

# EFFECTIVENESS OF A STRUCTURED MULTISENSORY HANDWRITING CURRICULUM ON HANDWRITING SKILLS OF KINDERGARTEN STUDENTS

*Denise Donica*

East Carolina University, NC, US

## ABSTRACT

Fostering educational development and advancement of students is one of the many roles of teachers in America today. Delivering the necessary academic content at an appropriate developmental level to promote foundational skill achievement in kindergarten is not a simple task. Because of changes in education, ability of kindergarten teachers to provide the most effective instruction requires a combination of new skills, creativity, patience, flexibility, and compassion. One critical skill, handwriting, is a foundational skill introduced in kindergarten.

One half-day kindergarten program at a private school recognized the importance of the development of handwriting skills and the challenges of students to produce written language. This school decided to implement a multisensory, developmentally-based handwriting curriculum in order to teach kindergarten students the foundational handwriting skills necessary to foster academic achievement. As the teachers embarked on a journey of improving the classroom education for their students, data were collected on student performance for comparison with a control group who had not used this multisensory curriculum. This article will explore the importance of handwriting skills, the handwriting curriculum used in the study, and the research that substantiates the use of a multisensory handwriting curriculum to build the foundational skills necessary in kindergarten for future academic success. Implications for educators of kindergarten students will be discussed as well as directions for future research.

## INTRODUCTION

The kindergarten classroom is an amazing and unique place where children from various backgrounds, skill levels, learning styles, interests, and personalities come together with a common purpose: to learn. Even though a common purpose is shared, the teaching methods, expectations, and challenges within a kindergarten classroom have changed and evolved over the years.

Historically, kindergarten had served as a major life transition point for students. Traditionally, this was the first significant separation from the home environment and full-

time care of the parent(s). It also served as the stepping-stone from home to the public elementary school. Students were exposed to new challenges such as getting along with others, working as a team, and learning basic classroom rules such as raising a hand to talk (Graue, 2010). As American culture has advanced, so has the curriculum and expectations of kindergarten students.

With advances in technology and changes in curriculum demands, some foundational skills are becoming neglected in kindergarten classrooms (Kiss, 2007). One important foundational skill that permeates through all academic curriculums is the ability to produce written language: handwriting. Research has demonstrated handwriting instruction is important not only for motor skill development but also neurological development of children (James, 2009). Research has also indicated that handwriting fluency challenges have a significant impact on composition length and quality; thus indicating a strong relationship between handwriting fluency which requires mastery of handwriting mechanics, and writing quality which incorporates ideation (Berninger, 2000; Graham, Harris, and Fink, 2000; Rosenblum, Weiss, and Parush, 2003). However, teachers are reporting little time available to teach this skill as well as limited training in handwriting instruction (Asher, 2006; Donica, Larson, and Zinn, 2012; Graham, Harris, Mason, Fink-Chorzempa, Moran and Saddler, 2008). In addition, multiple learning styles and achievement levels of kindergarten students creates a challenge for teachers to provide differentiated instruction to meet the needs of all students in a skill area not regularly taught to teachers. However, the demands for legible handwriting skills are critical for future academic success. This chapter will explore kindergarten classrooms past and present and will conclude with results of a research study that examined the effectiveness of one multisensory, developmentally-based handwriting curriculum.

## LITERATURE REVIEW

### The Importance of Handwriting Skills

As established by research, the importance of handwriting skills remains evident in American culture, especially for students (Cahill, 2009; Case-Smith, 2002; Graham et al., 2000; Hoy, Egan and Feder, 2011; James, 2009; Naidoo, Engelbrecht, Lewis and Kekana, 2009). Research supports this importance in a variety of ways. First, when analyzed, approximately 30%-60% of a typical school day required the use of fine motor skills. More importantly, 85% of the activities which required fine motor skills included handwriting and writing skills (McHale and Cermak, 1992). However, research indicates anywhere from 10%-34% of students have difficulty with handwriting (Parush, Lifshitz, Yochman, and Weinrub, 2010; Smits-Engelsman, Niemeijer and Van Galen, 2001). To further validate the impact of handwriting skills, the World Health Organization (2002) has identified writing difficulties as a limit to school performance (as cited in Clark, 2010) which was supported by prior research regarding the impact of handwriting fluency on writing skills (Berninger, 2000; Graham et al., 2000; Rosenblum et al., 2003).

