships with the school staff. Additionally, due to the parameters of the time allowed for the evidence-based project, qualitative characteristics were not fully explored. These areas included the volunteers' perspectives on the program, as well as the students' perspectives.

Since this evidence-based project was a single-group, pre-and post-test design, interpretation of the data is limited due to the lack of a control group for comparison. During the implementation of the program, other classes within the school and district were continuing with academic instruction utilizing the district provided resources. Without a control group, the

progress other students in differing classes were making is unknown. Additionally, the Handwriting Without Tears® sequence of letter instruction was not aligned to the district provided English-language arts program. Aligning any handwriting program with the plethora of English-language arts curricula would be challenging.

Future research in this area could expand this intervention model to a wider range of teachers and students, expanding the effectiveness to a larger population. Incorporating a qualitative component may provide insight into the perspectives of the teachers and students regarding how to most effectively implement this program within the school day. It is also possible that different combinations of handwriting programs and apps providing instruction may be as effective or more effective instruction methods.

# Recommendations for Practice, Policy, and Education

The results of this evidence-based project along with the previously published evidence which informed the project have implications for school-based occupational therapists and local and national policy makers. School-based therapists often receive referral for students who are struggling with handwriting skills (Asher, 2006; Nye & Sood, 2018). Several studies indicate the need for consistent handwriting instruction to acquire this skill (Asher, 2006; Hape et al., 2014; Randall, 2018). Occupational therapists are well suited to work with teachers to implement effective handwriting instruction for all students, utilizing various instruction methods including both traditional instruction and app-based instruction. By supporting the teachers in this area, school-based occupational therapists will be able to assist a wider range of students in their natural environment, the classroom.

Occupational therapists also should become advocates for the need for evidence-based handwriting instruction and developmentally based standards for education. Occupational

therapists have the unique expertise to lobby their local school systems for the incorporation of evidence-based handwriting curricula into the educational program of early elementary education students. The adoption of policies related to evidence-based handwriting instruction should be made with the understanding of the importance of legible and efficient handwriting skills as well as the impact handwriting skills have in supporting literacy skills. This should also be expanded to future revisions of state educational standards to include standards for efficient and legible handwriting skills at a developmentally appropriate level.

Finally, occupational therapy educators and their colleagues in elementary education should collaborate to provide training to future teachers on the fundamental skills of handwriting and effective, evidence-based teaching methods. The literature indicates that most teachers do not feel as though their previous training adequately prepared them to teach handwriting skills. Furthermore, school-based occupational therapists could provide training sessions to current teachers to facilitate improved handwriting instruction. Occupational therapy educators could assist education program educators to support future teachers in this area, just as school-based occupational therapists support classroom teachers.

#### **Epilogue of the Journey**

If you had told me three years ago that I would have been on the journey to my OTD, I would have called you crazy. Returning to school at any point was not something that I had ever considered. However, with a change in work environments and the need to continue my education for the best of my clients, and the push of a few specific colleagues, I applied to Chatham University in the spring of 2018. That push has led me on this journey I did not foresee occurring.

This experience over the last five semesters has taken me through a roller coaster of emotions, from the interview process to the culmination of the capstone project. I have gone from feeling stagnate as a therapist to feeling prepared to facilitate change in my setting and possibly beyond. At the start of this process, I did not have an understanding of evidence-based practice or how to apply evidence into practice but now I have a solid foundation for this and have incorporated this into my daily practice. I have become more aware of the importance of the Occupational Therapy Practice Framework and the importance of being client-centered. Probably the most significant change has related to my awareness of the need to advocate for the students with whom I work and to look to the evidence when searching for effective interventions.

Among all the changes that have occurred, is the one I least expected. I always knew I would need the support of my immediate family, but I did not realize how much support I would have from my local cohort as we embarked on this journey together. We have all served to support each other and diffuse frustration. We have cheered each other's successes and picked each other up when feelings of being overwhelmed prevailed. This is just the beginning step to the improvements and changes that I hope to continue to make in both my work setting and as an occupational therapist. I am looking forward to seeing what changes occur as a result of the completion of this OTD program.

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# Appendix A: Literature Matrix and Critically Appraised Topic Portfolio

	Literature Review Matrix								
Authors (Date)	Purpose	Study Design/ Level of Evidence	# subjects (or articles for SR)	Independent Variable(s)*	Variable(s)*	Results	Implications for Practice	Indicate "Shows effectiveness" or "indirect support for theme" **	
Asher, A. V. (2006)	To describe handwriting instruction strategies used across kindergarten through 6 <sup>th</sup> grade	Phenomenology Qualitative	90	Handwriting Instruction in elementary schools	Handwriting skills (quality, legibility)	Inconsistency for when handwriting should be taught, papers used, order of letters, and practice schedule; formation should be taught at initial instruction; no single program used for instruction	Students may miss instruction due to teacher beliefs or lack of practice in the day. There may not be a program in place for instruction leading decreased skill	Indirect support for the need for instruction to improve legibility; Indirect support for the perception of teachers regarding handwriting instruction	
Axford, C., Joosten, A. V., & Harris, C. (2018)	To determine the effectiveness of iPad applications that required specific motor	Two group, non- randomized pretest- posttest study design	54	iPad use	Fine motor skills	Motor coordination and Visual motor integration scores increased for the EG significantly more than the	Using technology with specific apps related to fine motor skills may improve	Shows effectiveness for the use of app- based intervention for improved fine motor/hand-	

	skills designed to improve fine motor skills.	Level II				CG; the experimental group demonstrated more gains in writing proficiency, scissor skills, dressing skills, one handed use for drinking from a container and grasp maturation when stringing beads; Statistically significant changes were noted in improved capitalization, and orientation when writing with the EG	motor coordination and visual motor integration positively impacting writing skills, cutting, and self-care skills	writing legibility; Indirectly supports the structure of the study; uses similar population
Bassok, D., Latham, S., & Rorem, A. (2016)	To provide empirical data regarding the changes in	Longitudinal study; Level IV	5,200 teachers total	Kindergarten classes in 1998 and 2010	Expectations placed on kindergarten students	Teachers rated academic skills, including learning to read	With the increase in demands, especially in	Indirectly supports the theme the need for handwriting
	public kindergarten classrooms over time		2,500 from 1998 and 2,700 from 2010			as more important than previously; Increase in the number of	the instruction of advanced skills, more students may	instruction to meet the demands of kindergarten
						teachers providing math and advanced	struggle to keep up.	

						skill instruction; decrease in non-academics and science/art centers; increase in use of worksheets, books, and assessments; K classes are like 1st grade classes from 1998		
Butler, C., Pimenta, R., Tommerdah I, J., Fuchs, C. T., & Cacola, P. (2019).	Compare the effectiveness of an app-based method of learning handwriting when added to the traditional method versus the use of the traditional method only on both manual dexterity and handwriting skills of kindergartners	Pre/Posttest with a control group; Level II	125 kindergarten students	App-based instruction combined with traditional handwriting instruction	Legibility and Manual dexterity	Results indicated only the EG showed statistically significant improvement from pre to posttest with manual dexterity; Both groups improved with handwriting skills with both letter and number legibility equally	Combined use of app based instruction with traditional methods for handwriting instruction shows improvement with manual dexterity and handwriting legibility	Directly supports the intervention of app-based instruction with the application LetterSchool <sup>TM</sup> and a stylus paired with traditional pencil/paper instruction for the outcome of improved handwriting legibility; Indirectly supports the structure, addressing possibly amount of time utilizing

								the app per session and the sessions per week
Donica, D. K., & Holt, S. (2018)	To answer the following research questions: How does first and second-grade performance on the THS-R (Test of Handwriting Skills-Revised) compare with performance on the non-standardized assessment the Print Tool®? and Do teachers' perceptions of first and second-grade students' handwriting ability align with the students' performance	Non- experimental correlational design study; Level IV	46 first and second grade students	Handwriting evaluation with both assessments (Print Tool® and THS-R); Teacher Perceptions	Validity of the <i>Print Tool</i> ® for assessing handwriting compared with validity of THS-R	Good concurrent validity of the Print Tool® compared to the THS-R; Sizing subtest was a biasing factor due to scoring criteria; Indicated alignment with teachers' perceptions of handwriting and results of the Print Tool®	The Print Tool® is an effective measure of handwriting skills and is sensitive to changes in skill upon reassessment	Supports the indirect theme related to using the <i>Print Tool</i> ® as an outcome measure

	on the <i>Print</i> Tool®?							
Hape, K., Flood, N., McAuthur, K., Sidara, C., Stephens, C., & Welsh, K. (2014)	To determine if the Handwriting Without Tears® (HWT) curriculum was more effective than the standard handwriting curriculum of Writer's Workshop within a first-grade classroom	Two group, non- randomized controlled trial using a pretest/ posttest design; Level II	Experimental group: 21 Control Group: 22	Handwriting Without Tears® Curriculum	Handwriting Skills	Results indicated that both the Writer's Workshop and HWT® program demonstrated student growth regarding handwriting skills; The combination of both curriculums provided more growth; There was no difference statistically in the groups at pretest; It was determined that the groups did not differ statistically at post testing; however, the control group's post-test scoring was not normally distributed.	For therapists in the school system, this is significant to support the use of the multisensory approach offered by the HWT program for handwriting instruction.	Shows effectiveness for the HWT program as an instruction method for improved legibility; Shows effectiveness for the use of the Print Tool® for an outcome measure; provides indirect support for the intervention of a traditional handwriting program including timing/number of sessions
Jordan, G., Michaud, F., &	Determine the effectiveness of a program that	Quasi- experimental pretest/ posttest with a	5 sets of twins: 10 students total	Intensive handwriting program including the	Handwriting skills including quality,	Post test scores were significantly better in the experimental	Clinically significant to support an intensive	Shows effectiveness for the use of app- based instruction

Kaiser, M L. (2016)	incorporates fine motor activities, animated models, tablet- based activities, and paper-pencil tasks on handwriting skills	control group; Level II		app LetterSchool TM	spacing, size, and formation	group; Post test scores of the CG indicated a decline in handwriting quality; Letter size increased in both groups but was better in the EG; Twins from the EG had better scores in 6 areas measured; CG was better in 2 areas; Size relationships of letters indicated the largest difference; Results were statistically significant indicating that the result is due to the intervention	program with both tech based and pencil/paper based interventions to improve handwriting tasks	combined with traditional pencil/paper instruction to facilitate increased legibility. Supports the use of the app LetterSchool <sup>TM</sup> and a pretest/posttest design.
Karlsdottir, R., & Stefansson, T. (2002)	To determine the extent and cause of handwriting dysfunction in elementary school children; To determine procedures for	Longitudinal experiment; Level III	407 students	Type of handwriting instruction	Functional vs. dysfunctional handwriting	Dysfunction in speed appears to be related to dysfunction in quality; Scores from the VMI, Figure Ground test, Motor Accuracy test, finger tapping and pegboard	Children with continued dysfunctional handwriting skills need remediation to correct errors, although improvement is noted over	Indirect support for the theme of structured handwriting intervention

	early		tests, and the	time in	
	identification		letter naming,	children with	
	of these		writing tests do	both	
	children and		not seem to be	functional and	
	remediation		good predictors		
			of future	dysfunctional	
1	processes		handwriting	handwriting.	
			proficiency;		
			Statistical		
			significance was		
			found for the		
			development of		
			handwriting		
			quality between		
			children with		
			functional and		
			dysfunctional		
			handwriting;		
			Improvement in		
			handwriting		
			from grades 1-5		
			is clinically		
			significant		
			meaning that		
			handwriting		
			quality for both		
			functional and		
			dysfunctional		
			groups improved		
			over time;		
			Handwriting		
			dysfunction		
			necessitates		
			remediation;		
			Most children		
			have adequate		
			motor and		
			motor and		

Lin, LY., Cherng, R J., & Chen, YJ. (2017)	Investigate the effects of touch-screen tablet use on fine motor development of preschool children without developmental delay	Cohort Study; Level II	80 children	Touch Screen Tablet Use	Fine motor development	perceptual abilities to develop handwriting.  Non-touch screen tablet group had higher scores in fine motor precision, fine motor integration, and manual dexterity (than the touch screen tablet group; no statistical difference noted between upper limb coordination or in pinch strength for the two groups)	Suggests that manipulative based play aids in development more so than tablet-based play so a combined approach needs to be utilized	Shows effectiveness indirectly for the use of traditional instruction combined with tablet based as it indicates tablet instruction is not sufficient for increased skill
Lorah, E. R., & Parnell, A. (2014)	To assess the obtainment of handwriting skills using the iPod Touch®, a stylus, and the app LetterSchool <sup>TM</sup> ; Whether completing all steps in the	Single Case design with before/after approach; Level IV	3 children	Instruction with LetterSchool TM app	Letter formation	Two of the three participants showed improvement using the instruction provided by the app; One participant needed additional instruction	The use of an app to remediate letter formation may be effective for some students and may generalize to	Shows effectiveness for the use of an app for letter formation instruction or remediation; Indirectly supports theme of use of technology for

	LetterSchool <sup>TM</sup> instruction generalized to paper/pencil writing; To determine if the participants preferred app- based instruction or pencil/paper activities.					initially with stimulus prompting and prompt fading; Rate of acquisition increased with each letter trained; Skills generalized to writing each letter with pencil/paper; Two out of three participants preferred the app instruction with the third showing a preference for pencil/paper although not exclusively (he chose the app 1 out of 3 times)	pencil/paper tasks.	motivation and the use of a stylus of increased generalizability to pencil/paper.
Nye, J. A.,	-	Phenomenology Qualitative	9 kindergerten	Needs and	Teachers'	5 themes emerged:	Can be used	Indirectly
& Sood, D. (2018)	needs of kindergarten teachers and the supports they require when teaching handwriting skills. Answer 2 questions: What impedes	Quantative	kindergarten teachers	supports for handwriting instruction in kindergarten	Perceptions	emerged: foundational skills needed for handwriting, challenges related to teaching handwriting, supports teachers required to facilitate	by school system therapists challenged to provide services to remediate handwriting skills in kindergarten	supports the theme of collaboration with teachers for handwriting instruction within the kindergarten classroom. Indirectly supports the need

	kindergarten teachers in facilitating handwriting skills among the children in their classes? And What supports do kindergarten teachers need to facilitate handwriting skills among the children in their classes?					handwriting in kindergarten, how occupational therapy can provide support to facilitate handwriting, and strategies teacher use to promote handwriting. Main findings included the need for a curriculum and training, access to OT services, teacher training in assessing handwriting, and need for a collaborative service delivery model to address handwriting concerns.	to support use of a curriculum within the classroom with teacher training and OT collaboration for best instruction	for handwriting curriculum within the classroom.
Randall, B. S. (2018)	To determine if teacher instruction using Handwriting Without Tears® with collaboration from the occupational	Single group, non- randomized study and qualitative; Level III and qualitative	2 teachers; 27 students	Handwriting Without Tears® Instruction; occupational therapist collaboration	Handwriting legibility; teacher perceptions	Statistically significant improvement was noted for the group regarding letters written from memory; Statistically significant improvement noted for	A collaborative approach between the OT and teacher for handwriting instruction using a handwriting	Shows effectiveness for utilizing the HWT handwriting curriculum as a traditional instruction method with kindergarten

be effectimprove kinderg students	garten ts' letter tion and			alignment; Qualitative data indicated the teachers perceived this as a positive experience and the students improved; Both teachers indicated preference for the therapist to be in the room during instruction to assist with struggling students or to model the method	curriculum is successful for improved handwriting performance	students; indirectly supports the theme of teacher perceptions/ collaboration for handwriting instruction; indirectly supports the theme of outcome measures and the use of the Print Tool®.
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Wells, K. E., Sulak, T. N., Saxon, T. F., & Howell, L. L. (2016)	To compare iPad based handwriting practice with traditional pencil-paper handwriting practice; to determine the extent to which iPad mediated handwriting practice transfers to pencil and paper assessment.	Small Scale Randomized Control Trial; Level II	12 students	iPad based handwriting practice using the iTrace app and a stylus	Handwriting legibility/skills	Letter production increased significantly for the treatment group; Letter formation improved for the treatment group; The control group and the treatment group increased by the same median amount regarding letter formation; Handwriting quality improved more so for the control group	Indicates traditional instruction may be superior but improvement can be made with iPad mediated instruction as well, especially regarding letter production	Shows effectiveness for both traditional instruction and iPad mediated instruction with the use of stylus during iPad practice for increased legibility
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<sup>\*</sup>Use this resource for help in identifying independent and dependent variables: <a href="http://www.pt.armstrong.edu/wright/hlpr/text/3.1.variables.htm">http://www.pt.armstrong.edu/wright/hlpr/text/3.1.variables.htm</a> \*\*It can also be effective to color code the studies, so perhaps shading the rows with direct effectiveness studies in green, and those that support particular themes as another color.

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Asher, A. V. (2006). Handwriting instruction in elementary schools. American Journal of

Occupational Therapy, 60, 461-471. https://doi.org/10.5014/ajot.60.4.461

Purpose of the	To describe handwriting instruction strategies used across
Study	kindergarten through 6 <sup>th</sup> grade
Setting	Suburban school district with approximately 2,900 students in
	grades K through 6.
Subjects/Sample	• Convenience sample of teachers from kindergarten to 6 <sup>th</sup> grade
	• 90 teachers in total were asked to complete the questionnaire.
	Completion was voluntary
	• 25 taught 5 <sup>th</sup> and 6 <sup>th</sup> grade,
	• 40 taught kindergarten through grade 2
	• 25 teaching grades 3 and 4.
C4 I D/	Years of teaching experience ranged from 2 to 30.
Study Design/	Qualitative study; appears to fit the criteria for phenomenology
Methodology	A survey inquiring how handwriting was taught to students in
	grades K-6 was completed
	Three versions of the open-ended survey were issued, depending
	on grade level
	• One version for grades K-2, one for 3-4 and one for 5-6
	Survey was distributed and the completed survey was picked up a
	week later
Level of Evidence	Qualitative
Data Collection	Data was collected via open-ended surveys which were created by
Tools/Measures	the author.
	The surveys were piloted with two teachers and revisions were
	made to create three different surveys based on grade level.
	The survey was piloted to determine validity
	<ul> <li>A secondary therapist assisted with data collection from the</li> </ul>
Results/	<ul> <li>surveys</li> <li>Return of surveys was as follows: 23/25 for grades 5-6; 17/40</li> </ul>
Main Findings	returned for K-2; and 7/25 returned for grades 3-4
1.24111 2 1114111150	<ul> <li>Results were broken down into areas questioned in the survey</li> </ul>
	<u> </u>
	Age when taught: There is inconsistency regarding the grade which handwriting is expected to be taught (kindergerten vs. first).
	handwriting is expected to be taught (kindergarten vs. first)
	Age correct formation is taught: Teachers believe that correct      formation about the translation of the property of th
	formation should be taught from the beginning, either in
	kindergarten or first grade. One teacher noted that by age 7,
	incorrect formation is difficult to change

	• Types of paper: Teachers were inconsisted used for handwriting instruction.	ent in the types of paper				
	<ul> <li>Programs used for instruction: No single handwriting program was used but teachers used a variety of commercial and informal programs to teach handwriting, if they used a program at all.</li> <li>Order of letters introduced: Inconsistency was noted in the order of letters introduced with some teachers using developmental progression, some introducing formation based on class themes, and others introducing letters based on the language arts curriculum</li> <li>Practice Schedule: There was not a consistent practice schedule reported among the teachers. Of the teachers teaching manuscript (13 teachers), three practiced daily, two practiced approximately 3x a week, three others 1x week and 5 had no scheduled practice time</li> <li>Inconsistency in handwriting skill/legibility was noted by teachers of grades 5-6 with some students needing additional instruction in cursive or manuscript.</li> </ul>					
Limitations	<ul> <li>Low return rate of surveys from grades 3-4 may have impacted the results.</li> <li>The article indicated this occurred only across one school district with questionnaire developed by the author which is stated as untested, therefore there are no conclusive answers to the research questions</li> <li>More information is needed to address normal and atypical</li> </ul>					
	<ul> <li>development of children's handwriting.</li> <li>The respondents replied voluntarily, which increased interest in the subject, possibly</li> </ul>					
How is this study useful for your EBP project? Check all that apply.	☐ Provides background info ☐ Study uses the same/similar Population to your proposed project ☐ DIRECTLY supports the Proposed Intervention (shows effectiveness of the intervention for desired/similar outcome) ☐ INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.) ☐ Provides info on tools/methods you could use to collect data/evaluate your project	Please Note: You will need literature to support all areas of the project, with at least 50% of your literature supporting the intervention itself.				
This study was identified as the 'best' evidence and can be applied to your proposed EBP project in these SPECIFIC ways:	<ul> <li>This article provides background inform perceptions of handwriting instruction.</li> <li>It provides information to support the noinstruction to improve legibility</li> <li>Provides information regarding tradition in grades k-6 in relation to handwriting</li> </ul>	eed for handwriting				

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Axford, C., Joosten, A. V., & Harris, C. (2018). iPad applications that required a range of motor skills promoted motor coordination in children commencing primary school. *Australian Occupational Therapy Journal*, 65, 146-155. https://doi.org/10.1111/1440-1630.12450

Purpose of the	To determine the effectiveness of iPad applications that required
Study	specific motor skills designed to improve fine motor skills.
Setting	Western Australia co-educational school
	Two pre-primary classrooms (US equivalent of kindergarten)
	Middle-class suburb
Subjects/Sample	A convenience sample of 5 to 6-year-old children
	• 29 (50% males) students in the intervention classroom and 25 (48%
	males) students in the control classroom.
	One child in the experimental group was intellectually disabled and
	his scores were excluded.
Study Design/ Methodology	• Two group, non-randomized pretest-posttest study design over the course of 9 weeks
	• The control group (CG) continued with 30 minutes of daily fine motor table top activities embedded within their day.
	The experimental group (EG) participated in 30 minutes of iPad use
	in lieu of table top/fine motor activities.
	• Students were given a choice of three apps within each curriculum
	area each day
	A daily checklist of the used apps was completed by teachers and students
Level of Evidence	Level II
Data Collection Tools/Measures	• The Beery-Buktenica Developmental Test of Visual Motor Integration, 6 <sup>th</sup> edition (VMI), The Hawaii Early Learning Profile (HELP), and
	The Shore Handwriting Screen (SHS) were used to measure visual
	motor integration, fine motor and self-help skills and pencil grasp,
	coloring, drawing abilities, and cutting skills, respectively
	An observation checklist was created for use during administration
	of the Beery VMI to increase consistency of observations. This
	included posture, starting points, direction and segmentation of lines,
	and pencil grip as well as writing their name, capitalization, sizing of
	letters, orientation, placement, and start/end letter positions. This was
	scored from 0-5 (lowest to highest). Not deemed reliable or valid.
	• The VMI is a standardized, norm referenced tool with high reliability
	and validity

