CARRY-OVER EFFECT OF A HANDWRITING READINESS PROGRAM ON HANDWRITING-RELATED SKILLS OF CHILDREN THE YEAR FOLLOWING INTERVENTION

by

Whitney Shay Lear

November, 2012

Director of Thesis: Denise Donica, DHS

Major Department: Occupational Therapy

The purpose of this follow-up study was to determine if children who had participated in an occupational therapy based handwriting readiness program would show greater improvements in handwriting-related skills a year following intervention when compared to a control group and an alternate experimental group. The entire study (initial study and follow-up study) was a time series longitudinal design with 4 data collection points. Sixteen children (4 from the control group, 6 from the experimental group, and 6 from the alternate experimental group) were tested in September 2010, received intervention, and were again tested in March 2011 during the initial study. This follow-up study then included 2 more post-testing sessions in September 2011 and in March 2012. Testing sessions included the Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI) and four of the eight subtests from the Bruininks–Oseretsky Test of Motor Proficiency – Second Edition (BOT-2). All children completed all

testing at the first session of the initial study in September 2010, participated in the intervention during the initial study, and completed all tests at both testing sessions for this follow-up study in September 2011 and in March 2012. (At the second testing session in March 2011, 2 children did not complete the Upper-Limb Coordination Subtest of the BOT-2 and 1 child did not complete the Fine Motor Integration Subtest or the Fine Motor Precision Subtest of the BOT-2). The dependent variables were the scores received on the VMI and the Fine Motor Precision Subtest, Fine Motor Integration Subtest, Manual Dexterity Subtest, and Upper-Limb Coordination Subtest of the BOT-2. The independent variable was the handwriting instruction program in which the child participated during the initial study.

Data analysis indicated that children who participated in the Fine Motor and Early Writing (FMEW) Pre-K curriculum (experimental group) showed greater improvements in median scores on the BOT-2 Fine Motor Precision and Manual Dexterity subtests from the end of the intervention year to one year following intervention when compared to the control group and the alternate experimental group. Both the VMI and the Fine Motor Integration and Upper-Limb Coordination subtests of the BOT-2 showed the control group with the greatest median change in scores.

It is difficult to draw conclusions from the results of this study, as limitations including a lack of randomization between the three groups leading to considerable differences in age and gender strongly affected results, leading to inconclusive data about the effects of the FMEW curriculum on handwriting-related skills of children one year following intervention.

CARRY-OVER EFFECT OF A HANDWRITING READINESS PROGRAM ON HANDWRITING-RELATED SKILLS OF CHILDREN THE YEAR FOLLOWING INTERVENTION

A Thesis

Presented To the Faculty of the Department of Occupational Therapy

East Carolina University

In Partial Fulfillment of the Requirements for the Degree

Masters of Science in Occupational Therapy

by

Whitney Shay Lear

November, 2012

CARRY-OVER EFFECT OF A HANDWRITING READINESS PROGRAM ON HANDWRITING-RELATED SKILLS OF CHILDREN THE YEAR FOLLOWING INTERVENTION

by

Whitney Shay Lear

APPROVED BY:

DIRECTOR OF THESIS: _____

Denise Donica, DHS

COMMITTEE MEMBER: _____

Carol Lust, Ed.D

COMMITTEE MEMBER: _____

Mary Hildebrand, OTD

COMMITTEE MEMBER: _____

Paul Vos, PhD

CHAIR OF THE DEPARTMENT OF OCCUPATIONAL THERAPY:

_____

Leonard Trujillo, PhD

DEAN OF THE GRADUATE SCHOOL: _____

Paul J. Gemperline, PhD

ACKNOWLEDGEMENT

I would like to thank Dr. Denise Donica for all of her guidance and support throughout this process, Dr. Vos for his time and help with the data analysis for this study, and lastly I would like to thank the parents and children who gave their time and participated in this study.

TABLE OF CONTENTS

ACKNOWLEDGMENT…… vii

LIST OF FIGURES…… xi

LIST OF TABLES…….. xii

CHAPTER 1: INTRODUCTION…….…….. 1

CHAPTER 2: LITERATURE REVIEW……. 5

The Importance of Good Handwriting Skills…….…….. 5

The Importance of Formal Handwriting Instruction……..……. 11

State and National Standards for Handwriting…….…….. 13

Handwriting Instruction Programs and Curriculums…….. 15

The Relationship Between Fine Motor Skills and Handwriting Difficulties…….. 16

CHAPTER 3: METHODS…….. 22

Design…….…… 22

Subjects……... 26

Instrumentation……... 27

Beery-Buktenica developmental test of visual-motor integration – sixth edition 27

Bruininks–Oseretsky test of motor proficiency-second edition…… 29

Procedure…… 30

CHAPTER 4: RESULTS……..... 37

Description of the Sample……... 37

Data Analysis…….. 38

The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI) Results……. 40

VMI line plot……... 40

VMI mean scores……..... 40

VMI side-by-side box plot…….. 42

The Bruininks-Oseretsky Test of Motor Proficiency – Second Edition (BOT-2) Results……. ……... 43