Limited handwriting skills can negatively impact a student's school performance. Students who have not mastered the mechanics of handwriting have difficulty shifting

attention from these basic mechanics to composition, ideation, planning, and organizing written text (Jones and Christensen, 1999; Medwell and Wray, 2007). Kindergarten is a critical time to address this skill because students who demonstrate poor handwriting skills in kindergarten often continue to demonstrate poor handwriting skills in first grade (Marr and Cermak, 2003). Therefore, performance at the kindergarten level sets the precedence for future performance. Limitations in writing speed can also limit a student's ability to complete time sensitive evaluations and assignments thus tainting the true representation of student abilities (O'Mahony, Dempsey, and Killeen, 2008).

Illegibility is another primary factor that limits student performance. Multiple studies indicate how a teacher's grading of written work may be reflective of handwriting legibility when content is held constant (Chase, 1986; Graham et al., 2000). Students with handwriting difficulties may not only struggle with the aforementioned components of school, but it may also impact their emotional well-being and social functioning (Cornhill and Case-Smith, 1996).

Handwriting skills are also linked to reading abilities. Research has indicated that reading skills are significantly correlated to handwriting skills and students at risk for reading challenges are also a risk for handwriting challenges (Berninger, 2000; Clark, 2010). Clark (2010) reviews and expands on this link between reading and writing indicating they both share some important concepts. Understanding the alphabet principle, linking letters to sounds and words, is critical to both reading and handwriting. Letter names and phonemes are important to both reading and writing tasks (Berninger, 2000; Fitzgerald and Shanahan, 2000). Handwriting was also significantly correlated with word recognition (Berninger, 2000). However, in kindergarten classrooms the reading skills are addressed much more effectively than handwriting skills (Clark, 2010).

## **Handwriting and Academic Standards**

Common Core includes many standards that necessitate mastery of written language for success. Based on the kindergarten Common Core language standards, students are expected to print many upper and lowercase letters, capitalize, recognize punctuation, and spell phonetically by the end of the year. This is the precursor to the first grade expectation to print all upper and lowercase with correct capitalization and punctuation. These foundational handwriting skills provide the structure for future writing success at upper grades that span across content areas including opinion papers, narratives, research, and math skills (NGA Center and CCSSO, 2010).

In addition to written expression, skills necessary for handwriting are also foundational for reading. These skills, noted in the Common Core standards, include following words top to bottom and left to right on the page, understanding words are separated by spaces, and recognizing and naming all upper and lowercase letters (NGA Center and CCSSO, 2010).

A definition of what constitutes proficient handwriting has been the subject of research and controversy over the years. The two most commonly accepted aspects of good handwriting are speed and legibility. Naidoo et al. (2009) defines legibility as "general appearance, accuracy, size, slant, rhythm, reversals, and preservation" (p. 20). In addition, speed and fluency with handwriting are required for effective written expression (Berninger, 2000; Graham et al., 2000). Even though there are not a multitude of Common Core standards

that specifically dictate handwriting legibility achievements, the process of handwriting is a necessary foundational skill that supports academic success through the Common Core Standards. Because of the impact of handwriting skills on reading, writing, social and emotional skills, math, and other language skills, it is critical that handwriting be instructed in a method offering opportunity for future academic success (Berninger, 2000; Chase, 1986; Clark, 2010; Cornhill and Case-Smith, 1996; Fitzgerald and Shanahan, 2000; Graham et al., 2000).

## **College Training for Teachers**

College education programs for teachers historically have taught handwriting skill instruction to upcoming teachers (Donica, 2010a; 2010b). However, recent surveys of teachers have indicated that only 12-35% of teachers are receiving training in college on handwriting instruction (Graham, et al., 2008; Donica, Larson, and Zinn, 2012). Not only are the children entering the classroom with such a variety of skill levels (NAEYC, 1998), but the teachers are not prepared to teach handwriting skills to the average student, let alone those that require differentiated instruction. Teachers also indicated that although many of them did not receive training in handwriting skills, 94.6% of them felt that handwriting skill instruction was important for upcoming teachers to receive in their college education programs (Donica et al., 2012). This is a missing component in efforts to improve the foundational skill of handwriting.