	T	
	The HELP has both concurrent and content	nt validity and strong
	interrater reliability	
	• The SHS is a criterion referenced tool used	
	coloring accuracy, scissor skills, and draw	ring abilities. Photos were
	taken of each grasp during the test to incre	ease reliability and validity
	of scores	
Results/	Motor coordination score for the EG show	ved a statistically
Main Findings	significant increase over the control group	<u>•</u>
	VMI scores increased for the EG more that	
	Small effect size noted for the VMI and vi	
	large effect size in motor coordination ind	
	<ul> <li>Statistically significant changes were note</li> </ul>	
	, , ,	<u>-</u>
	capitalization, and orientation when writin	<del>-</del>
	• Improvements noted with cutting skills, sp	
	helper hand with more students in the EG	0 1
	statistical significance was reported however	<del>_</del>
	significant for therapists within the school	
	• Overall, the EG demonstrated more gains	
	scissor skills, dressing skills, one handed u	_
	container and grasp maturation when strin	ging beads.
Limitations	• Short length of the study (9 weeks), lack of	of diversity, and the small
	sample group could impact generalizabilit	y
	Post testing was only completed after the completed after the complete after the com	experimental groups' iPad
	use and does not consider natural maturati	on of skills
	• Exposure to tablet use or manipulative task	ks outside of the classroom
	which could have impacted the results	
How is this study	⊠Provides background info	Please Note: You will need
useful for your	Study uses the same/similar Population to	literature to support all areas
EBP project?	your proposed project	of the project, with at least
Check all that		50% of your literature
apply.	Intervention (shows effectiveness of the intervention for	supporting the intervention
	desired/similar outcome)	itself.
	⊠INDIRECTLY supports Intervention (supports	
	smaller aspects of the intervention—content, structure, etc.)	
	□Provides info on tools/methods you could use	
	to collect data/evaluate your project	
This study was	Provides background information regarding	ng the relationship of
identified as the	handwriting and fine motor skills.	
'best' evidence	• Supports the use of app-based intervention	n for improved fine
and can be	motor/handwriting legibility	-
applied to your	Provides information about structure of the study regarding the	
proposed EBP project in these	length of time utilizing applications within the scheduled day and the	
SPECIFIC ways:	several applications to consider use for the	•
of Ecuric ways.	including LetterSchool <sup>TMTM</sup> and Ready to	
	<ul> <li>Uses similar/same population</li> </ul>	
	- Oses similar same population	

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Bassok, D., Latham, S., & Rorem, A. (2016). Is kindergarten the new first grade? AERA Open,

*1*(4), 1-31. https://doi.org/10.1177/2332858415616358

Purpose of the	To provide empirical data regarding the changes in public
Study	kindergarten classrooms over time
	• Answer the following research questions:
	1. How much and how has the public-school kindergarten experience
	changed between 1998-2010?
	2. Is kindergarten the new first grade? Do current kindergarten
	classrooms mimic first grade classrooms from the late 1990s?
	3. Are these changes in the kindergarten experience over this time
	period different in schools serving a large proportion of children
	eligible for free/reduced lunch or non-white children?
Setting	• Specific setting is not identified although the US is implied.
	• Examines the data compiled from two national surveys of kindergarten
	and first grade teachers from two time periods.
Subjects/Sample	The final sample included approximately 2,500 public school
	kindergarten teachers from 1998 and approximately 2,700 teachers
	from 2010.
	Utilized a multistage probability design to ensure a nationally
	representative sample
Study Design/	Longitudinal study
Methodology	• The researchers compared results of the Early Childhood Longitudinal
	Study (ECLS-K) survey from 1998 and 2010.
	Data from the surveys was compared in the areas of school readiness
	beliefs and kindergarten expectations, curricular focus and time use,
	classroom set-up and materials, pedagogical approach, assessment
	practices, and school and teacher characteristics
Level of Evidence	Level IV
Data Collection	Early Childhood Longitudinal Study (ECLS-K) survey was used to
Tools/Measures	collect the data
	National level survey which includes detailed surveys of parents,
	teachers, and school administrators along with assessments of the
	children
	Developed by the US Department of Education to gather reliable data
	to understand children's experiences in early education
Results/	Teacher beliefs: Teachers from 2010 rated academic skills and school
Main Findings	readiness as more important than the teachers from 1998.
	•

All areas surveyed in the area of academic/readiness demonstrated a statistically significant increase in beliefs. Curricular focus and time use: Number of teachers providing literacy instruction remained stable. Increase in the number of teachers providing instruction in math and instruction of advanced skills (spelling, sentence composition, story composition, place value, math equations and probability). Decreased time was spent in non-academic instruction (art, music, etc.). Statistical significance was reported in the areas of instruction of math, non-academics, and exposure to science/and social studies. Classroom setup: Similarities in classrooms related to math and literacy centers. Decrease in the number of classrooms which included science or art style centers. This is statistically significant. Pedagogical Approach: Less time on child-selected activities, more time on whole class activities and utilizing textbooks, worksheets, etc. These results are statistically significant. Assessment: Increase in the importance placed on a child's achievement when compared to local and state standards. Compared to first grade classrooms from 1998-1999, kindergarten classrooms from 2010 are similar. Results are clinically significant to understand the expectations placed on students. Limitations Data was not from the same teachers each time, so the authors were unable to identify changes in perceptions of individual teachers. Full day kindergarten programs have increased so the results of the survey may not be comparing same experiences between the years. Time factors within the classroom may impact exposure to instruction. How is this study Please Note: You will need ⊠Provides background info useful for your literature to support all areas □Study uses the same/similar Population to EBP project? of the project, with at least your proposed project Check all that 50% of your literature □DIRECTLY supports the Proposed supporting the intervention apply. Intervention (shows effectiveness of the intervention for itself. desired/similar outcome) □INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.) □Provides info on tools/methods you could use to collect data/evaluate your project This study was The study provides background information related to the expectations identified as the of kindergarten students currently compared to previously. 'best' evidence It speaks to the increased writing demands on kindergarten students. and can be applied to your proposed EBP project in these **SPECIFIC** ways:

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Butler, C., Pimenta, R., Tommerdahl, J., Fuchs, C. T., & Cacola, P. (2019). Using a handwriting app leads to improvement in manual dexterity in kindergarten children. *Research in Learning Technology*, 27, 1-10. https://doi.org/10.25304/rlt.v27.2135

Purpose of the Study	Compare the effectiveness of an app-based method of learning handwriting when added to the traditional method versus the use of the traditional method only on both manual dexterity and handwriting skills of kindergartners
Setting	9 kindergarten classrooms
	Middle class area
	Large, urban city in North Texas
Subjects/Sample	<ul> <li>Convenience sample of 125 participants (76 boys, 49 girls; represents the gender differences in the population of this school)</li> <li>Age range of 4.5 years to 5 years</li> <li>Experimental Group: 58 students randomly selected from 4 classes</li> </ul>
	• Control group: 67 students from the remainder of the classes
Study Design/ Methodology	<ul> <li>Pretest/post-test with a control group</li> <li>Study conducted over 12-week period from August to December</li> </ul>
	<ul> <li>Control Group participated in the traditional pencil/paper handwriting instruction methods determined by the school curriculum</li> <li>Experimental Group used the same curriculum but replaced 20% (1 day a week) with a stylus-based handwriting app on the iPad.</li> <li>Used the app LetterSchool<sup>TM</sup> and a stylus to practice the letter of the day and previously learned letters.</li> <li>Each child was assessed for manual dexterity and handwriting legibility prior to intervention and after the 12 week period of intervention</li> </ul>
Level of	Level II
Evidence	
Data Collection	• Movement Assessment Battery for Children, 2 <sup>nd</sup> ed.: (MABC-2)
Tools/Measures	<ul> <li>Standardized test designed for children age 3-16 testing manual dexterity, aiming and catching, and balance</li> <li>Only used the manual dexterity subtest, with 3 sections</li> <li>Author states the measures of reliability is .75 for test-retest and .70 for inter-rater reliability;</li> </ul>

	<ul> <li>Evaluation Tool of Children's Handwriting (ETCH): criterion referenced standardized assessment of handwriting speed and legibility with seven tasks including cursive and manuscript. The manuscript version was administered.</li> <li>Author states the manual indicates ages for grades 1-6</li> <li>Used the first 3 subtests following the example of another study for kindergarten students</li> <li>Reported inter-rater reliability of 0.84 and Pearson coefficients for test-retest reliability ranging from 0.63-0.77</li> </ul>
Results/	Results indicated only the EG showed statistically significant
Main Findings	<ul> <li>improvement from pre to posttest with manual dexterity</li> <li>Both groups improved with handwriting skills with both letter and</li> </ul>
	number legibility equally
Limitations	Convenience sample limited randomization
	Unable to control use of tablets/apps outside of school
	• Use of ETCH which is validated for children starting in grade 1;
	however, the first 3 subtests have been used with 5 year olds in other studies
How is this	□ Provides background info Please Note: You will
study useful for	Study uses the same/similar Population to need literature to support
your EBP	vour proposed project, all areas of the project,
project? Check	
all that apply.	Intervention (shows effectiveness of the intervention for desired/similar outcome)  literature supporting the intervention itself.
	⊠INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.)
	⊠Provides info on tools/methods you could
	use to collect data/evaluate your project
This study was	Study uses a kindergarten population
identified as the 'best' evidence	• Directly supports the intervention of app-based instruction with the application LetterSchool <sup>TM</sup> and a stylus paired with traditional
and can be	pencil/paper instruction for the outcome of improved handwriting
applied to your	legibility
proposed EBP	• Indirectly supports the structure, addressing possibly amount of time
project in these	utilizing the app per session and the sessions per week
SPECIFIC ways:	Provides information for possibly outcome measures (ETCH) to
ways.	assess handwriting legibility with the given population

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Donica, D. K., & Holt, S. (2018). Examining validity of the Print Tool® compared with Test of

Handwriting Skills-Revised. OTJR: Occupation, Participation and Health, 1-9.

https://doi.org/10.1177/1539449218804529

Dumpes of the	To answer the following research questions:
Purpose of the	To answer the following research questions:
Study	1. How does first and second-grade performance on the THS-R
	(Test of Handwriting Skills-Revised) compare with performance
	on the non-standardized assessment the <i>Print Tool</i> ®?
	2. Do teachers' perceptions of first and second-grade students'
	handwriting ability align with the students' performance on the
	Print Tool®?
Setting	Two first grade and two second grade classrooms
	Eastern North Carolina private school
Subjects/Sample	• Convenience sample of 46 first and second grade students at a
	private school
	• First grade: 17 students with 6 males (13 six-year olds, 4 seven-
	year olds, 16 were right handed, Ethnicity-13 Caucasian, 1 each
	Korean, African American, Indian, Caucasian/Indian)
	• Second Grade: 29 students with 14 males (2 six-year olds, 19
	seven-year olds, 8 eight-year olds, 24 were right handed,
	Ethnicity- 21 Caucasian, 3 Indian, 2 African American, 1
	Egyptian, 1 Caucasian/Indian)
	• Inclusion criteria: age 6 or older, parental permission, English as a
	primary language
	Exclusion criteria: cognitive or physical impairments that would
	prevent participation
Study Design/	Nonexperimental correlational design
Methodology	• Each participant was designated three identifications numbers:
	master ID, <i>Print Tool</i> ® number, THS-R number
	• Training on the assessments was provided to the 3 examiners
	• Students individually completed both assessments over 2 sessions
	within 1 week of each other
	Order of assessment was randomly assigned
	Teacher perception data was collected for each participant
Level of	Level IV
Evidence	
Data Collection	The Print Tool®-moderate to good reliability reported with good
Tools/Measures	sensitivity to change. This study addresses validity.
I GOIS/ IVICUSUI CS	sensitivity to change. This study addresses variatty.

Results/ Main Findings	<ul> <li>Test of Handwriting Skills-Revised-both test-retest reliability of .80 and interrated .59-1.0. Author indicates validity becaus samples consistent with school-based se</li> <li>Teacher Perception of Handwriting Rating good test-retest reliability. Likert style suresearch. Information on validity was ur</li> <li>Results indicate good concurrent validity compared to the THS-R</li> <li>Results for this correlation were statistice.</li> <li>Clinical significance is not addressed; he validity of the <i>Print Tool</i>® is important therapists assessing handwriting skills of Sizing subtest was a biasing factor due to Indicated alignment with teachers' percentaged.</li> </ul>	r reliability ranging from se it requires writing ttings ng Scale-reported to have urvey used in past table to be located by of the <i>Print Tool</i> ® cally significant towever, determining for school system f students o scoring criteria
Limitations		ay not be generalizable
Limitations	<ul> <li>Small sample size from 1 school so it m</li> <li>The small sample lacked representative impact generalizability</li> <li>The article indicates the <i>Print Tool</i>® was of study, so results are not based on new the general premise is the same. The subtremoved in the new version due to scori Adjustments were also made for sizing of samples.</li> </ul>	diversity which could  as revised after completion as scoring criteria, although assection of the control was ang subjectivity.
How is this	□Provides background info	Please Note: You will
study useful for your EBP project? Check all that apply.	Study uses the same/similar Population to your proposed project  □DIRECTLY supports the Proposed Intervention (shows effectiveness of the intervention for desired/similar outcome)  □INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.)  ☑Provides info on tools/methods you could	need literature to support <u>all areas</u> of the project, with at least 50% of your literature supporting the intervention itself.
TDIstanta 1	use to collect data/evaluate your project	1 1 1 1
This study was identified as the 'best' evidence and can be applied to your proposed EBP project in these SPECIFIC ways:	<ul> <li>This study looks at first and second graders which encompasses early education students similar to the target population</li> <li>Provides evidence to support the use of the <i>Print Tool</i>® as an outcome measure for the EBOT project due to reliability and validity reported.</li> </ul>	

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Hape, K., Flood, N., McAuthur, K., Sidara, C., Stephens, C., & Welsh, K. (2014). A pilot study of the effectiveness of the Handwriting Without Tears® curriculum in first grade. *Journal of Occupational Therapy, Schools, & Early Intervention*, 7, 284-293.

http://dx.doi.org/10.1080/19411243.2014.975071

Purpose of the	• To determine if the Handwriting Without Tears® (HWT) curriculum
Study	was more effective than the standard handwriting curriculum of
	Writer's Workshop within the first grade in developing handwriting
	skill including legibility
Setting	Two first grade classrooms in an inner-city charter school in
	Indianapolis, Indiana
Subjects/Sample	• Convenience sample of the children in two first grade classrooms.
	• The principal designated the classrooms as experimental or control.
	• Inclusion criteria included enrollment in one of the classes.
	• Initially, no students in either room were eligible for special education
	services. Three were later identified during the study.
	• The experimental group consisted of 26 students with a mean age of 6
	years. Five of these students withdrew during the study bringing the
	total down to 21 (12 girls, 9 boys).
	• The control group consisted of 26 students with a mean age of 6 years.
	Four students withdrew from the school during the study resulting in a
	total of 22 (13 girls, 9 boys) in the control group.
Study Design/	Two group, non-randomized controlled trial; pretest/posttest design
Methodology	• In the control group, students participated in the school's adopted
	curriculum of Writer's Workshop.
	The experimental group participated in the adopted curriculum in
	addition to HWT instruction.
	• Five graduate students and the principal investigator reviewed letters
	and writing concepts in small groups of 5-6 students once a week for
	20 minutes for 11 sessions between August to December
	• Three graduate students and the principal investigator reviewed letters
	and concepts for 20 minutes per week for 9 sessions from January to
	April
	• The teacher used the curriculum to cover 1 to 3 lessons per week.
Level of	Level II
Evidence	
<b>Data Collection</b>	The Print Tool® was used for pretest/posttest measurements
Tools/Measures	

	T
	• It has been determined that the Print Tool® has concurrent validity
	and interrater reliability (Donica & Holt, 2018)
Results/	• Results indicated that both the Writer's Workshop and HWT program
Main Findings	demonstrated student growth regarding handwriting skills.
	The combination of curriculums provided more growth.
	• The groups did not differ statistically at post testing; however, the
	control group's post-test scoring was not normally distributed.
	• Results were clinically significant and support the use of the HWT®
	multisensory approach for handwriting instruction
Limitations	Teacher turnover was high during the intervention period which could
	have impacted student progress within both classrooms.
	Bias may have been introduced by using the Print Tool® as the
	outcome measure as the HWT® program and the assessment were
	written by the same author.
	Testing location may have caused decreased attention to task
	impacting results.
	Some of the students in the study later qualified for special education
	services, which may have presented outlying scores, or they may have
	received additional handwriting instruction.
	Individual attention due to additional adults in the room may have
	contributed to the treatment effect.
How is this	□Provides background info Please Note: You will
study useful for	Study uses the same/similar Population to need literature to support
your EBP	your proposed project  all areas of the project,  all areas of the project,
project? Check	your proposed project
all that apply.	MDIRECTL I supports the Floposed literature supporting the
	Intervention (shows effectiveness of the intervention for desired/similar outcome)  Intervention (shows effectiveness of the intervention for intervention itself.
	⊠INDIRECTLY supports Intervention
	(supports smaller aspects of the intervention—content,
	structure, etc.)
	⊠Provides info on tools/methods you could
	use to collect data/evaluate your project
This study was	• Study uses similar population of early education students (first graders
identified as the 'best' evidence	as opposed to kindergarten students)
and can be	• Study demonstrates the benefit of a handwriting program for
	improving legibility addressing a traditional handwriting program
applied to your	Provides insight into intervention of a traditional pencil/paper
proposed EBP	handwriting program including timing of sessions and number of
project in these SPECIFIC	sessions possibly needed.
	Supports the use of the Print Tool® as an outcome measure to detect     improvement with head desiring a little.
ways:	improvement with handwriting skills.

Donica, D. K., & Holt, S. (2018). Examining validity of the Print Tool® compared with Test of

Handwriting Skills-Revised. OTJR: Occupation, Participation and Health, 1-9.

https://doi.org/10.1177/1539449218804529

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Jordan, G., Michaud, F., & Kaiser, M.-L. (2016). Effectiveness of an intensive handwriting

program for first grade students using the application LetterSchool<sup>TM</sup>: A pilot study.

Journal of Occupational Therapy, Schools, & Early Intervention, 9(2), 176-184.

https://doi.org/10.1080/19411243.2016.1178034

<ul> <li>Purpose of the Study</li> <li>To determine the effectiveness of a handwriting program that incorporates fine motor activities, animated models, tablet-based activities, and paper-pencil tasks.</li> <li>Setting</li> <li>Two first grade classrooms in a private English-speaking school in Switzerland.</li> <li>Subjects/Sample</li> <li>Experimental group (EG) of 16 children, (11 girls, mean age-6.9 yrs)</li> <li>Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).</li> <li>Convenience sample</li> </ul>
activities, and paper-pencil tasks.  Setting  Two first grade classrooms in a private English-speaking school in Switzerland.  Subjects/Sample Experimental group (EG) of 16 children, (11 girls, mean age-6.9 yrs) Control group (CG) of 14 children, (9 girls, mean age of 6.7 years). Convenience sample
<ul> <li>Setting         <ul> <li>Two first grade classrooms in a private English-speaking school in Switzerland.</li> </ul> </li> <li>Subjects/Sample         <ul> <li>Experimental group (EG) of 16 children, (11 girls, mean age-6.9 yrs)</li> <li>Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).</li> <li>Convenience sample</li> </ul> </li> </ul>
Switzerland.  Subjects/Sample  Experimental group (EG) of 16 children, (11 girls, mean age-6.9 yrs)  Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).  Convenience sample
Switzerland.  Subjects/Sample  Experimental group (EG) of 16 children, (11 girls, mean age-6.9 yrs)  Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).  Convenience sample
<ul> <li>Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).</li> <li>Convenience sample</li> </ul>
<ul> <li>Control group (CG) of 14 children, (9 girls, mean age of 6.7 years).</li> <li>Convenience sample</li> </ul>
Convenience sample
•
• Inclusion criteria: 1) enrolled in the two classes 2) for the EG-
completed 80% of sessions 3) completed pre/post-test.
• Exclusion criteria included refusal from the parents to participate.
• The final sample included 5 pairs of twins, 2 identical and 3 fraternal
with 8 girls and 2 boys (mean age 6.7 years). One of each twin set was
placed in each group.
Study Design/ • Quasi-experimental pretest/posttest design with a control group
<b>Methodology</b> • 10-week program including 10 minutes of writing exercises and a 45-
minute handwriting lesson each week. Weekly schedule follows:
• Day 1 consisted of 10 minutes of fine motor exercises, 20 minutes of
instruction on 2-3 lower case letters on LetterSchool <sup>TM</sup> , 10 minutes of
paper/pencil activities
• Day 2 consisted of 10 minutes of upper-case letters on LetterSchool <sup>TM</sup>
• Day 3 consisted of 10 minutes of paper/pencil handwriting practice to
transition between blank and lined sheets of paper
• Day 4 included paper and pencil activities on lined paper
• Day 5 included creation of words containing the letters of the week.
Level of Level II
Evidence
<b>Data Collection</b> • The BHK (translated to) the Concise Assessment Method for
Tools/Measures Children's Handwriting was used to assess handwriting quality
(BHK= Beknopte Beo-ordelingsmethode voor Kinder Handschriften)
Not validated in English
Utilized the text in the McMaster Handwriting Assessment Protocol

	• The authors report the BHK shows sensitive	•
	concurrent validity with the Scale of Dysg	-
	<ul> <li>Construct validity was demonstrated by co dysgraphia and a control group.</li> </ul>	omparing a group with
Results/	<ul> <li>No significant differences between the twi</li> </ul>	ne in aither group (pretect)
Main Findings	<ul> <li>Post test scores were significantly better in</li> </ul>	
	<ul> <li>Post test scores of the CG indicated a decli</li> </ul>	
	<ul> <li>Letter size increased in both groups but wa</li> </ul>	<u> </u>
	<ul> <li>Twins from the EG had better scores for si</li> </ul>	
	CG was better in two subtests	ix subtests
	<ul> <li>Size relationships of letters was the largest</li> </ul>	t difference between groups
	<ul> <li>Results were statistically significant indica</li> </ul>	<u> </u>
	the intervention	ating that the result is due to
	<ul> <li>Results are clinically significant, indicating</li> </ul>	g that an intensive
	handwriting program incorporating pencil	<del>-</del>
	instruction is beneficial for the improvement	
Limitations	Small sample group from a private school	
	and generalizability	,
	2 outcome measures were combined impact	cting their psychometric
	properties	
	No fine motor assessment was administered	ed to support the results
	Possibility that other interventions may ha	ve influenced the results
	Additional attention to the students in the control of the students in the students	1 0 1
	provided, which could have produced the	
How is this	□Provides background info	Please Note: You will
study useful for	⊠Study uses the same/similar Population to	need literature to support
your EBP	your proposed project	all areas of the project,
project? Check	☑DIRECTLY supports the Proposed	with at least 50% of your
all that apply.	Intervention (shows effectiveness of the intervention for	literature supporting the intervention itself.
	desired/similar outcome)	intervention itself.
	SINDIRECTLY supports Intervention (supports smaller aspects of the intervention—content,	
	structure, etc.)	
	□Provides info on tools/methods you could	
	use to collect data/evaluate your project	
This study was	Supports the use of app-based instruction	
identified as the	instruction and pencil/paper tasks for incre	eased handwriting skill
'best' evidence	including legibility	
and can be	• Supports the use of the app LetterSchool <sup>TM</sup>	
applied to your	Supports using pretest/posttest design	
proposed EBP project in these	Addresses the early education population	
SPECIFIC		
ways:		
wajs.	L	

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Karlsdottir, R., & Stefansson, T. (2002). Problems in developing functional handwriting.

Perceptual and Motor Skills, 94, 623-662. http://dx.doi.org/10.2466/PMS.94.2.623-662

	T
Purpose of the	• To determine the extent and cause of handwriting dysfunction in
Study	elementary school children
	• To determine procedures for early identification of these children and
	remediation processes
Setting	• Twenty 1 <sup>st</sup> grade classrooms in primary schools in Trondheim,
	Norway
Subjects/Sample	• Convenience sample of 407 students (217 boys, 190 girls)
	• Attending 1 <sup>st</sup> grade
	Participating in the Learning Experience Approach to reading
	instruction
Study Design/	• Longitudinal experiment; children were followed from 1 <sup>st</sup> to 5 <sup>th</sup> grade
Methodology	• Four instruction groups (2 x 2 x 2 x 2 factorial design) with 5 classes
	in each group
	• Handwriting was assessed at the ends of grades 1, 2, 3, and 5
	• Four factors were included: 1) print script or disjoint cursive 2)
	tracing or copying 3) functional or dysfunctional 4) girls or boys
	A specific handwriting instruction plan was implemented in each of
	the groups in each grade as the students moved from grade to grade
Level of	Level III
Evidence	
<b>Data Collection</b>	Developmental Test of Visual Motor Integration of Beery (VMI)
Tools/Measures	Southern California Motor Accuracy test
	Southern California Figure Ground test
	Right hand grooved pegboard test
	Right hand finger tapping
	Letter Naming: capitals and small letters
	Writing letters: capitals
	Handwriting quality and speed tests
	Validity and reliability were discussed for each assessment.
	The authors determined each assessment was valid and all were
	reliable although concerns were noted with the Southern California
	Figure Ground test due to its moderate test-retest reliability
Results/	Approximately ¼ of the sample demonstrated dysfunctional
Main Findings	handwriting at the end of 1 <sup>st</sup> grade with only about 1/3 of that group
	remaining dysfunctional by the end of 5 <sup>th</sup> grade
	• Dysfunction in speed appears to be related to dysfunction in quality

	<ul> <li>Scores from the VMI, Figure Ground test, Motor Accuracy test, finger tapping and pegboard tests, and the letter naming, writing tests do not seem to be good predictors of future handwriting proficiency</li> <li>Statistical significance was found for the development of handwriting quality between children with functional and dysfunctional handwriting.</li> <li>Improvement in handwriting from grades 1-5 is clinically significant meaning that handwriting quality for both functional and dysfunctional groups improved over time</li> <li>Statistically significant for improvement in speed in grades 3-5</li> <li>Handwriting dysfunction necessitates remediation</li> <li>Most children have adequate motor and perceptual abilities to develop handwriting.</li> </ul>
Limitations	The research study did not list limitations; limitations are present
	<ul> <li>The assessments for the population were completed by one person, the primary author, which may have caused skewing of the results</li> <li>The population is limited to one region in Norway and may not generalize to other populations</li> <li>The assessments used appeared to be older assessments compared to the timing of the study, causing one to question if the standardization was still valid</li> <li>The study was completed many years prior (1980s) to publication (2002) leading to concerns about the generalizability to current populations.</li> </ul>
How is this	⊠Provides background info Please Note: You will
study useful for your EBP project? Check all that apply.	□Study uses the same/similar Population to your proposed project □DIRECTLY supports the Proposed Intervention (shows effectiveness of the intervention for desired/similar outcome) □INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.) □Provides info on tools/methods you could use to collect data/evaluate your project
This study was	While the study takes place many years ago, the background
identified as the	information presented regarding the development of handwriting
'best' evidence	skills is still relevant.
and can be	The study discusses specifics regarding handwriting intervention
applied to your	which is successful (8 instruction periods of 40 min. each for 4
proposed EBP	weeks)
project in these	The study indicates handwriting should be taught letter by letter for
SPECIFIC	mastery and individualized for the specific child.
ways:	•

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Lin, L.-Y., Cherng, R.-J., & Chen, Y.-J. (2017). Effects of touch screen tablet use on fine motor development of young children. *Physical & Occupational Therapy in Pediatrics*, *37*, 457-467. https://doi.org/10.1080/01942638.2016.1255290

Purpose of the	Investigate the effects of touch-screen tablet use on fine motor	
Study	development of preschool children without developmental delay	
Setting	• The activities of the study took place within the participants home in	
	Taiwan	
Subjects/Sample	Fliers were used to recruit participants from 6 preschools	
	Convenience sampling	
	• Eighty children (52 boys [65%]) without development delays	
	Ranged in age from 48-72 months old	
	No previous diagnosis of diseases or disorders related to	
	developmental delays	
	All the children were attending a preschool.	
	• The touch-screen tablet group contained 40 children (26 boys)	
	• The non-touch-screen tablet group contained 40 children (26 boys)	
	Both groups had a mean age of 61 months	
Study Design/	Cohort study	
Methodology	• Two groups (n=80) participated in 20 minutes per day of activities	
	for 24 weeks	
	• Experimental group (n=40)-iPad activities based on Uncolor for	
	iPad and Dexteria Jr.	
	• 24 age appropriate apps designed for improving fine motor skills	
	were used	
	• Control group (n=40)-Fine motor activities based on Developmental	
	frame of reference	
	Parents maintained a log of activities	
Level of	Level II	
Evidence		
Data Collection	Bruininks-Oseretsky Test of Motor Proficiency – 2 <sup>nd</sup> Edition, 4	
Tools/Measures	subtests: fine motor precision, fine motor integration, manual	
	dexterity, upper-limb coordination	
	Authors report good reliability and validity	
	Hand-held pinch dynamometer in 3-point pad pinch position	
	Results compared to developmental norms indicating	
	validity/reliability	

#### Results/ Non-touch screen tablet group had higher scores in fine motor **Main Findings** precision, fine motor integration, and manual dexterity than the touch screen tablet group no statistical difference noted between upper limb coordination or in pinch strength for the two groups Results were reported as statistically significant Clinical Significance is implied for pediatric therapists because the study indicates play with manipulative based toys/media aids in fine motor development as opposed to tablet-based play, which does not appear to aid in fine motor development Limitations Small sample size and the lack of low socioeconomic participants limits the generalizability to the greater population. The authors did not record how long participants had used touched screens prior to the study. Norms for the measurement tools, Pinch strength and BOT-2, do not exist for the culture where the study took place. The authors did not report other developmental factors that may be involved with use of a touch screen tablet such as cognitive and visual perceptual skills. Children in non-tablet group may have been exposed to tablet use Children in either group could have participated in additional activities that may have impacted their fine motor skills. How is this Please Note: You will ⊠Provides background info study useful for need literature to support ⊠Study uses the same/similar Population to **your EBP** all areas of the project, your proposed project project? Check with at least 50% of your ⊠DIRECTLY supports the Proposed all that apply. literature supporting the Intervention (shows effectiveness of the intervention for intervention itself. desired/similar outcome) **⊠INDIRECTLY** supports Intervention (supports smaller aspects of the intervention—content, structure, etc.) □Provides info on tools/methods you could use to collect data/evaluate your project This study was Age of participants is consistent with preschool-kindergarten age identified as the students which is the target population of the EBOT project 'best' evidence Provides background information relating the use of tablet and can be activities to the development of fine motor skills. applied to your Directly supports that apps alone are not effective at improving proposed EBP fine motor skills project in these Indirectly supports the use of utilizing a combination approach of **SPECIFIC** traditional instruction combined with app-based instruction to ways: increase handwriting skills may be needed

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Lorah, E. R., & Parnell, A. (2014). The acquisition of letter writing using a portable multi-media

player in young children with developmental disabilities. Journal of Developmental &

Physical Disabilities, 26, 655-666. https://doi.org/10.1007/s10882-014-9386-0

	T	
Purpose of the	• Assess the obtainment of handwriting skills using the iPod Touch®, a stylus,	
Study	and the app LetterSchool <sup>TM</sup> ,	
	• Whether completing all steps in the LetterSchool <sup>TM</sup> instruction generalized to	
	paper/pencil writing	
	Determine the preference for app-based vs pencil/paper instruction.	
Setting	Unused occupational therapy office	
	• Inclusion education learning center in the US (specific state not specified	
	though the author is associated with the University of Arkansas); participants	
	attended 7.5 hours per day, 5 days per week	
	• Room contained 2 bookshelves, toys, a child size desk, and 2 chairs.	
Subjects/Sample	Purposive sample; 4 participants (age range 4.6-6.0 yrs) were recruited	
	although 1 was dismissed due to excessive absences.	
	• Inclusion criteria included a diagnosis of autism spectrum disorder (ASD) or	
	developmental delay (DD), demonstration of pre-writing skills, the ability to	
	maintain attention for at least 30 seconds and no previous instruction in	
	handwriting skills.	
	• All 3 participants attended an inclusion educational learning center, were	
	diagnosed with DD, and had occupational therapy (OT)	
Study Design/	Single-Case design with a before-after approach	
Methodology	• Each participant's OT selected three letters for instruction	
	Baseline data was collected by having the participant write the letter with the	
	target letter presented at the top of the paper	
	• Training was initiated and the participant completed the three phased protocol	
	in the LetterSchool <sup>TM</sup> app using a stylus. They were then given paper to write	
	the letter with model at the top. Training continued until mastery was reached	
	over two sessions	
	One session was given per day	
	Adaptive training provided to 1 participant due to lack of progress	
	Maintenance sessions were completed after mastery	
	After mastery of the three letters each participant was told to "practice writing"	
	(insert letter)" with both paper/pencil and iPod Touch®/stylus available to	
	determine preference	
Level of Evidence	Level IV	
Data Collection	A task analysis and probe for the letters was used to collect data	
Tools/Measures	12 man and property and received was used to contect data	
	I .	

	<ul> <li>Each letter was divided into parts and each part was scored as correct or incorrect, followed by a calculation to determine the percentage of the steps completed correctly.</li> <li>Developed by the authors; validity and reliability not indicated, nor was this scoring piloted or revised</li> <li>Second Observer was used for 35% of all baseline and training sessions. Interobserver agreement was calculated and was 95% during baseline, 90% during training, 100% during maintenance</li> <li>Fidelity checklist was completed after each session.</li> </ul>	
Results/ Main Findings	<ul> <li>Two of the three participants showed improvement using the instruction provided by the app</li> <li>One participant needed additional instruction initially with stimulus prompting and prompt fading.</li> <li>Rate of acquisition increased with each letter trained</li> <li>Skills generalized to writing each letter with pencil/paper</li> <li>Two out of three participants preferred the app instruction with the third showing a preference for pencil/paper although not exclusively</li> <li>Statistical significance was not stated in the article although a moderate to high experimental effect was identified with most letters assessed (minimal affect with 2 out of the 9 letters)</li> <li>Clinically significant to the efficacy of utilizing an app for letter formation</li> </ul>	
Limitations	<ul> <li>Time constraints limit long-term maintenance data and prevent training of additional letters to determine rate of acquisition</li> <li>Minimal experimental effect for one letter for two participants, possibly due to few sessions conducted prior to mastery</li> <li>Small sample and lack of diversity make generalization difficult.</li> </ul>	
How is this study useful for your EBP project? Check all that apply.	□ Provides background info □ Study uses the same/similar Population to your proposed project □ DIRECTLY supports the Proposed Intervention (shows effectiveness of the intervention for desired/similar outcome) □ INDIRECTLY supports Intervention (supports smaller aspects of the intervention (supports smaller aspects of the intervention—content, structure, etc.) □ Provides info on tools/methods you could use to collect data/evaluate your project	
This study was identified as the 'best' evidence and can be applied to your proposed EBP project in these SPECIFIC ways:	<ul> <li>Directly supports the use of LetterSchool<sup>TM</sup> as instruction method for improved legibility, followed by use of pencil/paper to ensure carryover</li> <li>Provides insight into possible project design, with time using the app followed by pencil/paper practice</li> <li>Provides information regarding the motivation factor of app-based instruction</li> <li>Supports use of stylus for increased generalization to pencil/paper writing skills.</li> </ul>	

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Nye, J. A., & Sood, D. (2018). Teachers' perceptions of needs and supports for handwriting instruction in kindergarten. *The Open Journal of Occupational Therapy*, 6(2), 1-12.

https://doi.org/10.15453/2168-6408.1411

Purpose of the	Explore the needs of kindergarten teachers and the supports they	
Study	require when teaching handwriting skills	
	Answer 2 questions	
	What impedes kindergarten teachers in facilitating handwriting	
	skills among the children in their classes?	
	What supports do kindergarten teachers need to facilitate	
	handwriting skills among the children in their classes?	
Setting	Four elementary schools in Illinois	
Subjects/Sample	9 kindergarten teachers	
	Held a current license in the state of Illinois	
	Excluding factors included employment outside of the district and	
	teaching a grade other than kindergarten	
	All participants were female with a bachelor's degree or higher in	
	Education	
	<ul> <li>Mean years of teaching experience was 11 years with the mean</li> </ul>	
	years kindergarten teaching experience at 9.5 years	
Study Design/	Phenomenology	
Methodology	Open ended questions during a semi-structured interview were used	
	to collect data	
	Interviews were voice recorded for transcription and were	
	transcribed verbatim	
Level of	Qualitative	
Evidence		
<b>Data Collection</b>	Semi-structured interviews with open-ended questions were used to	
Tools/Measures	gather data	
	Credibility/confirmability was obtained through a member check to	
	ensure accuracy	
	Transferability was evidenced by thorough description of the	
	setting/participants	
	Dependability established through the transparency of data	
	collection methods and questions	
Results/	• 5 themes emerged: foundational skills needed for handwriting,	
Main Findings	challenges related to teaching handwriting, supports teachers	
	required to facilitate handwriting in kindergarten, how occupational	

How is this study useful for your EBP project? Check all that apply.	therapy can provide support to facilitate he teacher use to promote handwriting  • Main findings included the need for a curaccess to OT services, teacher training in need for a collaborative service delivery handwriting concerns.  • Small study size and in one school districted. No discussion of assumption or biases so the results were skewed towards a desired.   ⊠Provides background info  ⊠Study uses the same/similar Population to your proposed project  □DIRECTLY supports the Proposed	rriculum and training, assessing handwriting, and model to address et may limit generalizability it cannot be determined if doutcome  Please Note: You will need literature to support all areas of the project, with at least 50% of your
all that apply.	□DIRECTLY supports the Proposed Intervention (shows effectiveness of the intervention for	literature supporting the
	desired/similar outcome)	intervention itself.
	⊠INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content, structure, etc.)	
	□Provides info on tools/methods you could	
	use to collect data/evaluate your project	
This study was	Provides background information regard	ling current handwriting
identified as the	instruction and the need for curriculum	
'best' evidence and can be	Supports a collaborative approach to har	_
and can be applied to your	Addresses instruction within a kindergar	rten classroom, the target
proposed EBP	population	ration
project in these	Indirectly supports the theme of collaboration and indirectly supports utilizing a consistent.	
SPECIFIC SPECIFIC	Indirectly supports utilizing a consistent     Discusses foundational skills product for	
ways:	Discusses foundational skills needed for	nanuwitting skins.

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Randall, B. S. (2018). Collaborative instruction and Handwriting Without Tears®: A strong

foundation for kindergarten learning. Journal of Occupational Therapy, Schools, & Early

Intervention, 11(4), 374-384. https://doi.org/10.1080/19411243.2018.1476200

Purpose of the	• To determine if teacher instruction using Handwriting Without Tears®	
Study	with collaboration from the occupational therapist would be effective to	
	improve kindergarten students' letter formation and alignment.	
Setting	2 kindergarten classes; rural, upstate New York elementary school.	
Subjects/Sample	• Convenience sample of two teachers with extensive teaching experience	
	(24 years and 31 years) who volunteered to participate.	
	• Regular education kindergarten classrooms with a combined total of 35	
	students participating in instructional activities.	
	• 27 of the students were enrolled in the data collection section	
	• Class A had 17 students (8 girls, 9 boys) with 5 of these having either an	
	IEP or 504 plan	
	• Class B had 10 students (3 girls, 7 boys) with 5 having a 504 plan.	
Study Design/	• Single group, nonrandomized study; qualitative (interview strategies)	
Methodology	• Teachers were trained in a single 1.5-hour training session which covered	
	the components of legible handwriting, pencil grasp and the basics of the	
	curriculum.	
	Students were pretested using the PrintTool®	
	Instruction included the lower-case alphabet	
	• For the first 5 weeks, letter instruction occurred 4 days per week with one	
	exception (Week 5 was 3 days of instruction with 2 lessons on one day due	
	to time constraints)	
	The sixth week focused on reinforcing the skills	
	• The occupational therapist was present for 2-3 sessions per week.	
	• Sessions were co-taught, or the non-teaching adult helped students.	
	• The teachers and therapist met weekly to discuss progress, problems, and	
	review lessons.	
	Retest occurred following the last week of instruction.	
Level of Evidence	Level III and Qualitative	
Data Collection	• Modified version of the Handwriting Without Tears® Print Tool®. The	
Tools/Measures	Print Tool® has been found valid and has interrater reliability (Donica &	
	Holt, 2018). The test was modified with permission.	
	• Review of notes from logs, verbal communications and a debriefing held at	
	the conclusion of the project provided qualitative data showing credibility	
	(reflective approach with logs)	

	Dependability: Data and findings are consistent, and the data collection  mathods were described.	
	methods were described	
	Confirmability: The teachers were debriefed in a collaborative planning time at the conclusion of the study.	
Results/	time at the conclusion of the study.	
	• Statistically significant improvement was noted for the group regarding	
Main Findings	letters written from memory	
	Statistically significant improvement noted for alignment	
	Qualitative data indicated the teachers perceived this as a positive	
	experience and the students improved.	
	Both teachers indicated preference for the therapist to be in the room    Description   Descrip	
	during instruction to assist with struggling students or model method	
	• Results were clinically significant indicating support for a collaborative	
Limitations	approach to handwriting instruction with a formal handwriting curriculum	
Limitations	Small sample size would limit the ability to generalize.  In the sample size would limit the ability to generalize.	
	• Lack of control group for comparison is also a limitation as data is limited	
	for comparison to those not receiving the intervention.	
	• The time limitations of the study with regards to timing of limitations may	
	have impacted the results as students may have poor habits.	
	• Intervention and evaluation were completed by the same therapist	
Harria thia atrada	eliminating blinding which could impact the results.  Provides background info  Please Note: You will need	
How is this study useful for your	Trovides suckground into	
EBP project?	Study uses the same/similar Population to literature to support <u>all areas</u> of the project, with at least 50% of	
Check all that	your literature supporting the	
apply.	intervention itself	
uppij.	Intervention (shows effectiveness of the intervention for	
	desired/similar outcome)  MINDIDECTI V supports Intervention	
	⊠INDIRECTLY supports Intervention (supports smaller aspects of the intervention—content,	
	structure, etc.)	
	⊠Provides info on tools/methods you could	
	use to collect data/evaluate your project	
This study was	Provides background information regarding handwriting skills and the	
identified as the	reason for choosing the HWT® program	
'best' evidence	Utilizes the same population of kindergarten students	
and can be	Directly supports using the HWT® program as a traditional pencil/paper	
applied to your	curriculum for handwriting for improved legibility	
proposed EBP	• Indirectly supports the structure of the project as well as the time for	
project in these	instruction, including possibly focusing on lower case letters	
<b>SPECIFIC</b> ways:	Supports the use of the Print Tool® for an outcome measure	

Donica, D. K., & Holt, S. (2018). Examining validity of the Print Tool® compared with Test of

Handwriting Skills-Revised. OTJR: Occupation, Participation and Health, 1-9.

https://doi.org/10.1177/1539449218804529

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

Wells, K. E., Sulak, T. N., Saxon, T. F., & Howell, L. L. (2016). Traditional versus iPad-

mediated handwriting instruction in early learners. Journal of Occupational Therapy,

Schools, & Early Intervention, 9(2), 185-198.

https://doi.org/10.1080/19411243.2016.1176548

Purpose of the	To compare iPad based handwriting practice with traditional pencil-	
Study	paper handwriting practice	
	Determine the extent to which iPad mediated handwriting practice	
	transfers to pencil and paper assessment.	
Setting	Urban public elementary school in central Texas	
Subjects/Sample	Purposive Sample	
	Students were recruited through teacher referral.	
	• Kindergarten and 1 <sup>st</sup> grade students scoring in the bottom 25% of the	
	midyear literacy assessment	
	Received Tier 3 services under the RTI framework.	
	• Twelve students (4 females and 8 males; average age 6 years, 4	
	months) participated in the study.	
	• Racial make-up: 50% African American, 33% Hispanic, 17% White	
Study Design/	Small scale randomized control trial	
Methodology	Students randomly assigned to the control or treatment group	
	• The treatment group completed Zaner-Bloser handwriting instruction	
	on the iPad using the iTrace app and a pencil like stylus	
	Only letters which needed remediation were available	
	Sequence of letters was related to results of student's testing	
	individualizing the intervention	
	• The student practiced for 15 minutes, 3 times per week for 6 weeks	
	• Control group received pencil/paper instruction for formation,	
	placement, and size for the same time period	
	Sequence of instruction included model on white board, model on	
	paper with dashed line, guided practice, followed by independent	
	practice. Each letter was mastered before moving to a new one	
	On task behavior was rewarded through a sticker	
Level of	Level II	
Evidence		
Data Collection	Primary spelling inventory and a one-minute spelling sample were	
Tools/Measures	used as work samples for scoring	

-	
	<ul> <li>Initially, a handwriting rubric was utilized for scoring however after realizing it was possible to receive a high score without meeting the lower criteria, the rubric was revised.</li> <li>To ensure reliability two researchers scored a sample of the handwriting and reconciled any difference with discussion. After 100% agreement was reached a single researcher scored the remaining samples.</li> <li>Validity is implied after the revision of the rubric but is not stated.</li> </ul>
Results/	Letter production increased 50% for the treatment group vs. control
Main Findings	<ul> <li>Letter production increased 50% for the treatment group</li> <li>Letter formation improved for the treatment group</li> </ul>
Widin I manigs	
	• The control group and the treatment group increased by the same
	median amount regarding letter formation
	Handwriting quality (formation and orientation) improved more so for
	the control group
	• Due to the small sample size of the study, inferential statistics were not
	generated so statistical significance cannot be reported.
	• The study is clinically significant as it indicates that traditional
	instruction appears superior, but improvements can be made with iPad
	mediated instruction, especially regarding letter production
Limitations	• Small sample size which may limit generalizability.
	• Due to randomization the two groups were not matched in ethnicity,
	gender, or age, with the control group averaging 9 months younger.
	• The original rubric for scoring did not appear to follow a linear
	progression for worse to better indicating a need for revision.
	• More consistent writing tasks for the pre/posttest would be beneficial.
	Having timed and untimed portions added confusion to the results.
How is this	□Provides background info Please Note: You will
study useful for	⊠Study uses the same/similar Population to need literature to support
your EBP	your proposed project  all areas of the project,
project? Check	Solution proposed project  Solution proposed project  With at least 50% of your with at least 50% of your proposed project.
all that apply.	literature supporting the
	Intervention (shows effectiveness of the intervention for desired/similar outcome) intervention itself.
	■INDIRECTLY supports Intervention
	(supports smaller aspects of the intervention—content,
	structure, etc.)
	⊠Provides info on tools/methods you could
-	use to collect data/evaluate your project
This study was	• Uses kindergarten and first grade students, a similar population.
identified as the	• Utilized a tablet-based application for handwriting instruction (iTrace)
'best' evidence	to improve legibility
and can be	Discusses design points for instruction utilizing technology for
applied to your	handwriting instruction (intervention time, number of sessions)
proposed EBP	• Discusses the use of rubric for handwriting assessment as a possible
project in these	outcome measure
SPECIFIC	Utilizes a stylus for tablet-based instruction
ways:	

#### **Appendix B: Handwriting Without Tears® Certificate**

# CERTIFICATE OF COMPLETION

Kerri Sheffield

has successfully completed eight hours of self-paced study to complete Handwriting Without Tears® Level I Certification.