## **Handwriting Curriculum**

Due to the importance of handwriting and the incidence of students with handwriting challenges, there has been much debate and study over the best way to instruct handwriting skills. There are two common approaches to handwriting instruction: a cognitive function approach and a multisensory approach. The cognitive function approach utilizes visual cues, self-instruction strategies, self-monitoring, and a task oriented approach that requires direct instruction and practice (Wientraub et al., 2009). The multisensory approach utilizes sensory experiences, media and instructional materials (Amundson, 2005). The aim of the multisensory approach is to offer different sensory experiences so the sensory input is integrated through the nervous system thus facilitating effective execution of motor skills (Amundson, 2005). Although research is conflicting regarding which approach is more effective (Weintraub, et al., 2009; Woodward and Swinth, 2002; Zwicker and Hadwin, 2009), the Handwriting Without Tears® program has elements of both approaches integrated in one curriculum.

Handwriting Without Tears®, known to and utilized by both teachers and occupational therapists, was developed in the 1970s by occupational therapist Jan Olsen (Donica, 2010b; Olsen and Knapton, 2008). Handwriting Without Tears® (HWT) utilizes a cognitive function approach including visual cues, self-monitoring, and direct teacher demonstration followed by student practice. In addition, HWT includes a multisensory approach to assist through the use of hands-on manipulatives, music, and consistent child-friendly language in addition to addressing posture, pencil grasp, and the use of the non-dominant hand (Donica, 2010b;

Olsen and Knapton, 2008). The capital letters are taught first as they are deemed easiest (Olsen and Knapton, 2008; Clark, 2010). Letters are then taught in groups based on level of difficulty, frequency in use, and beginning stroke (Olsen and Knapton, 2008). Since its development, the program has grown to include a preschool readiness program and a full curriculum for kindergarten through fifth grade (Donica, 2010b).

Research has been published on the HWT curriculum, but there has been little research on the effectiveness of HWT with kindergarten-aged students. Both Kiss (2007) and Benson, Salls and Perry (2010) found that the teachers' perceptions of HWT included that it was easy to use and had a positive effect on their students' handwriting. When looking at program effectiveness, Lust and Donica (2011) determined that the Handwriting Without Tears® – Get Set For School preschool program had significant positive impacts on handwriting development when implemented two times per week in a Head Start classroom. However, due to this limited body of research to support the curriculum selection process of school administration, the research study described in this article was conducted to broaden the research base for effectiveness of a handwriting curriculum to enhance the handwriting skills of kindergarten students. One hope is that this study may help administrators execute evidence-based decision making when determining appropriate curriculum and teaching methods for their kindergarten classrooms.

It is clear that the development of handwriting skills is important to the role of students. Research described within this article shows how much time is spent utilizing these skills, the relationship of these skills to other critical developmental skills, and the frequency of challenges demonstrated by students. Often, because of the frequency of handwriting challenges, students are referred to occupational therapy within the school system to evaluate and address handwriting and associated motor skills. While this process is effective for students who have underlying deficits which manifest through poor handwriting skills, many students may effectively learn the skill of handwriting through a structured, developmentally appropriate, and multi-sensory curriculum.

## Purpose

The purpose of this study was to determine if kindergarten students who were educated in the classroom using the Handwriting Without Tears® (HWT) curriculum would demonstrate better handwriting skills than students who were not educated through a formal developmentally-based handwriting curriculum. Specific research questions included:

1. Will students who participated in handwriting instruction using HWT demonstrate better overall legibility than students who did not?
2. Are there specific handwriting skills (ie. letter, number, word, or sentence writing) that were significantly better for students using HWT than those in the control group?

It was hypothesized that the students who participated in the HWT formal handwriting instruction would demonstrate higher scores overall on a handwriting legibility assessment than students who did not receive the formal handwriting instruction. In addition, specific

handwriting skills were hypothesized to be better for students in the HWT experimental group than the control.

## METHOD

### Research Design

A static group comparison was used for this study. A control group and manipulation of an independent variable occurred; however, there was not randomization due to the logistics of the study and no pretest scores were secured since the data collection had not begun at the appropriate time to conduct a pre-test with the control group. The participants were kindergarten students at a half-day kindergarten program in a private school in eastern North Carolina. This half-day schedule accentuated some of the aforementioned teaching challenges including time constraints to include developmentally appropriate content to meet the academic standards. The HWT curriculum required 15 minutes per day of teacher instructional time. The student participants completed the Test of Handwriting Skills – Revised (THS-R) (Milone, 2007) administered to the entire class near the conclusion of their kindergarten year. The research study was approved by the university Institutional Review Board and it was identified as less than minimal risk.