Handwriting Without Tears®

Christina Bretz

November 26, 2019

Date

Christina Bretz, OTR/L

#### **Appendix C: Volunteer Recruitment Email**



Dear Kindergarten teachers,

Date:

I am currently an occupational therapy doctoral student at Chatham University. After the semester break, I will be carrying out an evidence-based practice project at Timber Ridge Elementary. I have received approval from Mrs. McRae, school principal, Debra Delaine, Director of Exceptional Student Services, and Chatham University's Institutional Review Board to conduct my project. Through my project I will be answering the question, "Do kindergarten students who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation demonstrate improved legibility?" My project is utilizing current evidence that shows traditional instruction using paper and pencil methods, in this case the Handwriting Without Tears® Program, supplemented with app-based instruction with the application LetterSchool<sup>TM</sup> improves student handwriting skills. I will support this instruction by providing handwriting instruction within the small group literacy centers, teacher training, and instruction utilizing the application.

I am asking that you consider participating in my project. To participate, you will be asked to commit to reinforcing accurate letter formation of the lowercase letters which will be targeting in the program. I will be available to provide instruction on 2-3 days a week and will supervise usage of the application LetterSchool<sup>TM</sup>. You and I would also meet weekly for a collaborative planning period after school hours to address any concerns that arise during the program.

You will also participate in an initial training session of approximately one hour in length after school hours, scheduled at your convenience. Students whose parents consent will be assessed at the beginning and end of the program. I will complete the assessments which will involve the children being briefly removed from the classroom.

I will only be able to enroll one teacher in the project at this time. The enrolling teacher must have students who receive occupational therapy services on his or her class roll and have at least one year of teaching experience. If more than one teacher expresses interest and meets the criteria, I will allow Ms. McRae to make the final decision. One classroom is the number of students that can be logistically managed at the time. Those not selected may be offered the opportunity to participate at a future date and time. If you are interested, please contact me at kerri.sheffield@chatham.edu by the end of the workday on (insert date here). The selected participant will be provided with informed consent paperwork to review and sign.

Thank you for considering participation in this project.

Kerri Sheffield, OTR/L. OTDS

Kerri Sheffield, OTR/L

Chatham University faculty advisors name and contact information:

Dr. Jennifer Lape: j.lape@chatham.edu; Dr. Andrea Collins: a.collins@chatham.edu

#### **Appendix D: Volunteer Consent Form**



Dear Kindergarten teacher,

Date:

I am currently an occupational therapy doctoral student at Chatham University. This semester, I will be carrying out an evidence-based practice project at Timber Ridge Elementary. I have received approval from Mrs. McRae, school principal, Debra Delaine, Director of Exceptional Student Services, and Chatham University's Institutional Review Board to conduct my project. Through my project I will be answering the question, "Do kindergarten students who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation demonstrate improved legibility?" My project is utilizing current evidence that shows traditional instruction using paper and pencil methods, in this case the Handwriting Without Tears® Program, supplemented with app-based instruction with the application LetterSchool<sup>TM</sup> improves student handwriting skills. I will support this instruction by providing handwriting instruction within small groups, teacher training, and instruction utilizing the application. You are receiving this form because you have expressed an interest in participating in this project.

Participation would involve an initial training session of approximately one hour in length after school hours, scheduled at your convenience. Next, any students whose parents consent will be assessed using the Print Tool®. This will involve the children being briefly removed from the classroom for individual testing for 15-20 minutes.

The instructional period lasts for approximately six weeks. You will be asked to commit to reinforcing accurate letter formation of the lowercase letters using the Handwriting Without Tears® program. I will provide instruction on 2-3 days a week and supervise the usage of the application LetterSchoolTM. This will be scheduled during morning hours when morning work is being completed, prior to the beginning of new instruction. You and I would also meet weekly for a collaborative planning period outside of school hours to address any concerns that arise during the program.

Students whose parents consent will be retested after completion of instruction. The retesting will utilize the same tool and will be again completed outside of the classroom.

Attached is a volunteer consent form. No data will be collected on you, the teacher/paraprofessional. Please review the form thoroughly and contact me at kerri.sheffield@chatham.edu if you have any questions. Please return it to me if you would like to participate.

Thank you for considering participation in this project.

Kerri Sheffield, OTRIL, OTDS

Kerri Sheffield, OTR/L

Chatham University faculty advisors name and contact information: Dr. Jennifer Lape: j.lape@chatham.edu; Dr. Andrea Collins: a.collins@chatham.edu



#### Volunteer Written Agreement

INVESTIGATOR(S) NAME: Kerri Sheffield, OTR/L

**EVIDENCE BASED PROJECT TITLE:** Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility **Concise Summary**:

- Volunteers are being sought for an evidence-based project to assist with implementation
- The purpose of this evidence-based project is to determine if providing traditional
  handwriting instruction with paper and pencil combined with instruction provided through a
  tablet-based application will improve handwriting legibility of kindergarten students.
- You will be volunteering in the implementation of the program during class time for six weeks, including training, monitoring application use, reinforcing instruction, and collaborating with the therapist for a total of approximately 6.50 hours.
- Risks and discomforts related to participation are minimal. You may feel mild discomfort
  providing instruction on handwriting skills in a way that may be different than you currently
  provide instruction.
- Benefits may include improved handwriting skills of the students. There is the potential the
  project will provide data to support the adoption of a district-wide handwriting program.
  This could also add to the current knowledge base on this topic for teachers and therapists
  outside the school district.

PURPOSE OF THE EVIDENCE BASED PROJECT: The purpose of this evidence-based project is to determine if providing traditional, paper and pencil, handwriting instruction combined with instruction provided through a tablet-based application will improve handwriting legibility of kindergarten students. Improved handwriting skills have been linked to improved classroom performance. As a volunteer, you will be asked to reinforce instruction on letter formation and use of the application as needed. You will be trained on the use of the application as well as the traditional handwriting program. Weekly collaboration with the therapist will take place to problem-solve concerns and review the plan for the following week. You are being invited to volunteer as you showed interest in the project and meet the inclusion criteria to volunteer.



**DESCRIPTION OF THE EVIDENCE BASED PROJECT:** The project will include a pretest to measure current handwriting skills, followed by the six-week handwriting program. After completion, your students will be given a post-test to determine if improvements have been made. The entire class will complete the six-week program, but only students with consent will be given the pre and post-test. Traditional handwriting instruction involves pencil and paper instruction. The app will be used to reinforce the traditional instruction provided. The primary investigator will be in the classroom as well, providing instruction within the small group setting. The table below explains the program plan and the time commitment for you, the volunteer.

Week	Intervention	Assessment	Time Commitment for Volunteer
Pre	Teacher/paraprofessional training		1 hour
1	Day 1: traditional instruction c, o, s		15 minutes
	Day 2: traditional instruction v, w, t		
	Day 3: LetterSchool Practice of c, o, s, v, w, t		
	Volunteer/therapist collaboration		
2	Day 1: traditional instruction a, d, g		15 minutes
	Day 2: LetterSchool Practice of a, d, g		
	Day 3: traditional instruction u, i		
	Day 4: LetterSchool Practice of u, i-		
	Day 5: Review of letters/Make up sessions		
	Volunteer/therapist collaboration		
3	Day 1: traditional instruction e, l,		15 minutes
	Day 2: LetterSchool Practice of e, l,		
	Day 3: traditional instruction k, y		
	Day 4: LetterSchool Practice of k, y		
	Volunteer/therapist collaboration		
4	Day 1: traditional instruction j, p		15 minutes
	Day 2: LetterSchool Practice of j, p		
	Day 3: traditional instruction r, n		
	Day 4: LetterSchool Practice of r, n		
	Day 5: Review of letters/Make up sessions		
	Volunteer/therapist collaboration		
5	Day 1: traditional instruction m, h		15 minutes
	Day 2: LetterSchool Practice of m, h		
	Day 3: traditional instruction b, f		
	Day 4: LetterSchool Practice of b, f		
	Day 5: Review of letters/Make up sessions		
	Volunteer/therapist collaboration		

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6	Day 1: traditional instruction q, x, z	The Print	15 minutes
	Day 2: LetterSchool Practice of q, x, z	Tool	
	Day 3: Review of letters/Make up sessions		
	Volunteer/therapist collaboration		
	Day 4: Post Testing		
	Day 5: Post Testing		
			Total Time
			Commitment
			for each
			Volunteer:
			2.50 hours

**RISKS AND DISCOMFORTS:** This project has minimal discomforts for you. You will be asked to reinforce accurate formation and to monitor application use. This may lead to mild discomfort as instruction may be provided in a way that is different from what you are accustomed. There will also be collaboration with the primary investigator. This may lead to some mild discomfort if there are concerns related to the program. Risks associated with this project are no more than would occur on a typical school day.

**BENEFITS:** By volunteering for the project, your students may improve their handwriting skills. You may also learn new ways to provide handwriting instruction within your current schedule. In addition, results of the project may be shared with administration at the school and district level. Improvement in handwriting skills may support the adoption of a district wide handwriting curriculum. Also, results of this project may be submitted to a professional journal for publication, sharing the outcomes with therapists and educators outside of the district and adding to the current body of knowledge about handwriting interventions.

**CONFIDENTIALITY:** As a volunteer, no data will be collected from you aside from this signed written agreement. Volunteers will not be identified in the final reports created from the results. As volunteers for this project, it is important to maintain confidentiality regarding the identities of the student participants and any observations made during this project.

**TERMINATION OF PARTICIPATION:** I understand that my participation in this project is completely voluntary and can be terminated at any point within the project. The decision to withdraw will not have any negative consequences or negative effects.



**COMPENSATION:** I understand that there is no personal, monetary cost associated with participating in this project. I also understand that there will be no compensation made by the primary investigator, the Henry County School System, nor Chatham University for participating in this project.

**INJURY COMPENSATION:** Neither the Henry County School System, Chatham University, nor any government or other agency funding this project will provide special services, free care, or compensation for any injuries resulting from this project. I understand that treatment for such injuries will be at my expense and/or paid through my medical plan.

**QUESTIONS:** All my questions have been answered to my satisfaction and if I have further questions about this project, I may contact Kerri Sheffield, OTR/L, the primary investigator, by email at kerri.sheffield@chatham.edu. If I have any questions about the rights of project participants, I may call the Chairperson of the Chatham University Institutional Review Board at 412-365-2937.

**VOLUNTARY PARTICIPATION:** I understand that my participation in this project is entirely voluntary, and that refusal to participate will involve no penalty or loss of benefits. I am free to withdraw or refuse consent, or to discontinue participation in this project at any time without penalty or consequence.

I voluntarily give my consent to participate in this project. I understand that I will be given a copy of this consent form.

Signatures:		
D. C. C. M. (D. O.		
Participant's Name (Print)		
Participant's Signature	Date	



I, the undersigned, certify that to the best of my knowledge, the subject signing this consent form has had the project fully and carefully explained by me and have been given an opportunity to ask any questions regarding the nature, risks, and benefits of participation in this project.

Kerri Sheffield, OTR/L, OTDS Investigator's Name (Print)	
Kerri Sheffield, OTRIL, OTDS Investigator's Signature	Date
Dr. Andrea Collins, OTD, OTR/L Faculty Advisor Name (Print)	
Dr. Order Collins Oto Otell	Date

The Chatham University IRB has approved the solicitation of participants for this project until 10/28/2020.

#### **Appendix E: Participant Recruitment Email**



Dear Parent or Guardian,

Date:

I am currently an occupational therapy doctoral student at Chatham University. This semester, I will be carrying out an evidence-based practice project at Timber Ridge Elementary. I have received approval from Mrs. McRae, school principal, Debra Delaine, Director of Exceptional Student Services, and Chatham University's Institutional Review Board to conduct my project. Through my project, I will be answering the question, "Do kindergarten students who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation demonstrate improved legibility?" My project is utilizing current evidence that shows traditional instruction using paper and pencil methods, in this case the Handwriting Without Tears® Program, supplemented with app-based instruction with the application LetterSchool<sup>TM</sup> improves student handwriting skills. All students in your child's classroom will be participating in the handwriting program, but students will only participate in the data collection (assessments) if the parent consent form is signed. Pre and Posttests are voluntary. The purpose of the assessments will be to determine if your child benefited from the program as well as informing future classrooms and teachers if the program is beneficial.

The entire classroom will participate in handwriting instruction. I will join Mrs. McKneely in her classroom to assist with instruction of this valuable skill. Due to the timing of this program and the frequency of use in written language, lower case letters will be the focus of the program.

I am asking that you consider allowing your child to participate in the assessment portion of this project. Before the start of the six weeks of instruction, participating students will complete a handwriting test, the Print Tool®. This test will take less than 20 minutes and would be completed outside the classroom. The same test will be given after the six-week instruction period. Including assessment weeks and instruction, the entire project will last approximately seven weeks.

Your child's participation in the assessment portion of this project is completely voluntary, and there are no negative consequences for not participating. The results of this project may be published, but your child's name or any other identifying information will not be used. In addition, if your child receives any additional services (i.e. Tier I-III intervention, 504 Accommodation plan, IEP services or gifted services), those services will not be impacted by their participation. Your child's schedule will not change.

Attached to this letter are a parental consent form and labeled envelope. If you are interested in having your child participate, please sign the attached forms and return them to Mrs. McKneely. If you have any questions about this project, your child's participation in it, or this consent form, please feel free to contact me at kerri.sheffield@chatham.edu.

Thank you for considering your child's participation in this project.



Kerri Sheffield, OTR/L, OTDS

Kerri Sheffield, OTR/L

Chatham University faculty advisors name and contact information:

Dr. Jennifer Lape: j.lape@chatham.edu Dr. Andrea Collins: a.collins@chatham.edu

#### **Appendix F: Informed Consent Form**



#### CONSENT FORM

INVESTIGATOR(S) NAME: Kerri Sheffield, OTR/L

**EVIDENCE BASED PROJECT TITLE:** Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility

#### **Concise Summary:**

- Consent for your child's participation is being sought for an evidence-based project and participation is voluntary
- The purpose of this evidence-based project is to determine if providing traditional, handwriting instruction with paper and pencil combined with instruction provided through a tablet-based application will improve handwriting legibility of kindergarten students.
- If you agree, your child will participate in the program during class time for six weeks, with
  a pretest and post-test given before and after the program, totaling approximately 6.75 hours.
- Risks and discomforts for your child are minimal. Your child may feel mild discomfort during the pretest and post-test as it is a testing situation.
- Benefits may include improved handwriting skills. There is the potential to provide data to support the adoption of a district-wide handwriting program. This could also add to the current knowledge on this topic for teachers and therapists outside the school district.
- Alternative procedures would include participation in the handwriting program but not taking the pretest and post-test.
- Your child will continue to receive any and all services he/she currently receives and his/her schedule will not be altered.

**PURPOSE OF THE EVIDENCE BASED PROJECT:** The purpose of this evidence-based project is to determine if providing traditional, paper and pencil, handwriting instruction combined with tablet-based instruction to improve handwriting legibility of kindergarten students. Improved handwriting skills have been linked to improved classroom performance. Your child is being invited to participate in this project as they are enrolled in the classroom which will receive the handwriting instruction program.



**DESCRIPTION OF THE EVIDENCE BASED PROJECT:** The project will include a pretest to measure current handwriting skills, followed by the six-week handwriting program. After completion, your child will complete a post-test to determine if improvements have been made. The entire class will complete the six-week program, but only students with consent will be given the pre and post-test. Traditional instruction as well as app-based instruction will be provided. Traditional instruction will consist of instruction on the proper formation, placement and size of the lowercase letters. The app reinforces the handwriting skills taught through traditional methods. The table below explains the program plan and the time commitment for your child. This will be scheduled at the beginning of the school day, starting at 7:30.

Week	Intervention	Assessment	Time Commitment for Participants
Pre	Pre-intervention: Pretest Students	The Print	20 minutes
		Tool	
1	Day 1: traditional instruction c, o, s		45 minutes
	Day 2: traditional instruction v, w, t		
	Day 3: LetterSchool Practice of c, o, s, v, w, t		
2	Day 1: traditional instruction a, d, g		1.25 hours
	Day 2: LetterSchool Practice of a, d, g		
	Day 3: traditional instruction u, i		
	Day 4: LetterSchool Practice of u, i		
	Day 5: Review of letters/Make up sessions		
3	Day 1: traditional instruction e, l,		1 hour
	Day 2: LetterSchool Practice of e, l,		
	Day 3: traditional instruction k, y		
	Day 4: LetterSchool Practice of k, y		
4	Day 1: traditional instruction j, p		1.25 hours
	Day 2: LetterSchool Practice of j, p-		
	Day 3: traditional instruction r, n		
	Day 4: LetterSchool Practice of r, n		
	Day 5: Review of letters/Make up sessions		
5	Day 1: traditional instruction m, h		1.25 hours
	Day 2: LetterSchool Practice of m, h		
	Day 3: traditional instruction b, f		
	Day 4: LetterSchool Practice of b, f		
	Day 5: Review of letters/Make up sessions		
6	Day 1: traditional instruction q, x, z	The Print	1 hour
	Day 2: LetterSchool Practice of q, x, z	Tool	
	Day 3: Review of letters/Make up sessions		

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Day 4: Post Testing	
Day 5: Post Testing	
	Total Time
	Commitment for
	each Student:
	6.75-7 hours

RISKS AND DISCOMFORTS: This project has minimal risks and discomforts for your child. Risks associated with this project are no more than would occur on a typical school day. The entire class will complete the handwriting program, but only those students with parental consent will be assessed with the pretest and post-test for data collection purposes. This is an individually administered test, so your child will be tested in a one-on-one setting which may be mildly uncomfortable. The testing period will be short and will only test handwriting skills. Your child's information will be kept confidential and no information will identify your child.

**BENEFITS:** By participating in the project, your child may improve his or her handwriting skills. In addition, results of the project may be shared with administration at the school and district level. Improvement in handwriting skills may support the adoption of a district wide handwriting curriculum. Also, results of this project may be submitted to a professional journal for publication, sharing the outcomes with therapists and educators outside of the district and adding to the current knowledge base about handwriting interventions.

ALTERNATIVE PROCEDURES: Participation in the project is not required. Alternatively, your child could participate in the handwriting program without taking the pretest and post-test. If your child receives any services in Tiers I-III, the gifted program, a 504-accommodation plan, or IEP services, those services will continue to be provided. No student schedules will not altered in order to participate in the project. If your child's schedule conflicts with the program, they will not be able to participate.

**CONFIDENTIALITY:** Children whose parents sign consent will be assigned a code to identify their testing materials. Demographic information related to the project will be collected (age, gender, educational program, attendance, etc.) and linked to your child's specific code. The code will be used to match pre and post test results for comparison. Your child will not be identified in any reports created from the results of the project. Testing material will be stored in a locked filing



cabinet at the primary investigator's office. Data will be stored on the primary investigator's password protected computer. Only the primary investigator and faculty advisors will have access to the coded data. No part of the data will become part of your student's permanent school record.

**TERMINATION OF PARTICIPATION:** I understand that consent to participate can be terminated at any point within the project. The decision to withdraw will not have any negative consequences on the participation in the handwriting program or negative consequences within the classroom.

**COMPENSATION:** I understand that there is no personal, monetary cost associated with participating in this project. I also understand that there will be no compensation made by the primary investigator, the Henry County School System, nor Chatham University for participating in this project.

**INJURY COMPENSATION:** Neither the Henry County School System, Chatham University, nor any government or other agency funding this project will provide special services, free care, or compensation for any injuries resulting from this project. I understand that treatment for such injuries will be at my expense and/or paid through my medical plan.

#### QUESTIONS

All my questions have been answered to my satisfaction and if I have further questions about this project, I may contact Kerri Sheffield, OTR/L, the primary investigator, by email at kerri.sheffield@chatham.edu. If I have any questions about the rights of project participants, I may call the Chairperson of the Chatham University Institutional Review Board at 412-365-2937.

#### **VOLUNTARY PARTICIPATION**

I understand that my child's participation in this project is entirely voluntary, and that refusal to participate will involve no penalty or loss of benefits to my child. I am free to withdraw or refuse consent, or to discontinue my child's participation in this project at any time without penalty or consequence.



I voluntarily give my consent for my child to participagiven a copy of this consent form.	ate in this project. I understand that I will be
Signatures:	
Parent's Name (Print)	Child's Name (Print)
Parent's Signature	Date
I, the undersigned, certify that to the best of my know has had the project fully and carefully explained by n any questions regarding the nature, risks, and benefit	ne and have been given an opportunity to ask
Kerri Sheffield, OTR/L, OTDS Investigator's Name (Print)	
Monei Malhield, OTR/L. OTDS Investigator's Signature	Date
Dr. Andrea Collins, OTD, OTR/L Faculty Advisor Name (Print)	
Dr. Onder a Collins Otto Otell Faculty Advisor Signature	Date

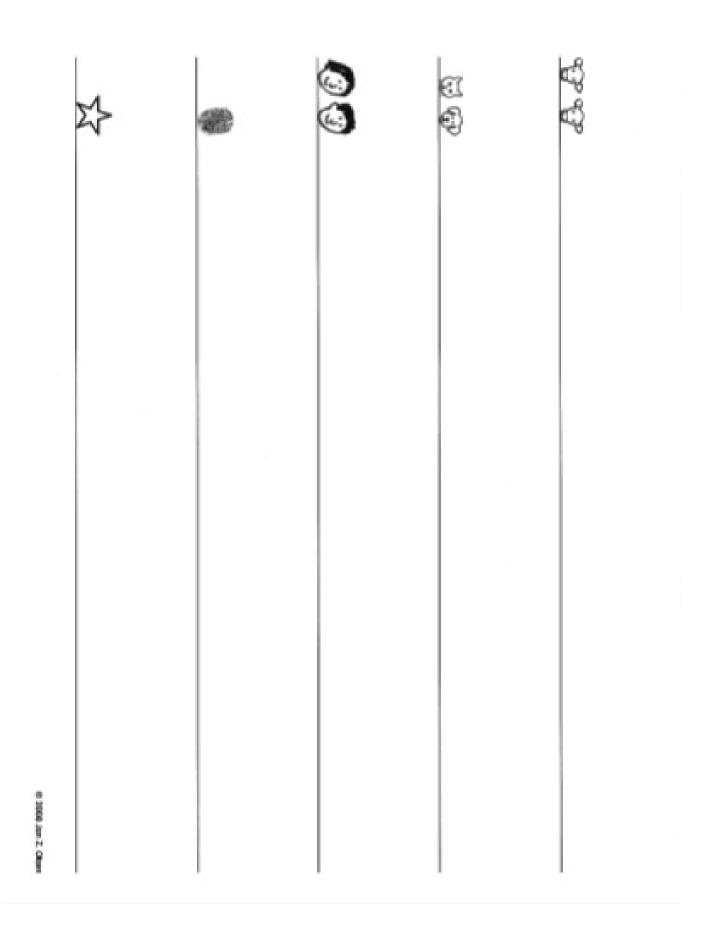
The Chatham University IRB has approved the solicitation of participants for this project until 10/28/2020.