### Procedure

Students were selected out of convenience for participation in this study. There were two cohorts of students, one year apart. The same teachers taught both cohorts. The first cohort, the control group, included two classrooms of half-day kindergarten students who received handwriting instruction through the use of handwriting worksheets generated in the D'Nealian style of writing. The control group included 25 total students who received traditional handwriting instruction and then was tested at end of the academic year with THS-R.

The second cohort, the experimental group, received HWT curriculum and then was tested at end of the academic year with THS-R. The experimental group consisted of 28 kindergarten students. The independent variable was the handwriting curriculum implemented while the dependent variable was the score on the THS-R. Demographic characteristics of the two groups are identified in Table 1.

Although the THS-R assessments were coded and scored blindly, the two cohorts were scored by trained occupational therapy graduate students at different times, so the scorers were not blind to the cohort. However, this kindergarten study was part of a larger study including first grade THS-R assessments as well as additional administrations of the THS-R with the experimental cohort. Therefore, even though the scorers were aware of the year of the assessments they were scoring, they were blind to the grade level or the specific timing during the academic year the assessment occurred. Although no formal inter-rater reliability was calculated between the two scorers, both were trained by the author and by the DVD included in the assessment. They both scored four sample handwriting assessments and

discussed their differences in scoring for consistency prior to scoring the participants' assessments. The scorers were randomly assigned assessments to score but the author ensured that there was an equal mix (by classroom and assessment time) of assessments for each scorer to complete.

**Table 1. Characteristics of Control and Experimental Groups**

Variable	Control (n=25)	Experimental (n=28)
Age in months <i>M</i> (SD)	75.73 (5.3)	73.43 (3.1)
	<i>n</i> (%)	<i>n</i> (%)
Gender		
Male	19 (76)	16 (57)
Female	6 (24)	12 (43)
Hand Dominance		
Left	4 (16)	2 (7)
Right	21 (84)	26 (93)

## Curriculum Implementation

Prior to the implementation of HWT within the experimental group, the two kindergarten teachers attended a full-day workshop on the HWT curriculum, which included information on the kindergarten curriculum. This workshop was designed to help teachers understand the fundamentals of the program, the developmental sequence, and multisensory components. It provided a foundation for them to integrate the curriculum into their classrooms. Some degree of training is recommended by Handwriting Without Tears® to help answer questions and facilitate this integration of the new curriculum; however, training is not required to use the program.

During the 2011-2012 school year, the kindergarten teachers implemented the HWT kindergarten handwriting curriculum into their respective classrooms. Implementation was approximately 15 minutes daily. Each lesson typically began with a gross motor activity coordinated with a handwriting related song on the Rock, Rap, Tap, and Learn CD, which is part of the curriculum. Next, a learning activity was implemented following the Teaching Guidelines (Olsen and Knapton, 2008) as a guide. The learning activity may be specific letter formations with multisensory manipulatives (i.e., rolling dough, chalk and slate, wooden pieces to form capital letter) or writing in the uniquely designed workbook. In addition, an occasional review activity often with manipulatives was used as a morning work activity. One time per week a registered occupational therapist and/or two occupational therapy graduate students were present in the room during the 15 minute handwriting instruction time. This presence allowed the occupational therapy personnel to answer questions regarding the implementation of the curriculum as well as to provide occasional assistance to struggling writers. The teachers worked together to develop their lesson plans based on the HWT teacher's guide. These lesson plans were then implemented by the classroom teachers. In

order to address fidelity to instruction, approximately one lesson per week was observed by the author.

## **Instruments**

The Test of Handwriting Skills-Revised (THS-R) was designed to assess a child's neuorsensory integration skill and can be used to test both manuscript and cursive writing. For this study, the manuscript component was used (Milone, 2007). The test is standardized for children ages 6 years 0 months to 18 years 11 months. Students were asked to write both upper and lower case letters in alphabetical order from memory, a non-alphabetical sequence of all upper and lower case letters from dictation, and a non-numerical sequence of 8 numbers. In addition to the writing tasks requiring visual memory, students were asked to copy twelve uppercase letters, copy ten lowercase letters, copy six lowercase words, copy two sentences, and write six words from dictation (but not spelled aloud) (Milone, 2007). All of the writing tasks were done on pages within the testing manual that had no lines for letter placement. Therefore, letter legibility and scoring did not include a measurement of alignment. In addition, the test booklet has pages indicated by picture instead of letter or number as to not provide a cue for the student during assessment. However, because of imposition upon the teacher's time and classroom to remove all of the letter and number displays as well as all of the name plates on the desks that also included these models, letter and number displays were not removed from the classroom walls during testing either control or experimental groups. The THS-R was administered over about an hour to all students within the each class simultaneously (one class at a time) by a single administrator.