Woodland Road . . . Pittsburgh, PA 15232 . . . 412-365-1100 . . . www.chatham.edu FOUNDED 1869

# **Appendix G: The Print Tool® Forms**

	EVALUATE
Evaluation administered by	Date of evaluation
STUDENT INFORMATION	
Name	Birthdate Age Sex
Parent/Guardian	Phone
Address	Email
Referred by	Referred for
SCHOOL INFORMATION	
Grade Teacher	School
	tion? Y N How often?
Does child receive handwriting accom-	
	rs® Zaner-Bloser® D'Nealian® None
COLLOGI DADEDO DEL VIENA	
Review of handwriting instruction: Wo	orkbook Worksheets None
Review of handwriting instruction: Wo Review of written work: Worksheets _	
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns:	orkbook Worksheets None Spelling Graphic organizers Journal
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev	orkbook Worksheets None Spelling Graphic organizers Journal versals Following lines Size consistency
Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing (	orkbook Worksheets None Journal   Spelling Graphic organizers Journal   versals Following lines Size consistency  Other
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing (	orkbook Worksheets None Spelling Graphic organizers Journal versals Following lines Size consistency
Review of handwriting instruction: Wo Review of written work: Worksheets Concerns: Mixes capitals/lowercase Rev Formation Spacing C Comments:	orkbook Worksheets None Spelling Graphic organizers Journal versals Following lines Size consistency Other
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:	orkbook Worksheets None Journal  Spelling Graphic organizers Journal  versals Following lines Size consistency  Other  ID FINE MOTOR
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore	orkbook Worksheets None Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR  today? Y N
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore Sitting Posture	orkbook Worksheets None Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR  today? Y N Attention/Effort
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore Sitting Posture Handedness: Left Right Use Paper Placement: Correctly placed for	prkbook Worksheets None Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR today? Y N Attention/Effort ad Both or handedness? Yes Sometimes No
Review of handwriting instruction: Wo Review of written work: Worksheets _ Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore Sitting Posture Handedness: Left Right Use Paper Placement: Correctly placed for	orkbook Worksheets None Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR  today? Y N
Review of handwriting instruction: Wo Review of written work: Worksheets Concerns: Mixes capitals/lowercase Rev Formation Spacing ( Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore Sitting Posture Handedness: Left Right Use Paper Placement: Correctly placed for Helping Hand: Uses hand to hold pa Pencil Grip: Tripod Quadropod	prkbook Worksheets None Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR  today? Y N Attention/Effort  ad Both or handedness? Yes Sometimes No  sper? Yes Sometimes No  Palmar Other
Review of handwriting instruction: Wo Review of written work: Worksheets Concerns: Mixes capitals/lowercase Rev Formation Spacing Comments:  PHYSICAL APPROACH AN Wears glasses? Y N Wore Sitting Posture Handedness: Left Right Use Paper Placement: Correctly placed fo Helping Hand: Uses hand to hold pa	Spelling Graphic organizers Journal  versals Following lines Size consistency Other  ID FINE MOTOR  today? Y N     Attention/Effort  ad Both or handedness? Yes Sometimes No  per? Yes Sometimes No  Palmar Other  y Light

#### **LOWERCASE** Size Preference Orientation Placement Memory Size Start Sequence C C C С С C 0 0 0 0 W W W S S S S S S PK a a a a a a +\* + + + + d d d d d d g 9 g 9 g g K 1 |\* 1 1 i\* i i k k k k k 1 е е е е е е y y У u u u u u 2 h h h h h h m m m m m m b b b b b b 3+ р p p p p p r r r r r r n n n n n f f f f f f ٧ ٧ ٧ V V j Spacing X X X X X Word Spacing Attempts Score Z Z Z Z Z Z 2 3 4 % q q q q q q 7 8 9 10 Lowercase Memory Orientation Placement Size Start Sequence **Total Correct Total Attempted** 26 **Total Correct** Total Attempted = % % % % % % To Mark the Score Sheet: To Calculate Total Score: Memory: Count the number of correct letters (not circled). All Others: Count the number of correct letters (not circled, not grayed out, Memory: Circle the letters with errors. Now mark a line from the circled letters across all categories. The line indicates that letters with Memory not lined through). errors are not scored in other categories. All Others: Circle the letters with errors. To Calculate Total Attempted: Memory: 26 Orientation: Count the number of circled letters. Add that number to the Total Correct in Orientation. \*t, I, i can be reversed in the D'Nealian® curriculum. All Others: 26 minus the number of circled letters in the Memory category. © 2016 Handwriting Without Tears®



#### **Appendix H: Permission Letter from Site**



Henry County Schools | Family & Student Services | Exceptional Student Education

May 17, 2019

#### To Whom It May Concern:

This letter is to serve as permission for Kerri Sheffield, OTR/L to complete an evidence-based practice capstone project in the Henry County School System. Specifically, Kerri Sheffield will be permitted to implement an evidence-based occupational therapy intervention/program related to increasing handwriting legibility in kindergarten students through the use of traditional pencil/paper handwriting instruction supplemented with app-based handwriting instruction. This specific project will involve provide explicit handwriting instruction within a kindergarten classroom with additional practice provided through an iPad application. Handwriting skills are an integral part of the skills needed to be successful in educational endeavors but these skills are not explicitly taught within the kindergarten classroom. The project will be completed in the spring semester of 2020, specifically the months of January and February. I understand that the purpose of the evidence-based capstone project is to improve handwriting legibility of kindergarten students utilizing a traditional handwriting instruction supplemented with app-based instruction.

Please direct all questions and concerns regarding permission for this project to my office.

Debra Delaine, Ed.S.

Director of Exceptional Student Education Family and Student Support Services Henry County Schools

770-957-8086

debra.delaine@henry.k12.ga.us

#### **Appendix I: Permission Letter from Principal**

#### **Conducting Research in Henry County Principal Approval Form**

A school level approval form must be signed by the School Principal of each school involved in the proposed study. Signature requests(s) must be obtained before final approval of the research application is reviewed by the district.

Researcher's Name Kerri Sheffield, OTR/L

Research Project Title

Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility

School Name Timber Ridge Elementary

Principal Name Kristin McRae

Summary of research study that includes:

- 1. Brief summary of your research study
- 2. Statement of the research problem/question
- Approximate number and description of intended research subjects/participants
- Data that will be needed and means of collection

This project provides traditional handwriting instruction supplemented with app-based instruction to improve handwriting legibility in kindergarten students. The students will participate in two days a week of traditional instruction and two days a week of app-based instruction over the course of six weeks as part of their classroom instruction. The fifth day will include a review. Participants will be assessed using the Handwriting Without Tears® Print Tool® for pre-test and post-test to determine changes in handwriting legibility (See Print Tool Forms). The handwriting instruction program constitutes a curricular change in which all students in the classroom will participate; however, pre- and post-test assessments will only occur for those children whose parents have provided consent.

The evidence-based question is:

Do kindergarten students who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation demonstrate improved legibility?

This project will be implemented in one kindergarten classroom at Timber Ridge Elementary School with a teacher who volunteers to participate along with the classroom paraprofessional. Approximately 20-25 students will be recruited to participate in the project.

Parent/guardian consent will be required for data collection; however, all students in the classroom will receive the handwriting intervention. Demographic data that will be collected includes gender, age (DOB), ethnicity, MTSS status, and pre- and post-test scores on Handwriting Without Tears® The Print Tool®. A check sheet to document the fidelity of implementation and absences will also be utilized. Students' identity will remain confidential and they will be assigned an identification number for pre- and post-testing comparison. Data will be kept on a password protected laptop and consent forms will be kept in a locked cabinet that is only assessable to the evidence-based practitioner and

Principal's affirmation: The researcher's application has been reviewed by me, or my designee, and meets all of the following requirements:

Includes a statement of approval from the program advisor.

Includes parental consent forms and informed consent documents (for participants), where

Note to research applicant: Please submit completed form with your district application.

**Henry County Schools** 33 N. Zack Hinton Parkway McDonough, GA 30243

# **Appendix J: Permission to Use Materials**

[Ticket #1864] Permission to use application for an Evidence-Based Occupational Therapy Capstone Project

LetterSchool <support@letterschool.org> 6/19/2019 11:30 AM</support@letterschool.org>
To: Sheffield, Kerri
reply above
sjoerdhuitema (sjoerd.huitema@letterschool.com) wrote:
Hello Kerri,
That's great , and of course you have permission to use LetterSchool for this purpose.
Good luck! If you have findings you can share, we're happy to receive them if possible!
Best regards,
Sjoerd Huitema CEO LetterSchool



June 24, 2019

Dear Ms. Sheffield,

You have our permission to initiate and complete your capstone project by using the Handwriting Without Tears® curriculum and the Print Tool®. If you need to use a modified version of the Print Tool®, you also have permission for that as well. Thank you.

Sincerely,

**Brittany Narlock** 

Sr. Workshop Coordinator & Level 1 Certification

Brittany Narlock

d. 402-682-3358 f. 402-492-2776

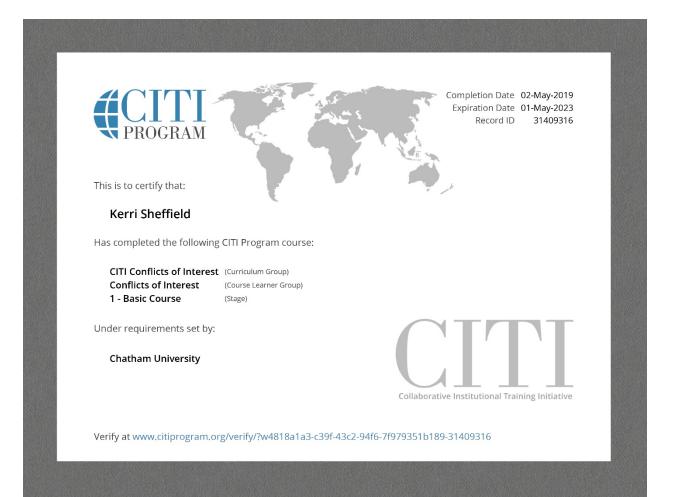
brittany.narlock@LWTears.com

**Learning Without Tears** 

Get Set for School . Handwriting Without Tears . Keyboarding Without Tears

# **Appendix K: CITI Training Certificates**







#### **Appendix L: Chatham IRB Proposal**

Submission Type:

Expedited

Date:7/22/2019

IRB #:

Title: Effectiveness of Traditional Handwriting Instruction Supplemented with App-

Based Instruction on Handwriting Legibility

Creation Date:

Principal Investigator: Kerri Sheffield

Status:

#### $1\,$ General Information

**How To Submit**: Please complete all sections. The routing/complete submission button will appear at the bottom of the left menu *after* all required fields (marked with red asterisk) are complete.

For technical problems completing this form, please contact the ITS Helpdesk at https://services.chatham.edu.

- A Study or project title: Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility
  - A.1.a Please select one of the following:

Research

Study

X Evidence-

based Project

A.1.b What type of review is the Investigator requesting?

**Exempt Determination** -Research which meets federal criteria that does not require subsequent IRB review or approval

**Expedited review** (Study involves no more than minimal risk, i.e., risks

encountered in

everyday life)

**EXPEDITED** 

# Please select the Expedited Review category that describes your study.

1. Social and Behavioral Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus

group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

- 2. Collection of data from voice, video, digital, or image recordings made for research purposes.
- 3. Prospective collection of biological specimens for research purposes by noninvasive means.

Examples: (a) hair and nail clippings in a nondisfiguring manner; (b) deciduous teeth at time of exfoliation or if routine patient care indicates a need for extraction; (c) permanent teeth if routine patient care indicates a need for extraction; (d) excreta and external secretions (including sweat); (e) uncannulated saliva collected either in an unstimulated fashion or stimulated by chewing gumbase or wax or by applying a dilute citric solution to the tongue; (f) placenta removed at delivery; (g) amniotic fluid obtained at the time of rupture of the membrane prior to or during labor; (h) supra- and subgingival dental plaque and calculus, provided the collection procedure is not more invasive than routine prophylactic scaling of the teeth and the process is accomplished in accordance with accepted prophylactic techniques; (i) mucosal and skin cells collected by buccal scraping or swab, skin swab, or mouth washings; (j) sputum collected after saline mist nebulization.

4. Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.)

Examples: (a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject=s privacy; (b) weighing or testing sensory acuity; (c) magnetic resonance imaging; (d) electrocardiography,

electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography; (e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

- 5. Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects.

  45 CFR 46.101(b)(4). This listing refers only to research that is not exempt.)
- 6. Collection of blood samples by finger stick, heel stick, ear stick, or venipuncture as follows:
- (a) from healthy, nonpregnant adults who weigh at least 110 pounds. For these subjects, the amounts drawn may not exceed 550 ml in an 8 week period and collection may not occur more frequently than 2 times per week; or
- (b) from other adults and children2, considering the age, weight, and health of the subjects, the collection procedure, the amount of blood to be collected, and the frequency with which it will be collected. For these subjects, the amount drawn may not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and collection may not occur more frequently than 2 times per week.
- 7. Clinical studies of medical devices only when condition (a) is met.
- (a) Research on medical devices for which (i) an investigational device exemption application (21 CFR Part 812) is not required; or (ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.

**Full Board Review** (greater than minimal risk, vulnerable populations, or does not fit into any of the federally defined expedited categories). *The Chatham IRB convenes every two months during the academic year. See IRB web page for submission deadlines.* 

Does this research involve an Institution, Entity or Individual outside of Chatham University? Including but not limited to:

Collaboration

- Reliance Agreement
- A.2 needed
  - Data Use/Sharing
  - Subjects at other sites

•

International Research

X Yes

No

Not sure / Maybe

# Study Personnel

В

Note: All Chatham faculty and staff listed below are required to have completed <u>CITI trainings</u> (COI, RCR, and Human Subjects Research courses) and submitted <u>FCOI disclosure forms</u>. These compliance requirements will be checked in pre-review, and

# must be complete before a study can be assigned to the IRB for review.

(Requests for help to determine if project is Human Subjects Research can be processed before completion of requirements.)

# Who is the Principal Investigator (PI)?

There can be only one PI listed on the study who is ultimately responsible for the

B.1 conduct and oversight of the study including education of study staff, study management, record-keeping and the protection of study participants.

Name: Kerri Sheffield

Organization:

Address: 157 Cotton Creek Drive, McDonough, GA 30252

Phone: 678-231-5760

Email: kerri.sheffield@chatham.edu

Who is the primary contact?

B.1a Name: Kerri Sheffield

Organization:

Address: 157 Cotton Creek Drive, McDonough, GA 30252

Phone:678-231-5760

Email: kerri.sheffield@chatham.edu

B.1b The PI listed above is which of the following?

Chatham Faculty

#### X Chatham Student

Chatham Staff

Use Find People button to select Chatham University Faculty **Co-Principal Investigators** 

#### **B.3**

Faculty chosen here: Dr. Andrea Collins, IRB Faculty Advisor

- will receive notices to review/certify all submissions from
- the PI can view/edit the study submission forms will
- receive Cayuse email correspondence

They stated for verification that this faculty member's training is up-to-date I replied, "Dr. Collins's training is up-to-date. I have attached her CITI certificates." I attached the forms to the reply.

Use Find People button to select Chatham University Faculty **Co-Investigators** 

# Faculty chosen here:

B.4

- can view/edit the study submission forms
- will receive Cayuse email correspondence
- will **not** be certifying the submission

List other study staff at Chatham University, including their:

- 1. department current status at Chatham (type of student, staff or
- 2. faculty)
- B.5 3. role in the research

Note: Study personnel from other institutions should be listed in Section 2 (Collaboration), not here.

# Funding and Chatham University Research Support Services

Is this study externally funded?

D.1

A sponsored project (SP) record must be created for most external funding. If you are not certain whether an SP record is needed for your particular source(s) of funding, please inquire with the IRB chair at irb@chatham.edu.

Yes

X No

D.2 Is this study internally funded?

Yes

X No

Please select any Chatham University Research Support Services that apply to this study

Research-related interaction with other Chatham University divisions/departments/groups the PI is not part of. (*Examples: Registrar, Student Health Center, etc.*)

Other

X None of the Above

# 3 Study Design

# A Main Study Design

# A.1 Select all categories that apply to the main study design.

X Studies involving social, behavioral, or educational procedures, such as field studies, cognitive tests, focus groups, surveys, questionnaires, or deception

Retrospective Collection or Review of Data (Use of Data from a previous study, data collected at another institution, Public Use Database, chart review, tissue samples, etc.)

Collection of data from voice, video, digital, or image recordings made for research purposes.

#### X Clinical Trial or Clinical Intervention Study or Evidence Based

Practice Project Prospective Collection of Clinical Data or Clinical

Specimens

Case Report / Case Study

Relying on external IRB

(If you check this box, make sure to not select any of the others above.)

# Study Summary, Background and Objectives

В

Please ensure the answers to the following questions are understandable to a nonscientist and all discipline-specific terms are defined.

# **Brief Summary**

Provide a very brief summary of this study or EBP project in lay language. (*Scientific details of study will be requested in subsequent questions.*)

B.1

This project provides traditional handwriting instruction supplemented with appbased instruction to improve handwriting legibility in kindergarten students. The students will participate in two days a week of traditional instruction and two days a week of appbased instruction over the course of six weeks as part of their classroom instruction. The fifth day will include a review. Participants will be assessed using the Handwriting Without Tears® Print Tool® for pre-test and post-test to determine changes in handwriting legibility (See Appendix G: Print Tool Forms, p. 104). The handwriting instruction program constitutes a curricular change in which all students in the classroom will participate; however, pre- and post-test assessments will only occur for those children whose parents have provided consent.

Provide the background and rationale of the study. Please include:

- Importance of the research and the research questions
- If Evidence-Based Practice project, include a summary of at least three studies that support the chosen intervention
- If a separate protocol with references is not attached, include references here.
- The rationale for inclusion of children or other vulnerable populations if applicable

#### B.2

Within school systems, a large number of referrals generated for occupational therapy services are due to difficulties with handwriting legibility and the related fine motor skills (Asher, 2006).

Asher (2006) also indicated that many of the students referred for occupational therapy services do not have deficits in visual motor or fine motor skills which would explain the difficulties with handwriting skills. With the increase in technology use, many students are not engaging in fine motor play activities, choosing to play games on tablets or gaming systems instead. This can negatively impact the acquisition of the necessary fine motor skills to complete handwriting activities (Lin, Cherng, & Chen, 2017). Also, the demands presented for our youngest students are higher than ever. A few decades ago, kindergarten students participated in center time, including art, dramatic play, science, and water/sand table centers with less demands on academia. Now, these same age students are expected to be able to write two to three sentence responses by the end of the school year, as well

participate in standardized testing throughout the year (Bassok, Latham, & Rorem, 2016). With the lack of formalized instruction and the increased demands for kindergarten students, difficulty with handwriting skills is becoming more prevalent (Asher, 2006).

Even though tablet use appears to have a mixed impact on the development of fine motor skills, the use of electronic devices is highly motivating for students (Butler, Pimenta, Tommerdahl, Fuchs, & Cacola, 2019; Karlsdottir & Stefansson, 2002; Lin et al., 2017). Children are struggling more and more with the ability to produce legible writing and often dislike practicing skills such as letter formation, but they may be willing to engage in this task if the practice is app-based. While technology is often blamed for the decrease in fine motor skills, research supports that it can result in improved handwriting legibility, especially when paired with more traditional instruction (Jordan, Michaud, & Kaiser, 2016).

Poor handwriting impacts many areas of education. According to Bassok et al. (2016), the expectation is for kindergarten students to be able to compose and write complete sentences as well as compose responses with a beginning, middle, and end by the end of kindergarten. One study indicates approximately 10% to 30% of students have dysfunctional handwriting which requires remediation (Karlsdottir & Stefansson, 2002, p. 623). With the increase in technology available, one might speculate as to the importance of handwriting skills. Handwriting skills continue to be an important occupational task for students within their school day (Randall, 2018). Randall (2018) also indicates that handwriting skills are an important method utilized for children to demonstrate knowledge and also reinforce early literacy skills making the development of legible handwriting of utmost importance.

Given the increase in referrals for occupational therapy evaluations related to handwriting, occupational therapists are typically viewed as the experts on handwriting remediation. Occupational therapists have the unique ability to analyze the performance task to locate the source of dysfunction. With occupational therapists playing a key role in the area of handwriting remediation, it is important

to identify the most effective and client-centered way to address this issue. Providing traditional handwriting instruction supplemented with the use of an application which teaches letter formation may provide the necessary skills for students to increase success in this area. Therefore, the purpose of this project is to apply the existing evidence related to effective handwriting instruction and technology use to promote improved legibility in handwriting of kindergarten students.

For this project, Handwriting Without Tears® was chosen as it is an evidence-based traditional handwriting curriculum. This instruction will consist of the Wet, Dry, Try Method combined with pencil/paper tasks as indicated in the Handwriting Without Tears® Curriculum. The application LetterSchool<sup>TM</sup> was also chosen to supplement traditional handwriting as the evidence supports its use combined with traditional instruction. The LetterSchool<sup>TM</sup> application reinforces the formation taught by the Handwriting Without Tears® Curriculum by first demonstrating the correct formation, followed by tracing the letter correctly and ending with independent formation with visual prompts as needed.

- Asher, A. V. (2006). Handwriting instruction in elementary schools. *American Journal of Occupational Therapy*, 60, 461-471. http://dx.doi.org/10.5014/ajot.60.4.461
- Bassok, D., Latham, S., & Rorem, A. (2016). Is kindergarten the new first grade? *AERA Open*, 1(4), 1-31. https://doi.org/10.1177/2332858415616358
- Butler, C., Pimenta, R., Tommerdahl, J., Fuchs, C. T., & Cacola, P. (2019). Using a handwriting app leads to improvement in manual dexterity in kindergarten children. *Research in Learning Technology*, 27, 1-10. http://dx.doi.org/10.25304/rlt.v27.2135
- Jordan, G., Michaud, F., & Kaiser, M. -L. (2016). Effectiveness of an intensive handwriting program for first grade students using the application LetterSchool<sup>TM</sup>: A pilot study. *Journal of Occupational Therapy, Schools, & Early Intervention*, *9*(2), 176-184. http://dx.doi.org/10.1080/19411243.2016.1178034
- Karlsdottir, R., & Stefansson, T. (2002). Problems in developing functional handwriting. *Perceptual and Motor Skills*, 94, 623-662. http://dx.doi.org/10.2466/PMS.94.2.623-662

- Lin, L.-Y., Cherng, R.-J., & Chen, Y.-J. (2017). Effects of touch screen tablet use on fine motor development of young children. *Physical & Occupational Therapy in Pediatrics*, *37*(5), 457-467. https://doi.org/10.1080/01942638.2016.1255290
- Randall, B. S. (2018). Collaborative instruction and Handwriting Without Tears®: A strong foundation for kindergarten learning. *Journal of Occupational Therapy, Schools, & Early Intervention*, 11(4), 374-384. http://dx.doi.org/10.1080/19411243.2018.1476200
  - Is this study related to any other studies in Cayuse IRB (*including active, archived, closed or expired studies*)?

Yes

X No

List the main objectives/hypothesis of the study or the purpose if it is an EBP project.

B.4 The evidence-based practice question was created after considering the need for successful, motivating interventions to address handwriting deficits in school aged children. Many of these students have not received explicit handwriting instruction in their classrooms as there is not an adopted handwriting curriculum in the school district at this time, leaving teachers to provide instruction without training. With technology becoming utilized more frequently within the educational setting, using this medium as way to practice letter formation in addition to the traditional methods implemented within the classrooms could be beneficial. The purpose of this project is to assess the effectiveness of implementing a consistent handwriting program in a kindergarten classroom with both traditional and app-based instruction to improve handwriting legibility of the kindergarten students.

State the main study/project outcome measures and anticipated outcomes.

B.5

The evidence-based project poses the question as to whether providing traditional handwriting instruction supplemented with app-based instruction will improve handwriting legibility of kindergarten students. In order to collect data on this question, students will participate in a pretest assessment of handwriting skills, followed by the intervention period. Upon completion of the intervention period, a post-test assessment of handwriting skills will be administered for comparison. The posttest assessment scores are anticipated to indicate improvement in handwriting legibility from pretest to posttest.

The outcome measure to be used is the Handwriting Without Tears® Print Tool®. The Print Tool® is a non-standardized assessment that evaluates specific components of handwriting including memory, orientation, placement, size, sequence, start, and spacing, all of which can impact legibility (Olsen & Knapton, 2016). Each subtest will be compared as well as the overall score from pretest to posttest. It is anticipated that students will demonstrate improved handwriting legibility as evidenced by improved scores on the administered subtests as well as the overall score on this assessment.

Permission to utilize The Print Tool® was obtained on June 24, 2019 (See Appendix K: Permission to Use Materials, p. 109).

Olsen, J. Z., & Knapton, E. F. (2016). *Handwriting Without Tears*®: *The Print Tool*<sup>TM</sup> (5th ed.). Cabin John, MD: Handwriting Without Tears®.

**Quantitative Research**: Describe the statistical plan for the study. This discussion should include a justification of the adequacy of the sample size (*detailed in Section C below*). If this is an EBP project, justification of sample size is not needed. The statistical methods for measuring study outcomes, plans for interim analyses, and any stopping rules also are required. **Qualitative Research**: Please describe the qualitative data analysis plan.

The results of this evidence-based occupational therapy project will be assessed by utilizing the Print Tool® (See Appendix G: Print Tool® Forms, p. 104) as an outcome measure. A pre-assessment/postassessment design was chosen based on the evidence supporting this project (Axford, Joosten & Harris, 2018; Butler et al., 2019; Hape et al., 2014; Jordan et al., 2016; Wells, Sulak, Saxon, & Howell, 2016). The students will complete the Handwriting Without Tears® Print Tool® assessment during both pre- and post-intervention to determine changes in their handwriting skills. The Print Tool® aligns with the components of the Handwriting Without Tears® program as it was developed by the makers of the handwriting program. It demonstrates reliability and validity to measure components of handwriting skills (Donica, 2018). With each component, the student receives a percentage score based on the number of letters which meet the criteria for accuracy. In addition, basic demographic information which will be collected will allow quantitative data to be compared by various factors, including age, gender, and special education status to determine the impact these areas have on performance. Confidentiality with this project will be addressed by using number identifiers for the students' pre-test and post-test forms. The students will have the same number, assigned by the primary investigator, on both tests so that they can be matched for comparison and data analysis.

The data will be analyzed using descriptive statistics with the percentage change in each area of the Print Tool® calculated per student. An overall legibility score for lower case letters will also be obtained from the assessment and the percentage change for this score will be calculated. The mean percentage scores of the total participants will be determined for each area and the overall legibility score. The percentage change for each area and the total score will be calculated. Comparisons can further be made based on demographic information such as gender or educational programs.

Axford, C., Joosten, A. V., & Harris, C. (2018). iPad applications that required a range of motor skills promoted motor coordination in children commencing primary school. *Australian* 

Occupational Therapy Journal, 65, 146-155. http://dx.doi.org/10.1111/1440-1630.12450

- Butler, C., Pimenta, R., Tommerdahl, J., Fuchs, C. T., & Cacola, P. (2019). Using a handwriting app leads to improvement in manual dexterity in kindergarten children. *Research in Learning Technology*, 27, 1-10. http://dx.doi.org/10.25304/rlt.v27.2135
- Donica, D. K., & Holt, S. (2018). Examining validity of the Print Tool compared with Test of Handwriting Skills-Revised. *OTJR: Occupation, Participation and Health*, 1-9. http://dx.doi.org/10.1177/1539449218804529
- Hape, K., Flood, N., McAuthur, K., Sidara, C., Stephens, C., & Welsh, K. (2014). A pilot study of the effectiveness of the Handwriting Without Tears® curriculum in first grade. *Journal of Occupational Therapy, Schools, & Early Intervention*, 7, 284-293.
  http://dx.doi.org/10.1080/19411243.2014.975071
- Jordan, G., Michaud, F., & Kaiser, M. -L. (2016). Effectiveness of an intensive handwriting program for first grade students using the application LetterSchool: A pilot study. *Journal of Occupational Therapy, Schools, & Early Intervention*, 9(2), 176-184. http://dx.doi.org/10.1080/19411243.2016.1178034
- Wells, K. E., Sulak, T. N., Saxon, T. F., & Howell, L. L. (2016). Traditional versus iPad-mediated handwriting instruction in early learners. *Journal of Occupational Therapy, Schools, & Early Intervention*, 9(2), 185-198. https://doi.org/10.1080/19411243.2016.1176548

# C Population

Indicate the age range of subjects that will be enrolled in this study. (Check all that apply.)

Fetuses

X Children

Adults (18 years and older)

Consent form should include an affirmation statement (before signature or button for clicking to agree) that subject is 18 or older.

Indicate all possibly vulnerable populations that are deliberately included in this

C.2 study. (Check all that apply. Note: in some cases, special regulatory protections apply.)

#### X Students

Indicate how the investigator will:

- 1. Minimize coercion to participate
- 2. Ensure participation will not affect student grades, academic-standing or status at the Institution
- 3. Protect student data covered by FERPA

C.2a

Students' grade, academic standing, and/or status at the school will not be affected whether they participate in the project or not. No incentives will be provided to those that participate in the project. Student data will be de-identified to ensure confidentiality

Employees

Prisoners/Detainees

Pregnant women, Fetuses

Nonviable Neonates and Neonates of uncertain viability

Research involving after delivery, the placenta, the dead fetus or fetal material

Minors who can consent for themselves (e.g., emancipated minors)

Cognitively Impaired Adult Subjects

Economically or socially disadvantaged populations

Other potentially vulnerable group

N/A

**Inclusion criteria:** Please describe the inclusion criteria. (Who is deliberately *included* in relation to the study design?)

C3.

All students enrolled within the volunteer teacher's classroom will participate in the intervention but only those students whose parents have consented will participate in assessments. In order to be included in the project, the students must meet the following criteria: must be enrolled in the participating classroom, parental consent must be obtained, and the student must be 5-7 years old. The age range of 5-7 years old was chosen to be sure to include all students who may be enrolled in kindergarten, including those who may be repeating the grade.

For the evidence-based occupational therapy project, one kindergarten teacher and paraprofessional team will be recruited to volunteer for participation. Recruitment of the teacher/paraprofessional team will take place through a letter forwarded via email by a teacher not involved in the project detailing the project and the requirements of the project including the inclusion and exclusion criteria composed by the primary investigator (See Appendix C: Volunteer Recruitement Email, p. 88). In order to be included, the teacher/paraprofessional team must have students receiving occupational therapy services enrolled in their classroom and have at least one year of teaching experience. The team must be willing to volunteer approximately six and a half hours over the six-week period during implementation of the project.

**RB Reviewer** 09-29-2019 6:09 PM

Please define "paraprofessional team". Who does this include?

Kerri Sheffield Today at 10:20 PM

The team consists of one kindergarten teacher and one paraprofessional in the classroom in which the evidence-based project will take place.

**Exclusion criteria:** Please describe the exclusion criteria. (Who is deliberately *excluded* in relation to the study design?)

Students will be excluded from the assessments if they are not enrolled in the classroom, parental consent is not granted, or if they have limited English proficiency and are unable to comprehend the instructions provided during the assessment. This criterion will be determined through a conversation with the English to Speakers of Other Languages teacher.

RB Reviewer last Thursday at 9:33 AM

What about students with disabilities that might limit their ability to write?

#### Kerri Sheffield Today at 10:26 PM

Students with disabilities will be allowed to participate to the best of their abilities in the program. If a student with a disability has consent but is unable to complete the pre and post-testing, his or her testing will be incomplete and not included in the results. As the project is looking for a change in legibility, if the student can complete the testing, his or her results could still be included as it could still indicate a result.

Teacher/paraprofessional teams will be excluded if there are no students receiving occupational therapy services within their classroom or if they are in their first year of teaching experience.

C.4

C.5

Note: For student subjects, consider whether to exclude minors. If students under 18 are not excluded, parental consent and adolescent assent will be necessary.

**Equitable Selection:** Are there any language (non-English speaking), age, ethnic, religious or gender based exclusion criteria? (*This refers to deliberate exclusions related directly to the study design.*)

X Yes

Please indicate the criteria and provide a justification for the exclusion.

Students who have limited English Proficiency and are unable to comprehend the instructions provided during the assessments will be excluded from the project. This will be

determined by consultation with the English to Speakers of Other Languages teacher.

C.3ca\_\_\_\_\_

No.

Will this study include enrollment of any health disparity population?

The U.S. Department of Health and Human Services defines health disparities as:

"a particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage. Health disparities adversely affect groups of people who have systematically experienced greater obstacles to health based on their racial or ethnic group; religion; socioeconomic status; gender; age; mental health; cognitive, sensory, or physical disability; sexual orientation or gender identity; geographic location; or other characteristics historically linked to discrimination or exclusion."

Yes. A health disparity population is a specific focus of this research

Yes. A health disparity population is not a specific focus of the research, but the recruitment and study contact methods are likely to enroll members of a health disparity population.

X No. A health disparity population is neither a specific focus nor is the study written to assure inclusion of health disparity populations

# **C.7** Projected Total Enrollment Numbers

**If this is research**: Based on statistical discussion above, how many subjects are necessary to enroll in this study? *Note this will be the maximum number the IRB will approve.* 

**If this is EBP project:** Give an estimated number of participants you are attempting to recruit?

- C.7a 27-This should be the maximum number of students enrolled within the kindergarten classroom
- C.7b Will subjects be enrolled at more than one site?
  Yes

C.6

X No

C.7c Will the study enroll more than one cohort or unique populations (e.g., patients and their parents will be enrolled)?

Yes

X No

## D Research Procedures

Describe all procedures/interventions done as part of this study. These may include:

- Paper based surveys or questionnaires
- Web-based surveys (describe platform)
- Interview procedures
- Nature of interaction with subjects (in person/at lab, computer based, phone, video/audio chat, social networking, etc.) How and by whom the
- data is recorded
- Educational techniques
- Research Tasks and Experiments Cognitive or Sensory Tests
- (must provide rationale and debriefing)
- Debriefing procedure
- Deception Follow up procedures
- Blood tests, saliva tests
- Etc.

D.1 -

Remember, you are describing - to a voting IRB member *who is possibly a non-scientist* - what the subjects will experience during the study. Please convey the whole picture for the reviewer.

All students enrolled within the volunteer teacher's classroom will participate in the intervention; however, only those students with parental permission will participate in the pretest and posttest for data collection. The students will invest a time commitment of approximately seven hours over a six-week intervention period. Recruitment and consent will occur as detailed in a later section.

Prior to beginning the intervention, participants with signed parental consent will be assigned a numeric code to be used on testing materials. A list of identifier codes will be stored in a locked drawer of the primary investigator's office. The participants will complete an individually administered pre-test in a separate room to obtain baseline data. The primary investigator will lead the traditional instruction on the specified days with the volunteers supervising the app-based instruction to ensure students are staying on task and practicing the correct letters. The traditional instruction time and application practice will be approximately 15 minutes per day per participant. This time period is based on the amount of time the students are engaged in each session of small group instruction time during the English/Language Arts instructional block. At the end of each week, the primary investigator will meet with the volunteers to discuss progress or concerns noted during the intervention week. Following the conclusion of the six-week intervention period, a posttest will be individually administered in a separate room.

List any procedures from above that have a purpose outside of research or an EBP project. If a procedure has a purpose outside the research or EBP, please explain. (If not applicable, put NA)

NA

Describe the study/project setting.

D.2 -

The proposed project will take place in a kindergarten classroom at Timber Ridge Elementary School in McDonough, Georgia. Typical kindergarten classes range in size from 18-23 students with a maximum number of 27 students. Children in kindergarten in these classrooms range in age from 5-7 years old.

## D.3 Please describe for study/project:

- Duration of participation
- Length of visits or procedures
- Number of visits or procedure
- Timetable for completion

The project will take place within the kindergarten classroom. All students will participate in the intervention within the class but only those with signed parental consent will participate in the pretest and post-test. The students will participate in approximately 25 sessions across six weeks. Those students who have signed parental consent will participate in an additional individually administered pretest and posttest session. Sessions will be for approximately 15 minutes per day of either traditional instruction, app-based instruction, or review of previously learned letters. The table below details the intervention plan. Prior to implementation of the intervention, the teacher/paraprofessional volunteer team will receive training on the use of the LetterSchool<sup>TM</sup> application as well as the Handwriting Without Tears® program.

Table 1.1 Outline of the Plan for Intervention Implementation							
Week	Intervention	Assessment	Time Commitment for	Time Commitment for Volunteer			
			Participants	<b>J</b>			

Pre	Pre-intervention: Pretest Students	The Print	20 minutes	1 hour
	Teacher/paraprofessional training	Tool®		
1	Day 1: traditional instruction c, o, s		45 minutes	45 minutes
	Day 2: traditional instruction v, w, t			
	Day 3: LetterSchool <sup>TM</sup> Practice of c,			
	o, s, v, w, t-volunteer supervised			
	Volunteer/therapist collaboration			
2	Day 1: traditional instruction a, d, g		1.25 hours	1 hour
	Day 2: LetterSchool <sup>TM</sup> Practice of a,			
	d, g (previous letters as needed-			
	volunteer supervised)			
	Day 3: traditional instruction u, i			
	Day 4: LetterSchool <sup>TM</sup> Practice of u,			
	i- (previous letters as needed-			
	volunteer supervised)			
	Day 5: Review of letters/Make up			
	sessions			
	Volunteer/therapist collaboration			
3	Day 1: traditional instruction e, l,		1 hour	1 hour
	Day 2: LetterSchool <sup>TM</sup> Practice of e,			
	1, - (previous letters as needed-			
	volunteer supervised)			
	Day 3: traditional instruction k, y			
	Day 4: LetterSchool <sup>TM</sup> Practice of k,			
	y- (previous letters as needed-			
	volunteer supervised)			
	Volunteer/therapist collaboration			
4	Day 1: traditional instruction j, p		1.25 hours	1 hour
	Day 2: LetterSchool <sup>TM</sup> Practice of j,			
	p- (previous letters as needed-			
	volunteer supervised)			
	Day 3: traditional instruction r, n			
	Day 4: LetterSchool <sup>TM</sup> Practice of r,			
	n (previous letters as needed-			
	volunteer supervised)			
	Day 5: Review of letters/Make up			
	sessions			
	Volunteer/therapist collaboration			
5	Day 1: traditional instruction m, h		1.25 hours	1 hour
	Day 2: LetterSchool <sup>TM</sup> Practice of			
	m, h (previous letters as needed-			
	volunteer supervised)			
	Day 3: traditional instruction b, f			
	Day 4: LetterSchool <sup>TM</sup> Practice of b,			
	f (previous letters as needed-			
	volunteer supervised)			
	Day 5: Review of letters/Make up			
	sessions			
	Volunteer/therapist collaboration			

6	Day 1: traditional instruction q, x, z	The Print	1 hour	45 minutes
	Day 2: LetterSchool <sup>TM</sup> Practice of q,	Tool®		
	x, z (previous letters as needed-			
	volunteer supervised)			
	Day 3: Review of letters/Make up			
	sessions			
	Volunteer/therapist collaboration			
	Day 4: Post Testing			
	Day 5: Post Testing			
			Total Time	Total Time
			Commitment	Commitment
			for each	for each
			Participant:	Volunteer:
			6.75-7 hours	6.50 hours

## D.4 Will this study involve genetic testing?

Yes

X No

If important incidental findings about individuals or groups are discovered during the study, describe the plan for disclosing and managing the findings?

 $D.5^{-}$ 

Example: You did not anticipate learning that a subject (or a group of subjects) could be depressed. Describe your plan.

If an unanticipated discovery occurs, the investigator will make the information known to the teacher verbally or through written documentation. The teacher will have the opportunity to seek further information if he/she deems it necessary. If an unanticipated deficit area regarding a child is uncovered, the information will be made known to the teacher as well as the student support facilitator at the school through verbal or written documentation. This will allow the educational team to address the concerns through the appropriate procedures as defined by the school system. This could include contacting the parent to inform them of the unanticipated discovery to best address the concerns.

#### Kerri Sheffield Today at 10:31 PM

An unanticipated discovery might be determining a student has fine motor or visual-motor impairments which may negatively impact his or her ability to successfully perform educational tasks in the classroom. This could be identified through the primary investigator's observation during the instruction periods in addition to the results of the pretesting and post-testing.

## F Survey, Questionnaire, or Interview

F.1 Will the study/project utilize surveys, questionnaires, or interviews/focus groups?

Yes

Attach all copies of surveys, questionnaires, or interviews/focus groups guides. If they are not self-created, attach letters or emails of

F.1a permission to use as well.

Notes for attachments above (optional)

X No

Will the survey, questionnaire, or interview request disclosure of any information that can identify the participants? (*This can include the collection of indirect* 

identifiers or demographic information that, put together, could identify individual participants.)

Yes

F.2

X No

## 4 Recruitment and Compensation

#### A Recruitment

Describe the recruitment process, including:

- What recruitment tools will be used
- Who will approach the subjects
- Timing
- Location of recruitment

A.1

For the evidence-based occupational therapy project, one kindergarten teacher and paraprofessional team will be recruited to volunteer for participation. In order to be included, the teacher/paraprofessional team must have students receiving occupational therapy services enrolled in their classroom and have at least one year of teaching experience. The team must be willing to volunteer approximately six and a half hours over the six-week period during implementation of the project. Teacher/paraprofessional teams will be excluded if there are no students receiving occupational therapy services within their classroom or if they are in their first year of teaching experience. Recruitment of the teacher/paraprofessional team will take place through a letter forwarded via email detailing the project and the requirements of the project including the inclusion and exclusion criteria composed by the primary investigator (See Appendix C: Volunteer Recruitment Email, p. 88). Contact information of the primary investigator will be included should the teachers or paraprofessionals have questions. This letter will be sent to kindergarten teacher/paraprofessional teams at the implementing school by a teacher in a different grade unrelated to the project. Having a person unrelated to the project distributing the information

letter will prevent coercion of the volunteers. The first teacher/paraprofessional team to respond and meet all the inclusion criteria will be chosen to participate. The team will be provided an information letter (See Appendix C: Volunteer Recruitment Email, p. 88), and a volunteer consent form will be obtained (See Appendix D: Volunteer Consent Form, p 90).

All students enrolled within the volunteer teacher's classroom will participate in the intervention, as it is a curricular change. In order to be included in the pre- and post-testing, the students must meet the following criteria: must be enrolled in the participating classroom, parental consent must be obtained, and the student must be 5-7 years old. The age range of 5-7 years old was chosen to be sure to include all students who may be enrolled in kindergarten, including those who may be repeating the grade. The students will invest a time commitment of approximately seven hours over a six-week intervention period. Students will be excluded if they are not enrolled in the classroom, parental consent is not granted, or if they have limited English proficiency and are unable to comprehend the instructions provided during the intervention. This criterion will be determined through a conversation with the English to Speakers of Other Languages teacher. Students will be recruited through an introductory letter sent via email detailing the project and providing contact information for the primary investigator in the event questions arise from the students' parents. This letter will be constructed by the primary investigator to be forwarded by the teacher to the parental distribution list of the class (See Appendix E: Parent Recruitment Email, p. 97). Following the email, a hard copy of the letter with the informed consent form will be sent home in the students' weekly folders (See Appendix F: Informed Consent Form, p. 99). A second copy of the email with a copy of the informed consent form attached will be distributed by the teacher one week after the initial contact as a reminder to return the consent forms. Distribution of materials by other individuals in place of the primary investigator will aid in the reduction of bias and coercion of participants.

IRB Reviewer last Monday at 12:26 PM

Please add in a way to collect assent for any Children age 7 who participate. Also attach an assent form for them.

Kerri Sheffield Today at 10:37 PM

For students who are seven years of age, verbal assent will be obtained by the primary investigator. A script will be used to explain the evidence-based project in language appropriate to the age and understanding of the student. The script for the verbal assent is attached.

Indicate the recruitment tools and approaches that will be used.

A.2

X Email

The primary investigator will send the teacher/volunteer recruitment letter to a teacher in a different area to be forwarded to the kindergarten teachers. The primary investigator will send the volunteer teacher the participant recruitment script to be forwarded to her class distribution email list.

Flyers

Chatham University Student Subject or Participant Pool (*Includes Student Pool via SONA*)

Note: When recruiting from Student Subject Pool, the consent form must inform subjects of alternative methods for receiving research credits (i.e. other studies in SONA or the Paper Option).

Also, consent form must include statement to affirm 18 or older. (If students under 18 are to be included, parental consent, child assent will be required for those students.)

Other Human Subject Pool (includes Amazon MTurk, Qualtrics Panels, etc.)

## A.2c Please specify.

Verbal (Direct participant contact)

Website created specifically for this study

Social Media (e.g., Facebook, Twitter, Instagram, etc.)

Direct recruitment by study staff in departments not represented by the study personnel

#### X Letter from investigator

Newspaper/Magazine Advertisements

Telephone (using a recruitment script)

Investigator's Sample Population (previous study records, classroom (course numbers, name/title, semester, year), databases, or registries)

Referral from colleagues

Snowball sampling

Please describe in detail below.

Other

Attach all recruitment materials.

#### Materials can include:

- Flyers
- A.3 Verbal script

Content of email or letter

- Document containing whatever description the subjects will see in
- SONA.

MTurk, or other online recruitment methods, even if all they see is the title. Etc. (*The reviewer needs to review whatever material the subjects will see in order to invite them to join this study.*)

B Compensation, Gifts or Incentives to Subjects and Families

Note: If the total payment (including reimbursement for expenses for time, effort and gifts) exceeds \$600 in a calendar year, ensure that the appropriate social security number(s) will be obtained in order to issue an IRS Form 1099 to the parent/child.

Will there be compensation or incentives for subjects or their families? (Monetary

payment, raffles, gifts, academic credit, etc)

Yes

Χ

No

B.1

Indicate the types of compensation/incentive to subjects or families (Check all that apply).

Reimbursement for expenses.

Compensation for time and effort.

Research Credits for Student Pool(SONA)

Gifts (such as presents or toys)

Other

- B.3 Provide the method, form and timing of payments (including specific dollar amount, credit hours, or specifics for other form of payment) to subjects, parents, or legal guardians for:
- Reimbursement for expenses
- Compensation for time and effort
- Credit hours for Student Pool via SONA
- Gifts

A.1

Be sure to specify the amount per category and whether compensation is still provided if subject withdraws from study before completion.

## A PHI (Protected Health Information)

Does the data used or accessed for this study relate to:

the past, present or future health or condition of an

- individual;
- the provision of health care to an individual or
- the payment for the provision of health care?

If the study will access medical records or any source with health information, select "Yes" for this question.

Yes

X No

## B Data Management, Confidentiality, Privacy

Please describe Data Management Plans including:

- The plan to protect the subjects' confidentiality
- Where the data and/or specimens will be stored (e.g., in Excel file on password protected laptop, password protected flash drives, paper forms in locked office/file cabinet, or samples are to frozen and saved).
- The plan, if applicable, to code the data (be specific)
- The plan to destroy identifiable information
- Be specific regarding the locations of offices, owners of electronic equipment, or locations or external servers.