The Test of Handwriting Skills-Revised provides an overall standard score, scaled subtest scores for each of the 10 subtests, and subsequent percentile scores. The test norms are a nationally stratified sample of 1,500 students. This standardized test also has established reliability and validity. The test-retest reliability was found to be 0.82 for the total test score with an interrater reliability that ranged from 0.75 to 0.90 based on the authors of the assessment (Milone, 2007). The authors of the test indicate that content validity is built into the test by careful consideration of task design and whether or not the task may engage other behaviors that can confound the results. They suggest that with a task like handwriting it is almost impossible to assess visual and motor abilities independently from one another. The tasks of the test were designed to be common to a wide variety of students in a standard academic setting as to minimize confounding of results (Milone, 2007). Although standard scores are ideal, most of the student participants in this study were not 6 years of age at the time of testing. Therefore, the results are presented in raw scores.

## **RESULTS**

The subtest raw scores and total raw scores of the THS-R (Milone, 2007) were used for data analysis as opposed to the standard and scaled scores. When looking at the data, initially, comparisons were made between the groups for the total raw scores representing overall handwriting legibility. In addition, analysis was completed on each subtest to identify specific skills within handwriting that reflected differences between groups. The mean (M) and

standard deviation (SD) for each subtest and overall is reported in Table 2. When controlling for age and gender, ANCOVA was used to determine significance as indicated in Table 2.

**Table 2. ANCOVA Results for Mean Raw Score Differences between Kindergarten Control (n = 25) and Experimental (n = 28) Groups**

THS-R Subtest	Control M(SD)	Experimental M(SD)	Adjusted p	Treatment Effect ( <i>d</i> )
Airplane- UC letters from memory alphabetical	43.4 (11.6)	51.8 (7.3)	.002	.90
Bus - LC letters from memory alphabetical	43.1 (11.7)	52.6 (11.3)	.012	.84
Butterfly - UC out of sequence from dictation	41.7 (11.2)	49.8 (8.0)	.011	.86
Frog – LC out of sequence from dictation	44.3 (9.0)	47.7 (13.0)	.183	.31
Bicycle – Single digit numbers from dictation	17.5 (4.2)	18.0 (3.2)	.264	.14
Tree – Copy selected UC letters	25.6 (4.0)	28.8 (2.8)	.002	.96
Horse – Copy selected LC letters	18.6 (3.1)	20.7 (3.4)	.007	.66
Truck – Copy words from a model	41.8 (7.6)	43.8 (5.5)	.312	.31
Book – copy sentences from a model	57.6 (9.0)	62.5 (8.1)	.193	.59
Lion – Writing words from dictation	32.8 (12.9)	40.9 (9.6)	.056	.73
Raw Total	366.3 (54.9)	415.1 (44.5)	.002	1.00

Note. UC= upper case; LC = lower case; M = mean; SD = standard deviation. For all results  $p < .05$  is significant.

The treatment effect was also calculated for each subtest and the overall score of the THS-R. This calculation was calculated using Cohen's *d*. This calculation serves as a frame of reference for the effect of the independent variable and is valuable due to the small sample size. The effect size is indicated as small if  $.20 \leq d \leq .49$ , medium if  $.50 \leq d \leq .79$ , and large if  $d \geq .80$  (Cohen, 1992; Thalheimer and Cook, 2002).

The total raw score for the experimental group was significantly higher than the control group (See Table 2). With such a large difference between the control and experimental total raw scores ( $M_s \pm SD_s = 366.3 \pm 54.9$  control and  $415.1 \pm 44.5$  experimental,  $p = .002$ ), each subtest mean was compared to determine significance for the specific skills addressed. The total raw score demonstrated a large treatment effect ( $d = 1.00$ ). The experimental group subtest scores reflected higher raw score means when compared to the control group for all subtests (See Figure 1). ANCOVA showed significant differences for 5 out of the 10 subtests ( $p < .05$ ). The subtests with significant differences included the skills of writing upper and lowercase letters from memory with a large treatment effect for both (upper case  $d = .90$ ; lower case  $d = .84$ ), writing upper case letters from dictation with a large treatment effect ( $d = .86$ ), copying selected upper and lowercase letters with large and medium treatment effects respectively (upper case  $d = .96$ ; lower case  $d = .66$ ). The 5 subtests that did not show

significant differences included writing lowercase letters out of sequence from dictation with a medium treatment effect ( $d = .31$ ), copying words from a model with a medium treatment effect ( $d = .31$ ), and printing numbers out of order from dictation with no treatment effect ( $d = .14$ ), and copying sentences with a medium treatment effect ( $d = .59$ ). The subtest of writing words from dictation was approaching significance with a medium treatment effect ( $d = .73$ ).

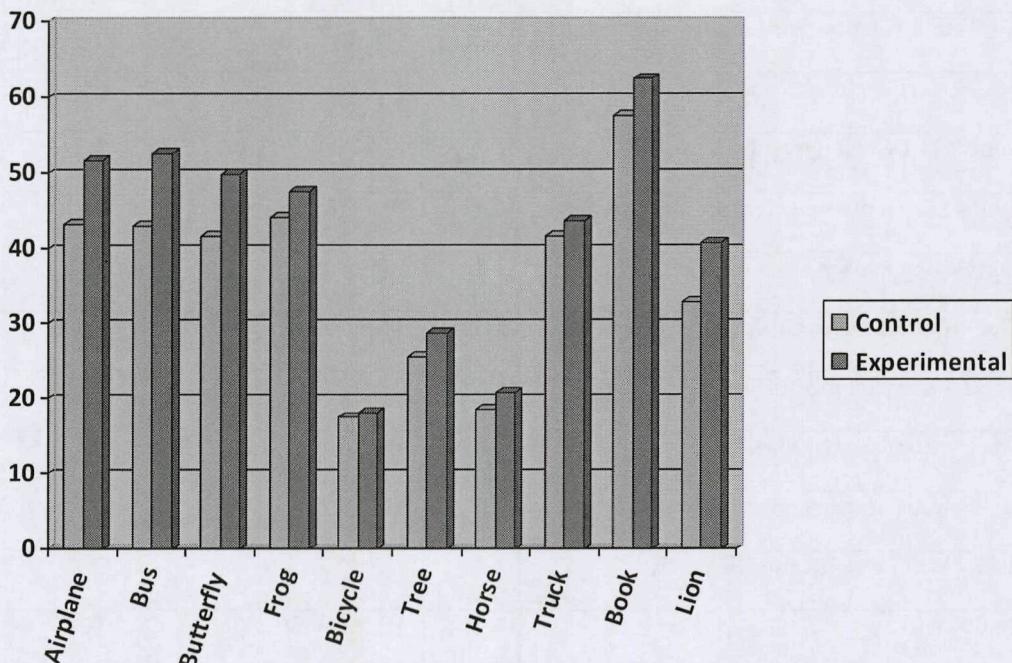


Figure 1. Comparison of raw score means for the experimental and control groups on the subtests of the Test of Handwriting Skills – Revised (Milone, 2007).

## CONCLUSION

This study looked at the effectiveness of the Handwriting Without Tears® (HWT) curriculum in a half-day kindergarten program after one full year of handwriting instruction. From the results, it is evident the kindergarten students who were taught using the HWT curriculum had significantly higher scores on the THS-R for handwriting legibility than those who used only the D'Nealian style with no formal handwriting program. Even though the experimental group was an average of 2 months younger than the control, the experimental group outscored the control on all subtests and total raw scores with 5 of the 10 subtests reflecting significant differences when adjusting for age and gender ( $p < .05$ ). This data supports prior research (Benson et al, 2010; Lust and Donica, 2011) showing the effectiveness of the HWT program on student's overall handwriting abilities. The results support both hypotheses that kindergarten students receiving HWT instruction would outscore the control group overall as well as with specific subtest performance.

When reflecting on the subtest data, explanations for results are as follows. Since the HWT curriculum begins with capital letter formations through multiple media, it is not

surprising that the experimental group outscored the control group on subtests involving the printing from memory and copying uppercase letters. Because research supports the repetition of letter writing for improved letter memory (James, 2009), this finding is to be expected, especially for the airplane subtest where students wrote the uppercase letters from memory in alphabetical order.