If utilizing web surveys, please be specific as to how long the data will be stored on the web survey platform (e.g. Qualtrics, how/when/where the data will be transferred to other locations or individuals, and when the data will be deleted from its final destination(s)

**Confidentiality** refers to the treatment of information that a participant has disclosed with the expectation that it will not be divulged to others in ways that are inconsistent with the understating of the original disclosure without permission. Examples: keeping study files in locked drawers and not in the open, sharing data as outlined in the consent forms/protocol, password protecting electronic files, etc.

#### Coded data refers to:

- 1. identifying information (such as name or social security number) that would enable the investigator to readily ascertain the identity of the individual to whom the private information or specimens pertain has been replaced with a number, letter, symbol, or combination thereof (i.e., the code); and
- 2. a key to decipher the code exists, enabling linkage of the identifying information to the private information or specimens.

**De-Identified data** refers to any data which does not contain any of the 18 elements of Protected Health Information identified by HIPAA or a link to a database where such PHI would exist.

All personal and identifiable information will be kept confidential throughout the project. Student participants will be assigned a unique numerical code to be used on both pretest and posttest forms. Codes will be assigned based on small group assignment, starting at one and progressing sequentially for each participating student. This identifier is required for comparison of pretest data with post-test data on an individual basis. This information will only be available

B.1

B.1

to Kerri Sheffield. The list of codes will be kept on the primary investigator's password protected computer. The list of codes will be deleted following completion of the project.

Presented information on the project will not disclose personal information regarding the students. No information which is identifiable will be distributed including names, initials, or codes. De-identified individual data will be compared to determine improvements for each student. Aggregate data will be available to the school, district, teachers, and parents.

The forms used for data collection will be maintained in a locked desk/cabinet in the primary investigator's office. The primary investigator will be the only person with access to the key of the cabinet. Student information related to coding and demographic information will be stored on the primary investigator's password protected computer. The names and codes will be destroyed after the completion of the project. The data will be stored for a maximum of five years, after which it will be shredded and disposed of properly. Electronic data will be deleted after a maximum of five years.

Only the primary investigator and faculty advisors, Dr. Jennifer Lape, and Dr. Andrea Collins will have access to the stored data.

Describe the plan to protect participant privacy. (Privacy is not the same as confidentiality. Privacy refers to a research participant having control over the extent, timing, and circumstances of sharing his/herself with others. Examples: conducting consent in private room, doing all study procedures in private, not discussing study participation with those not involved with the study, etc.)

B.2

Parents will have the opportunity to consent in their own homes. They will be given a privacy envelope to place their signed consent in for return to school. The consent will be addressed to the primary investigator.

When completing testing, the students will be identified with a code. No one, other than the primary investigator will know the student's code and others will not be able to determine

which data belongs to which student. Testing will take place in a one on one setting in a location separate from the kindergarten classroom.

Aggregate data will be presented to the teachers and administrators and all identifiable information will be removed. De-identified individual data will be compared to determine individual outcomes. The primary investigator will be the only person who will have access to the codes.

Will data or specimens be stored for other future research study purposes (i.e., a separate protocol)?

B.3 Note: Subjects must be informed of future use of the study data during the consent process, and in some cases given an opt-in/opt-out choice.

Yes

X No

C Transfer and Release of Data or Specimens

Will identifiable data or specimens be transferred outside of Chatham University to

another institution, individual, or entity?

Yes

C.1

X No

Will a Certificate of Confidentiality be obtained for this study?

Certificates of Confidentiality are issued by the National Institutes of Health (NIH) to protect the privacy of research subjects by protecting investigators and institutions from being compelled to release information that could be used to identify subjects with a research project. Certificates of Confidentiality are issued to institutions or universities where the research is conducted. They allow the investigator and others who have access to research records to refuse to disclose

identifying information in any civil, criminal, administrative, legislative, or other proceeding, whether at the federal, state, or local level.

Yes

X No

## 7 Consent and Debriefing

## Informed Consent and Waivers

Α

The IRB-Approved Informed Consent Template must be used. Please see the current template document <a href="here">here</a> (Login and scroll down to the appropriate IRB consent/assent templates.)

Note: there is a difference between a **full Waiver of Consent** (where consent does not take place at all) and a **Waiver of Documentation of Consent**, where there is indeed some form of consent (either verbal or implied by an electronic click), but no signature is collected on a consent form.

From the list below indicate how consent will be obtained for this study. (Check all that apply).

Written/signed consent by the adult subject

## X Written/signed consent (permission) for a minor by a Parent or Legal Guardian

Written/signed consent by a Legally Authorized Representative (for adults incapable of consenting).

Written/signed Assent (subjects 7-17 years of age)

Waiver or Alteration of the informed consent process including:

- waiver of informed consent
- waiver of documentation (no signature)
- verbal-only consent
- waivers of parental permission or adolescent assent
- alteration of informed consent
- deception

Informed Consent does not apply to this study (most retrospective studies)

From the list below, indicate the type of waiver of informed consent that applies to

A.2

this study.

Cover Letter includes Language of Implied Consent (instead of consent form)

Waiver of Informed Consent Process

Waiver of Documentation of Consent

- no signature will be collected at the time of consent
- commonly utilized/preferred for web surveys
- commonly utilized verbal consent is justifiable

## A.3 Who will be obtaining informed consent?

## X Principal Investigator (PI)

All Faculty (Sub-Investigators, etc.) listed in Section 1, B.3

All other study staff listed in Section 1, B.4

Study staff listed in Section 2 (Collaborators from outside CU)

Limited to the following personnel listed in Section 1, B.2, B.3, B.4 and/or Section 2:

Not applicable (full waiver of informed consent being requested or informed consent not required)

For this study, indicate whether you are obtaining authorization from the subject or

A.4

requesting a Full or Partial Waiver of HIPAA Authorization. (Check all that apply.)

Obtaining written HIPAA Authorization (in consent form)

Full or Partial waiver of HIPAA authorization

X HIPAA does not apply to this study.

Please explain why HIPAA does not apply (e.g., no Protected Health A.3a Information (PHI) will be obtained for this study)

No protected Health Information (PHI) will be obtained for this study

#### B Consent Process

Describe the consent/assent process including:

Where and by whom the subjects will be approached

- The plans to ensure the privacy of the subjects
- The measures to ensure that subjects understand the nature of the study,
- B.1 its procedures, risks and benefits and that they freely grant their consent.

For the evidence-based occupational therapy project, one kindergarten teacher and paraprofessional team will be recruited to volunteer for participation. In order to be included, the teacher/paraprofessional team must have students receiving occupational therapy services enrolled in their classroom and have at least one year of teaching experience. The team must be willing to volunteer approximately six and a half hours over the six-week period during implementation of the project. Teacher/paraprofessional teams will be excluded if there are no students receiving occupational therapy services within their classroom or if they are in their first year of teaching experience. Recruitment of the teacher/paraprofessional team will take place through a letter forwarded via email detailing the project and the requirements of the project including the inclusion and exclusion criteria composed by the primary investigator (See Appendix C: Volunteer Recruitment Email, p. 88). Contact information of the primary investigator will be included should the teachers or paraprofessionals have questions. This letter will be sent to kindergarten teacher/paraprofessional teams at the implementing school by a teacher in a different grade unrelated to the project. Having a person unrelated to the project distributing the information letter will prevent coercion of the volunteers. The first teacher/paraprofessional team to respond and meet all the inclusion criteria will be chosen to participate. The team will be provided an information letter and a volunteer consent form will be obtained (See Appendix D: Volunteer Consent Form, p. 90).

All students enrolled within the volunteer teacher's classroom will participate in the intervention. In order to be included in the project, the students must meet the following criteria: must be enrolled in the participating classroom, parental consent must be obtained, and the student must be 5-7 years old. The age range of 5-7 years old was chosen to be sure to include all students who may be enrolled in kindergarten, including those who may be repeating the grade. The students will invest a time commitment of approximately seven hours over a six-week intervention period. Students will be excluded if they are not enrolled in the classroom, parental consent is not granted, or if they have limited English proficiency and are unable to comprehend the instructions provided during the intervention. This criterion will be determined through a conversation with the English to Speakers of Other Languages teacher. Students will be recruited through an introductory letter sent via email detailing the project and providing contact information for the project coordinator in the event questions arise from the students' parents. This letter will be constructed by the primary investigator to be forwarded by the teacher to the parental distribution list of the class (See Appendix E. Participant Recruitment Email, p. 97). Following the email, a hard copy of the letter with the informed consent form will be sent home in the students' weekly folders (See Appendix F: Informed Consent Form, p. 99). A second copy of the email with a copy of the informed consent form attached will be distributed by the teacher as a reminder to return the consent forms. Distribution of materials by other individuals in place of the project coordinator will aid in the reduction of bias and coercion of participants.

Describe the measures that will be taken during the recruitment and consent/assent process to safeguard against potential coercion or the appearance of coercion. Include a discussion of the adequacy of the allotted time for subjects to make a decision.

Teacher recruitment will begin in the fall semester after IRB approval. The kindergarten teachers/paraprofessionals will be sent the scripted teacher volunteer letter via email by a teacher not in their grade level and not affiliated with this project. Contact information of the primary investigator will be supplied to answer any questions. The first teacher to respond that they would like to participate and who meets the criteria will be provided the information letter and volunteer agreement.

Parents will be introduced to the project in the fall semester. The participating teacher will forward the recruitment letter through email and a copy of the informed consent to the class distribution list. An additional copy of the letter and the consent will be sent home in the weekly folder by the classroom teacher. Contact information will be provided should the parents have any questions. The parents will be provided an envelope addressed to the investigator in which to return the signed consents to the school. A third copy will be sent to those who have not returned the consent to remind them to return the forms.

Attach copies of all Consent Forms, Assent forms, Verbal Consent Scripts, and/or Study Information Sheets, to be used for this study.

(See Appendices C-G)

B.3 **The IRB-Approved Informed Consent Template must be used/adapted**. Please see the current template document <a href="here">here</a> (scroll down to Guidance and Forms.)

**File Name Format** should include version number (V1) and date most recent version: "Consent\_V1\_date" or "Assent\_V1\_date"

Volunteer Agreement Parental Consent

Notes for Consent Related Attachments (optional)

Consent is parental consent.

**Deception and Debriefing** 

Does this study utilize deception or incomplete disclosure during study procedures or the consenting process?

C.1 (Example: withholding information in any part of consent form, or necessary use of a false title.)

Yes

X No

C.2 Will subjects be debriefed at the end of this study?

Yes, for reasons of deception.

Yes. Debriefing is provided for other reasons other than deception. Examples: to further inform subjects about the study, provide contact information, or teach students about the research process (i.e. Gen Psychology Human Subject Pool.)

X No, debriefing is not necessary or does not apply Though not required, please consider using debriefing as a courtesy to the subjects.

- G Waiver of Documentation of Consent and HIPAA Authorization
  - Select which criterion (for waiver of documentation of consent) applies to this study. (Check one.)
    - (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. The subject must be offered an opportunity to sign a consent form and be told this document will link them with the research.
    - (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

Please explain.

G.1a

This project presents no more risk to the participants than what would occur in a typical school day. Written consent to participate is only necessary due to the proposed project.

Describe the process for obtaining informed consent:

• If option 1, how subjects will be given the opportunity to decide to sign or not sign the informed consent document

G.2

If option 2, how subjects will be fully informed utilizing an information sheet describing the study.

Parents of participants will be informed of the purpose of the project as well as of the risks and benefits for participating in the information letter and informed consent form.

Volunteers will be informed of the purpose of the project as well as of the risks and benefits for participating in the information letter and volunteer agreement.

If verbal HIPAA Authorization is requested, confirm that the following information is complete in this application:

G.3

- plans to protect PHI form improper use in Section 7 plans
- to destroy PHI at earliest opportunity in Section 7

8 Risks and Benefits

## A Study/Project Risks and Potential Injury

Is there a reasonable possibility that any portion of the research could make the participants uncomfortable or be potentially upsetting?

A.1

X Yes

No

N/A (Research involves retrospective data only.)

Could any disclosure of the human subjects' responses outside the research reasonably place the subjects at risk of **criminal or civil liability** or be damaging to the subjects' **financial standing**, **employability**, **or reputation**?

Please consider the possibility of inadvertent disclosure, data breach, or thirdparty

A.2 interception while data is being entered, even if no identifiable information is being collected by the researchers.

\_\_\_\_\_\_

Example: A student survey about drinking behaviors could potentially place underage subjects at risk of criminal or civil liability if responses were disclosed.

Yes

X No

N/A (Research involves retrospective data only.)

Summarize and provide an overall assessment of the risks and discomforts of the study interventions and procedures.

A.2

This project has minimal risks and discomforts for the participant. Risks associated with this project are no more than would occur on a typical school day. All students in the class will complete the handwriting program; however, only students with parental consent will be assessed with the pretest and posttest for data collection purposes for this evidence-based practice project. This is an individually administered test, so participants will be tested in a one-on-one setting which may be mildly uncomfortable and inconvenient. The testing period will be approximately 20 minutes and will only test handwriting skills which should minimize any discomfort or inconvenience felt by the participant. The participant's teacher or paraprofessional can remain present during the assessment to alleviate discomfort, if needed. The participant's information will be kept confidential and no information will identify the participants.

Teacher Volunteers may experience some mild discomfort when providing instruction related to letter formation. The instruction methods may be different than what they are familiar with teaching. Training utilizing the Handwriting Without Tears® Kindergarten Teacher's Manual and the application LetterSchool™ will be provided to alleviate any discomfort. There will also be collaboration with the primary investigator. This may lead to some mild discomfort if there are concerns related to the program.

A.3 Describe steps that will be taken to minimize risk and the likelihood of harm.

The project presents no more risk to participants or volunteers than would occur on a typical school day. Some participants may be unfamiliar with the primary investigator initially so the teacher or paraprofessional can be present during pretesting or post-testing if needed to alleviate any discomfort. Testing should be no more than 20 minutes per assessment, keeping the experience to a minimum amount of time for each participant.

Teacher's Manual and the LetterSchool™ app to alleviate any discomfort related to alternative teaching methods. If the teacher/paraprofessional is uncomfortable personally sharing concerns related to the program, the teacher/paraprofessional could email or write the concerns for the primary investigator. The teacher/paraprofessional will only be asked to share what they are comfortable sharing related to the project.

## B Potential Benefits and Alternatives

interventions

Describe any direct benefits that would accrue to the subject as a result of the study/project (if any).

B.1

By participating in the project, students may improve their handwriting skills and teachers may learn more effective teaching methods. In addition, results of the project may be shared with administration at the school and district level. Improvement in handwriting skills may support the adoption of a district wide handwriting curriculum. Also, results of this project may be submitted to a professional journal for publication, sharing the outcomes with therapists and educators outside of the district and adding to the current knowledge base about handwriting

Describe any potential indirect benefits to future subjects, science, and society.

Results of this project could have the indirect benefit of providing increased knowledge regarding effective handwriting instruction in kindergarten students. The results could impact how this school district provides instruction to the future students. The results could also demonstrate the need for a district wide handwriting program to be implemented in the kindergarten curriculum.

## Miscellaneous Additional Documents

Α

# Please attach any other documents that have not been specified in previous questions, but are needed for thorough IRB review.

Describe documents in the text box, then attach below. Multiple documents can be A.1 attached.

Please use simple file names that describe the contents along with a date. Examples:

- Letter of permission from site\_6.27.2018.pdf
- permission to use survey\_6.27.2018.docx
- documentation of survey in public domain\_6.27.2018.docx
- study\_timeline\_2010thru2017.jpg
- training materials\_6.27.2018.pdf qualtrics\_terms\_8-12-2017.pdf
  - Print Tool Forms
- Permission for Programs
- Teacher Invitation Letter
- Teacher Information Letter
- Volunteer Agreement
- Parent Letter
- Parent Informed Consent
- Site Permission Letter
- Materials List

## 10 Training and FCOI

Disclosure of Investigators' Financial Interests *specifically* Related to this Protocol

In order to inform research subjects of all circumstances that may affect their decision about whether to participate, all researchers are required to disclose any financial interests they may have related to this particular study. Each positive disclosure (i.e., each affirmative response below) will be reviewed and approved by the IRB Chair or Co-Chair.

To complete this form, the Principal Investigator must ask all Chatham University personnel who are involved in designing or conducting the research the following question:

Do you, your spouse, or dependent children have any significant\* financial interests related\*\* to the work to be conducted as part of the above-referenced project??

\*Significant Financial Interests: With respect to any single entity external to Cayuse University whose business interests are related to the results of this study, researchers are deemed to have significant financial interests if they, their spouses, or their dependent children have any of the following interests:

- Outside income exceeding \$10,000 over the preceding twelve months or anticipated during the forthcoming twelve months. Income includes salary, consultant payments, honoraria, royalty payments, dividends, loan, or any other payments or consideration with value.
- Equity in the form of stock, stock options, real estate, loan to, or any other
   investment or ownership interest exceeding \$10,000 (current market value) or
  - 5% or greater ownership interest.

Α

- A management position (e.g., director, officer, partner, or trustee) with the interested entity.
- An intellectual property interest, e.g., a patent (actual, planned, or applied for) or a copyright for software assigned or to be assigned to a party other than the Regents.

\*\*Related Financial Interests: Related interest occurs when the investigator has Significant Financial Interests that would reasonably appear to be affected by the research or in entities whose financial interests would reasonably appear to be affected

by the research. Examples include situations where the investigator:

- Is conducting a project where the results could be relevant to the development, manufacturing or improvement of the products or services of the entity in which the investigator has a financial interest; or
- has a financial interest in an entity that might manufacture or commercialize a drug, device, procedure, or any other product used in the project or that will predictably result from the project; or
- has consulting income in his/her professional field where the financial interest of the entity or the investigator would reasonably appear to be affected by the project; or
- has a financial interest in an entity and the project proposes to subcontract a portion of the work, or lease property, or make referral of participants to, or make purchases from the entity, or the entity is part of a consortium or will otherwise participate in the project.

Are there any financial interests to report pertaining to this protocol?

Yes

Any member of the study team who answers in the affirmative must be listed in the box below.

A.1.

A staff person will contact any researcher listed below to obtain additional information regarding the specific financial interest(s).

X No

Upload your completed COI Forms for all researchers.

RB Reviewer last Monday at 10:30 AM

A COI form needs submitted for Andrea Collins

**Kerri Sheffield** Today at 10:42 PM

Based on communication received through Dr. Lape, Capstone Advisor, Dr. Collins does not need to complete a COI since she is a faculty advisor.

### **Appendix M: Chatham IRB Approval**



#### NOTICE of Chatham University Institutional Review Board Approval

To: Kerri Sheffield

From: Chatham IRB Committee

Date: Oct 28, 2019 4:47 PM EDT

RE: IRB-FY2020-32 Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction

on Handwriting Legibility

Decision: Approved

Review Category: 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Expiration Date: --

Findings:

#### Notes for Researcher (if applicable):

The above-referenced Expedited human subjects protocol has been approved by the Chatham University Institutional Review Board.

Note: If this protocol changes significantly during the review process, it is the PI's responsibility to bring the revisions to the attention of the Organizational Approvers (usually the IRB Chair), as they reviewed and approved only the initial, unedited submission.

This approval is limited to the activities described in the protocol application, and extends to the performance of these activities at each site identified in the protocol application. In accordance with this approval, the specific conditions for the conduct of this research and the obtaining of informed consent from subjects is detailed in our policy manual.

Any changes to your protocol require submitting an amendment request to the IRB. Please log into <u>Cayuse IRB</u> in order to process a modification.

Please contact an IRB Co-Chair if you have any questions or concerns.

Sincerely,

Jason Woollard PhD, IRB Chair Emily Stevens, RN, WHNP, FNP-BC, IRB Co-Chair John Dubé PhD, IRB Co-Chair

Woodland Road . . . Pittsburgh, PA 15232 . . . 412-365-1100 . . . www.chatham.edu FOUNDED 1869

#### **Appendix N: Henry County Schools Project Approval**



#### Henry County Schools | Learning & Performance

January 27, 2020

Kerri Sheffield 157 Cotton Creek Drive, McDonough, GA 30252

Re: Research Request

Dear Ms. Sheffield:

Your application to conduct research in our school system as part of your *doctoral* requirements from *Chatham University* has been reviewed. It is the Department's understanding that you plan to examine, *Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility*. Consideration was given to the description of your research project, proposed data collection procedures, instruments, and research timeline. Your research application meets the requirements of Henry County Board of Education policy KEBA, Solicitation of Information. Therefore, your application to conduct research in Henry County Schools (HCS) as described in your proposal has been approved subject to the conditions outlined below.

- Research may not interfere with students' instructional day, standard curriculum, and educational services.
- Research may not interfere with HCS employee work duties and responsibilities. If the researcher is a
  HCS employee, research cannot be conducted during your normal working hours. Any alteration to a HCS
  researcher's work schedule needs to be communicated in writing and approved by your supervisor,
  including you submitting any necessary leave to complete your research.
- The researcher must assume responsibility in conducting all aspects of the study including, but not limited to, recruitment, consent forms, and data collection.
- Participation in this study is completely voluntary. Employees, parents, and students who do not wish to
  participate have a right to refuse or withdraw consent. Principals may decline the opportunity for their
  schools to participate the study at any time.
- Any student, staff, school, or district information should be used solely for completion of your research study. To preserve the privacy of students and employees, information collected must remain completely confidential. Pseudonyms for students, employees, schools, and this school district must be used in all reporting.
- All data must be used solely for the purpose articulated in your research application.
- If modifications or changes to your research procedures or instruments (as outlined in your application)
  become necessary during the research project, changes must be submitted in writing to the Facilitator of
  Research and Grants, Alison Norsworthy at alison.norsworthy@henry.k12.ga.us prior to implementation.

www.henry.k12.ga.us | 770.957.6601 | 33 N. Zack Hinton Parkway | McDonough, GA 30253





## Henry County Schools | Learning & Performance

- After completing your research, you must submit a report detailing your findings and conclusions. Prior to publication, you must submit a copy of the finalized report to alison.norsworthy@henry.k12.ga.us.
- After publication or completion of the research project, you must delete all data collected or received as result of this application.

Your application to conduct research in Henry County Schools as described in your proposal has been approved by the school leader at:

• Timber Ridge Elementary School

I hope your research project goes well and the information you obtain will be beneficial to you and the students of Henry County Schools.

Sincerely,

Dr. Emily Klein

Director, Performance Analytics and Research



## **Appendix O: Student Verbal Assent**



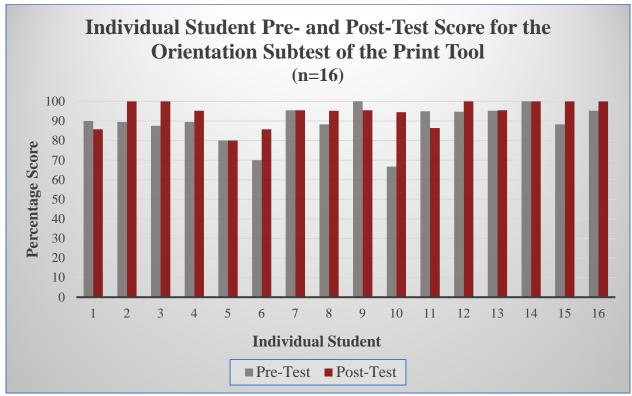
## **Student Verbal Assent Script**

Hi (Insert student's name here). My name is Mrs. Kerri and today we are going to see how you are writing your letters. I am going to say a letter and then you just have to write it down the best you can. This will help me, and your teachers be able to teach you and your classmates how to write better. Can you write your letters for me today?