Of the 10 handwriting subtests, four clearly did not reflect significance between groups and one was approaching significance. Number writing was a subtest where the scores of the experimental group were not significantly higher than the control. In the math curriculum used in these particular kindergarten classrooms, number writing is required very early in the school year. Because of the placement of the numbers in the HWT curriculum being very flexible and their location being in the back of the workbook, the numbers were not introduced through the handwriting curriculum until the spring. Therefore, the students were not actually instructed how to form their numbers through the HWT curriculum, but through the math curriculum. The HWT curriculum introduction of numbers would have been review rather than new learning due to timing. Therefore, both groups would have learned the printing of the numbers in the same manner, through the math curriculum. As a result, it is not surprising that there was not a significant difference between the mean scores of the two groups on this subtest.

Copying words from a model, copying sentences from a model, and writing words from dictation are more advanced skills. Even though the experimental group outscored the control on all three of these subtests, the differences were not significant. It was noted for the experimental group that the teachers expressed how pleased they were with the students' progress in the curriculum and how well they were doing when sentence writing during the second half of the year.

## Limitations

Although the hypotheses were supported, there were limitations to this study, which need to be recognized. Because this study was conducted in a private school setting, there was a smaller teacher to student ratio than the public school setting. However, this ratio was consistent between the experimental and control groups. The number of total students in each group was also relatively small.

Another limitation involves the introduction of a formal handwriting curriculum. Teachers involved in the study received training on the HWT curriculum prior to the implementation with the experimental group but after the year of instruction with the control group. Also, occupational therapy support was provided once per week to the teachers to answer questions regarding implementation of the curriculum. This support was not provided to the control group.

Interpretation of the data is limited by the lack of a pre-test and randomization of students into groups. However, statistical analysis controlled for differences in gender and age which are typically known to play a role in skill development. Handedness was considered as a confounding variable but there were relatively few students in each group who were left-handed (See Table 1) so this is noted but not controlled for within the analysis.

Last, the THS-R is a handwriting assessment that is not standardized for children younger than 6 years of age. This limited the use of the standard scores in data analysis. Also, the copy

sections of the THS-R depicted letters in a style more similar to the HWT style of print than the D'Nealian slanted style of print. However, the scoring of the assessment allowed credit for either style of writing. Another limitation is the small sample size and the impact that this has on power analysis.

## **Implementations for Education**

As academic standards continue to impact kindergarten education and new challenges unfold for kindergarten teachers, evidence-based curriculum is important to impact teaching methods for the kindergarten classrooms. As the foundational skill of handwriting is a critical skill not only in development but also academic achievement, discovering successful methods of handwriting instruction are very important. This study focused on the use of a handwriting curriculum that included both cognitive function approach and the multisensory approach, which are both documented in education literature. The data from this research study supports the use of Handwriting without Tears as a curriculum that can be implemented by the teacher into a day already limited by time constraints. More generally, it supports the use of using a structured handwriting program to facilitate writing success of students. The results of this study may be helpful to administrators when considering effective curriculum for the kindergarten classroom that helps meet the demands of both teacher-directed academically related content as well as student-directed developmentally appropriate tasks. This study also supports the teachers understanding the handwriting process and how to effectively teach that to a diverse group of learners. As the culture, demands, and environments change, so must the methods of instruction to help promote the successful students of the future.

## **Future Research**

The data collected from this pilot study revealed some interesting discoveries. Collecting data on a larger and more diverse group of students will assist in the generalizability of the results to multiple settings and populations. Future studies could also compare the long-term effects of the Handwriting Without Tears® program. The data could be collected from multiple intervals to reveal the maintenance of the effects of the handwriting program as students continue their educational careers. This would help to determine the effects of using the curriculum in multiple grades and determine the benefit of using it consistently not just during the kindergarten year. Although research has already been done on teacher perceptions of using the HWT program, adding that component to a quasi-experimental research study would add to the richness of the data. Handwriting is a critical skill that continues to play an important role in education and future research will help determine how this skill can be effectively incorporated into instruction to maximize student performance.

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*Reviewed by: Dr. Sara McCraw and Dr. Suzanne Hudson of East Carolina University and Dr. Jana Cason of Spalding University.*

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