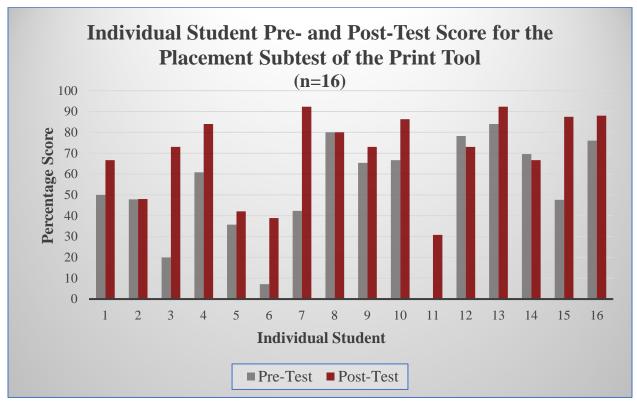
**Individual Student Pre- and Post-Test Score for the Memory Subtest of the Print Tool** (n=16)Percentage Score **Individual Student** ■ Pre-Test ■ Post-Test

**Appendix P: Individual Data Graphs for the Print Tool Subtests** 

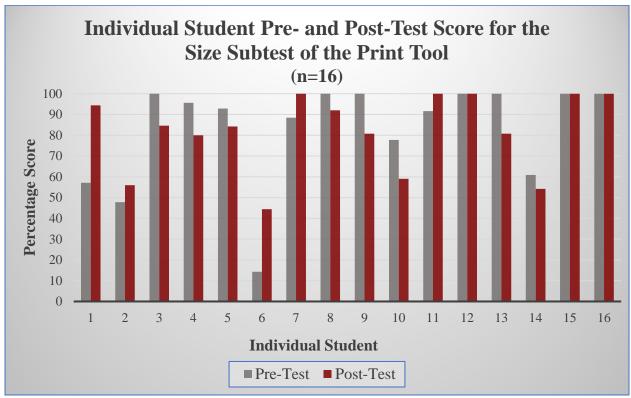
Comparison of the Pre- and Post-test Memory Subtest of Individual Students. The higher the score, the better the performance.



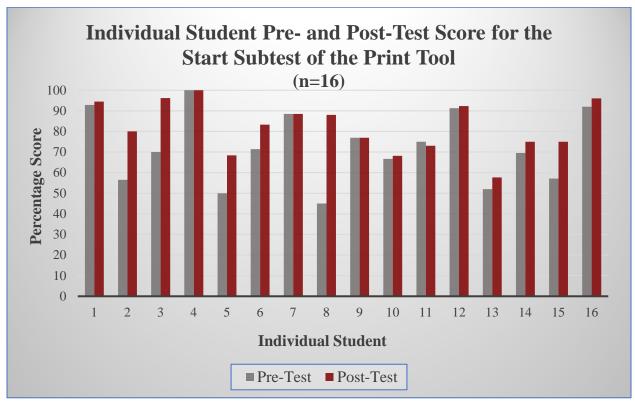
Comparison of the Pre- and Post-test Orientation Subtest of Individual Students. The higher the score, the better the performance.



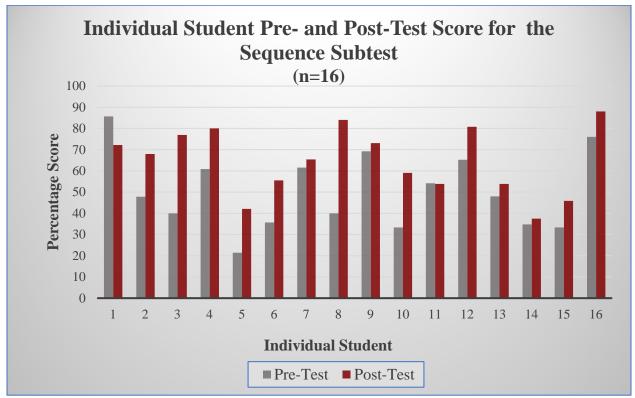
Comparison of the Pre- and Post-test Placement Subtest of Individual Students. The higher the score, the better the performance.



Comparison of the Pre- and Post-test Size Subtest of Individual Students. The higher the score, the better the performance.



Comparison of the Pre- and Post-test Start Subtest of Individual Students. The higher the score, the better the performance.



Comparison of the Pre- and Post-test Sequence Subtest of Individual Students. The higher the score, the better the performance.

Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility

KERRI SHEFFIELD, OTD, OTR/L

CHATHAM UNIVERSITY

APRIL 2020

# Setting: Henry County Schools

- Suburban public school setting south of Atlanta, Georgia
- > 52 learning sites including 28 elementary schools, 11 middle schools, 10 High Schools and 3 non-traditional educational programs of choice
- >Over 42,000 students ages 3-21 years with a variety of abilities





## Rationale For the Project

- Large number of students are referred to occupational therapy for handwriting difficulties (Asher, 2006)
- There is not a district adopted handwriting curriculum in place
- > Handwriting instruction is inconsistent
- Technology use is on the rise and is highly motivating for young children (Butler, Pimenta, Tommerdahl, Fuchs, & Cacola, 2019)



## PIO Question

Population: Kindergarten Students

Intervention: Traditional handwriting instruction supplemented with tablet-based application which teaches letter formation

Outcome: Improved legibility

Do kindergarten students who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation demonstrate improved legibility?

# Significance to Occupational Therapy









Increase the knowledge of school-based occupational therapists

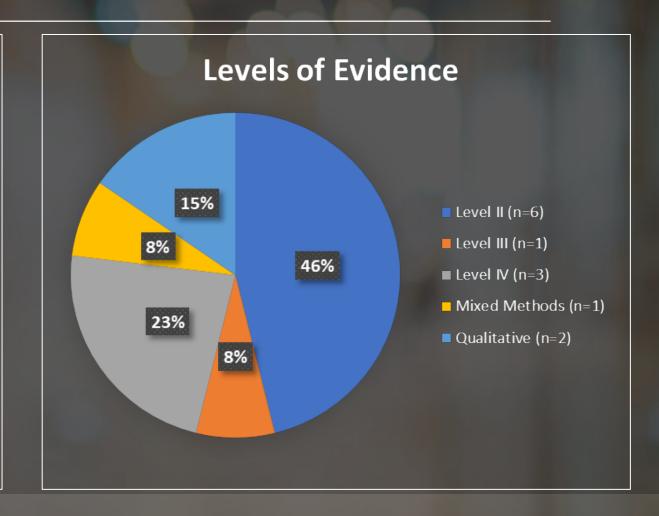
Support whole classrooms of students using a collaborative approach with teachers

Improve the perception of the value of occupational therapy services in the school setting

Decrease OT referrals for handwriting skills

# Literature Review

- ➤ 13 Critically Appraised Articles, Published between 2002 and 2019
- 6 Level II small RCT studies, cohort studies with a control or two group pretest-posttest designs
- ≥ 1 Longitudinal study
- ➤ 1 Survey study
- ≥ 1 Correlational study
- > 1 Single Case Design study
- ➤ 1 Mixed-Methods with Level III evidence and qualitative evidence
- 2 Phenomenological qualitative studies.



# What Does the Literature Reveal?

- Current state of handwriting instruction in schools (Asher, 2006)
- ➤ Handwriting instruction should be explicit and consistent (Asher, 2006; Hape et al., 2014; Randall, 2018)
- Effectiveness of traditional handwriting instruction including Handwriting Without Tears® (Hape et al., 2014; Randall, 2018)
- ► App based technology such as LetterSchool<sup>TM</sup> can be used to supplement traditional handwriting successfully (Butler et al., 2019; Jordan, Michaud, & Kaiser, 2016)



# What is Traditional Handwriting Instruction?

- Traditional instruction uses pencil and paper to practice letters as they are being taught
- ➤ Handwriting Without Tears® (HWT) is a developmental approach to traditional instruction

## Handwriting Without Tears®



**Evidence-Based**, with many schools utilizing the program



Introduces letters in groups based on the **development** of pre-writing strokes



Easy to incorporate into the school day



**Measurable**, free screener is available in addition to the Print Tool®



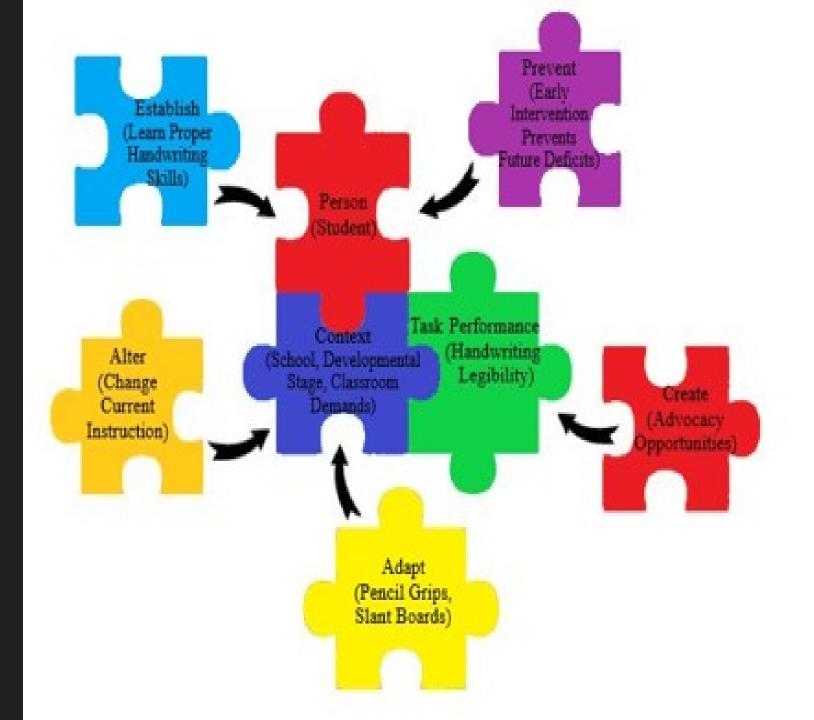
Focuses on legibility and letter formation.

# What is LetterSchool<sup>TM</sup>?

- ➤ LetterSchool<sup>™</sup> is an app that focuses on proper letter formation
- Uses an identify, watch, trace, try method
- > Available for both Apple and Android based products



Conceptual
Model
Ecology of
Human
Performance



# Steps for the Evidence-Based Project

## Prior to implementation:

- Teacher/paraprofessional training: 1 hour
- Pre-testing of students using The Print Tool®

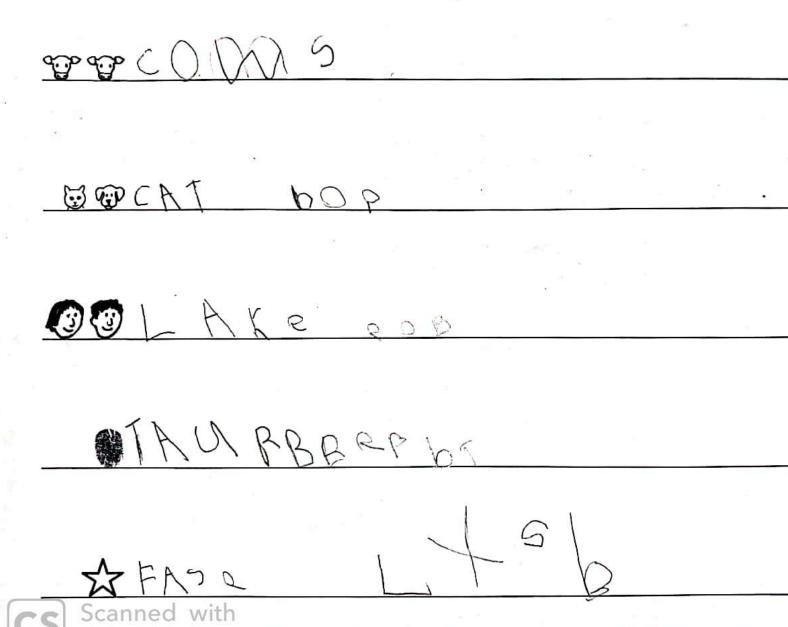
## Weeks 1-6:

- Rotating groups beginning with traditional instruction.
- Groups continued through the duration with instruction occurring daily
- Make-up sessions were scheduled during the class' Computer Lab Special
- Post-Testing completed



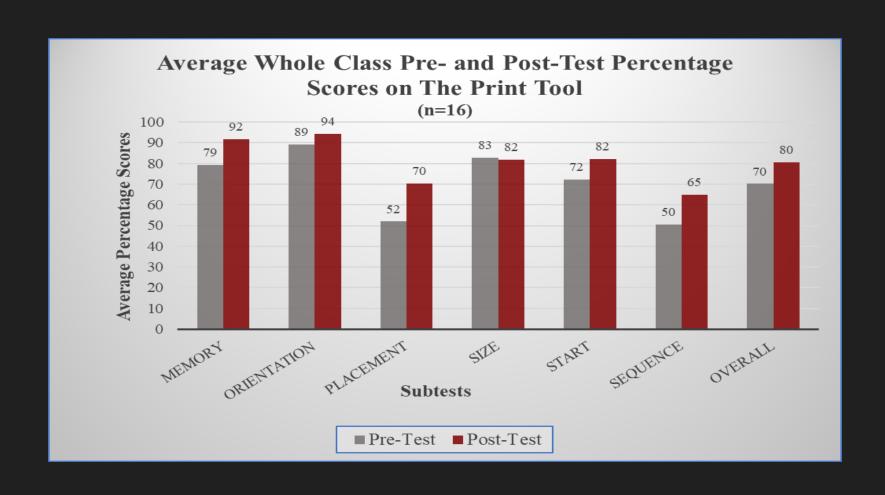
# Data Analysis

- ➤ Pre-test and Post-Test Design
- ➤ The Print Tool®
  - ➤ Functional based assessment (Donica, 2018)
  - ➤ Valid and Reliable (Donica, 2018)

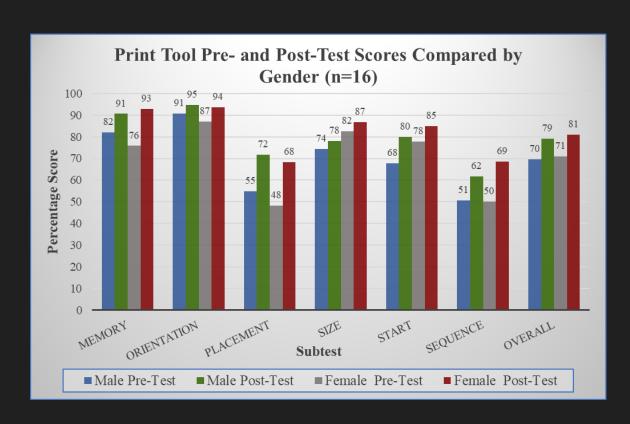


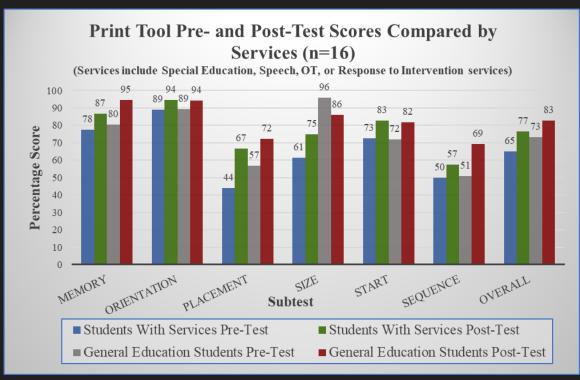
CamScanner

# Quantitative Outcomes-Whole Class



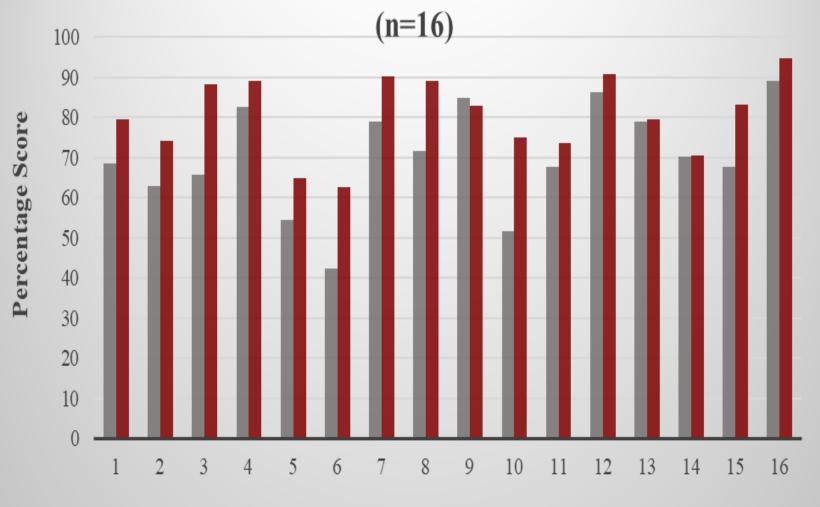
# Outcomes Compared by Gender and Program





# Outcomes by Individual Student

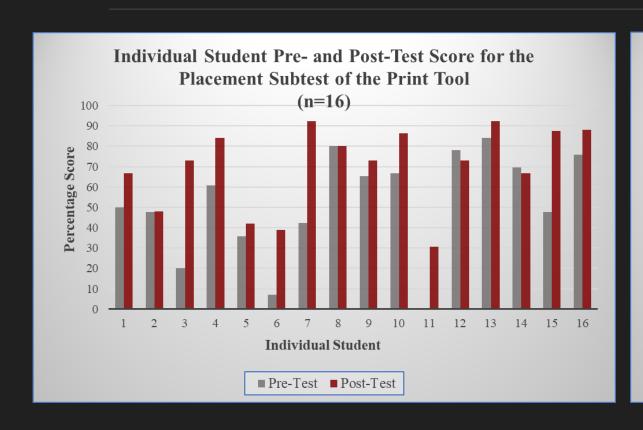
## Overall Pre- and Post-Test Handwriting Legibility Scores on The Print Tool

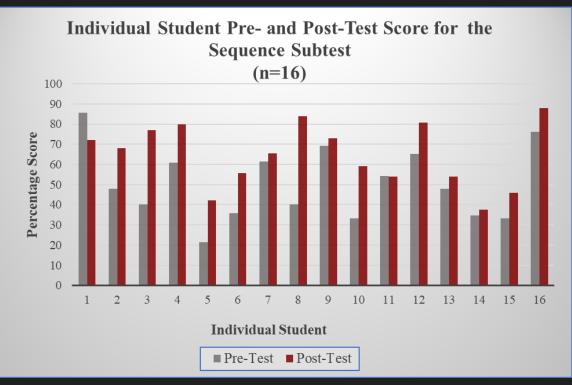


## **Individual Student**

■ Pre-Test ■ Post-Test

# Outcomes by Individual Student-Subtests





## Literature Connection

Most improvement in the area of placement, contrasting with Jordan et al. (2016)

Showed improvement in legibility using paper/pencil activities and LetterSchool™ as did Butler et al. (2019) and Jordan et al. (2016)

Those with lowest scores initially benefitted the most (Randall, 2018)

Consistent program for increased legibility (Nye & Sood, 2018; Randall, 2018)

Using a tablet is an effective way to increase legibility (Butler et al. 2019; Jordan et al. 2016; Lorah & Parnell, 2014; Wells et al., 2016)





# Expanding the Capstone-Future Plans

- > Provide education to school-based OTs
- >Advocate to administrators for daily handwriting instruction
- >Train teachers on handwriting instruction at the beginning of the school year
- > Provide in-services to special education teachers
- Collaborate with teachers
- > Present to the school board to advocate for a handwriting program

## References

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# Effectiveness of Traditional Handwriting Instruction Supplemented with App-Based Instruction on Handwriting Legibility

Kerri Sheffield, OTD, OTR/L

An Evidence-Based Occupational Therapy Intervention
Chatham University, Pittsburgh, PA

15%

2394

Levels of Evidence

46%

Percentage of Participants of

Each Gender

(n=16)

56%

Level II (n=6)

■ Level IV (n=3)

Mixed Methods

■ Male (n=9)

**■** Female

(n=7)

■ Level III

(n=1)

(n=1) ■ Qualitative

(n=2)



## **SETTING & BACKGROUND**

## Setting

- Suburban public-school district south of Atlanta, Georgia
- · 42,000+ students district wide
- 28 elementary schools
- Average of 20-22 students in each class

## Background

- Large number of occupational therapy referrals for handwriting (Asher, 2006)
- Lack of formalized instruction and increased demands related to higher prevalence of handwriting difficulty (Asher, 2006)
- Electronic device use is highly motivating for students even though it appears to have a mixed impact on fine motor development (Butler, Pimenta, Tommerdahl, Fuchs, & Cacola, 2019; Karlsdottir & Stefansson, 2002; Lin et al., 2017)
- Handwriting skills are an important occupational task for students within their school day (Randall, 2018)
- Explicit handwriting instruction combined with app-usage that provides accurate instruction is an effective way to improve handwriting legibility (Jordan, Michaud, & Kaiser, 2016)

## **PICO QUESTION**

Do kindergarten students (P) who participate in traditional handwriting instruction supplemented by a tablet-based application which teaches letter formation (I) demonstrate improved legibility (O)?

## SIGNIFICANCE TO OT

- Determine the effectiveness of supplementing traditional handwriting instruction with practice utilizing a tablet-based application for letter formation.
- Increase the knowledge base of school-based occupational therapists on evidence-based interventions to improve handwriting legibility
- Increase collaboration with teachers to allow occupational therapists to support whole classrooms of students.

## LITERATURE REVIEW

## **CAT Portfolio**

- 13 Articles
- Published between 2002-2019
- Direct support: 8 Articles
- · Indirect Support: 5 Articles

#### Themes:

- Inconsistency of handwriting instruction in early education
- Perceptions of teachers related to handwriting instruction
- Occupational Therapist collaboration with Teachers
- · Use of Technology
- Evaluation and Outcome Measures

## **DESIGN & IMPLEMENTATION**

44%

## Participants:

- 16 Kindergarten students
- 10 students in general education;
- 6 with additional services
- 1 with Occupational Therapy

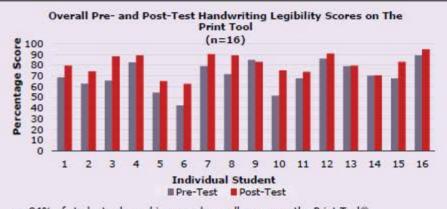
## Project Implementation:

- Small group lessons for 5 weeks
- Focused on lower case letter formation
- Rotating traditional and app-based instruction sessions
- Collaboration with classroom teacher and paraprofessional

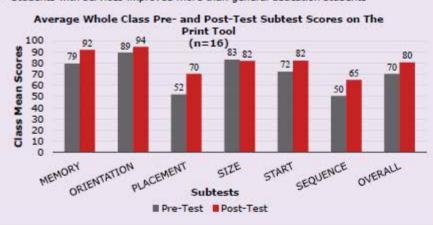
## Outcome Measures:

- Pre-test/post-test design
- The Print Tool® by Learning Without Tears™
  - · Subtests: memory; orientation, placement, size, starting point, and sequence
  - Overall Score

## **OUTCOMES**



- · 94% of students showed increased overall scores on the Print Tool®
- · 94% of students improved in letter sequencing
- 81% of students improved in memory and placement
- Students with services improved more than general education students



## SUMMARY

- · 15 out of 16 students (94%) showed improvement in overall scores
- · Only the size subtest showed a decrease in skill
- Traditional handwriting instruction supplemented with an application-based instruction method is effective to improve handwriting legibility in kindergarten students.
- A handwriting program that provides explicit instruction and is reinforced through practice on an application would benefit kindergarten students.