Fine Motor Precision line plot……..... 43

Fine Motor Precision mean scores…….. 44

Fine Motor Integration line plot…….. 45

Fine Motor Integration mean scores……... 46

Manual Dexterity line plot……. 47

Manual Dexterity mean scores…… 48

Upper-Limb Coordination line plot…… 49

Upper-Limb Coordination mean scores…….. 50

Fine Motor Precision side-by-side box plot……...……. 52

Fine Motor Integration side-by-side box plot…….…… 53

Manual Dexterity side-by-side box plot……. 53

Upper-Limb Coordination side-by-side box plot…… 54

CHAPTER 5: DISCUSSION…….. 56

REFERENCES……... 64

APPENDIX A: DEFINITIONS OF TERMINOLOGY……. 72

APPENDIX B: PARENTAL/GUARDIAN CONSENT FORMS AND LETTERS…….. 73

APPENDIX C: IRB APPROVAL LETTER…….. 76

LIST OF FIGURES

1. Ages in Months in Spring 2012…….. 38

2. VMI Raw Scores……. 41

3. VMI Raw Score Changes from Test 2 to Test 4……. 43

4. BOT-2 Fine Motor Precision Subtest Total Point Scores……..…… 44

5. BOT-2 Fine Motor Integration Subtest Total Point Scores…….…….. 46

6. BOT-2 Manual Dexterity Subtest Total Point Scores……. 48

7. BOT-2 Upper-Limb Coordination Subtest Total Point Scores……... 51

8. BOT-2 Fine Motor Precision Subtest Scaled Score Changes from Test 2 to Test 4….. 52

9. BOT-2 Fine Motor Integration Subtest Scaled Score Changes from Test 2 to Test 4... 53

10. BOT-2 Manual Dexterity Subtest Scaled Score Changes from Test 2 to Test 4……... 54

11. BOT-2 Upper-Limb Coordination Subtest Scaled Score Changes from Test 2 to Test 4 55

LIST OF TABLES

1. VMI Raw Scores of All Groups for All Testing Sessions……. 42

2. VMI Mean Change in Raw Scores from Test 2 to Test 4…….. 42

3. VMI Median Change in Raw Scores from Test 2 to Test 4……... 43

4. BOT-2 Fine Motor Precision Subtest Total Point Scores of All Groups for All Testing Sessions……... 45

5. BOT-2 Fine Motor Precision Subtest Mean Change in Total Point Scores from Test 2 to Test 4……... 45

6. BOT-2 Fine Motor Integration Subtest Total Point Scores of All Groups for All Testing Sessions…….. 47

7. BOT-2 Fine Motor Integration Subtest Mean Change in Total Point Scores from Test 2 to Test 4…… 47

8. BOT-2 Manual Dexterity Subtest Total Point Scores of All Groups for All Testing Sessions……... 49

9. BOT-2 Manual Dexterity Subtest Mean Change in Total Point Scores from Test 2 to Test 4……... 49

10. BOT-2 Upper-Limb Coordination Subtest Total Point Scores of All Groups for All Testing Sessions…….. 51

11. BOT-2 Upper-Limb Coordination Subtest Mean Change in Total Point Scores from Test 2 to Test 4…… 52

12. BOT-2 Subtests Median Change in Scaled Scores from Test 2 to Test 4……... 55

CHAPTER 1: INTRODUCTION

Children with handwriting difficulties are hindered in performing many school-related activities (Zwicker & Hadwin, 2009). In typically developing children, difficulty with handwriting is often seen as a lack of effort on the child's part (Zwicker & Hadwin, 2009). Judkins, Dague, and Cope (2009) found that 25% of typically developing children scored at least 1.5 standard deviations below the norm for their age group in handwriting skills, indicating that even typically developing children struggle with these skills. When children demonstrate poor handwriting legibility and classroom efforts to improve legibility do not result in substantial improvement, these children are typically referred to occupational therapy (Hammerschmidt & Sudsawad, 2004). In fact, difficulties with handwriting are cited as one of the most frequently mentioned reasons for the referral of school-aged children to school-based occupational therapy services (Feder, Majnemer, & Synnes, 2000; Missiuna, Pollack, Egan, DeLaat, Gaines, & Soucie, 2008; Schneck & Amundson, 2010). Holtzinger and Hight (2005) conducted a survey of five hundred school-based occupational therapists and found that excessively high caseloads affected one in three therapists. Many occupational therapists in schools are overwhelmed with large numbers of referrals for handwriting, which may impair the therapist's ability to work effectively (Asher, 2006). Traditionally, individualized handwriting instruction has been provided by occupational therapists after handwriting skill deficits resulted in a referral to occupational therapy services. However, if teachers provide more individualized handwriting instruction to meet the needs of children, handwriting abilities may improve without occupational therapy referrals, thereby alleviating referrals due to limited handwriting instruction that could be addressed in the classroom. This alleviation of unnecessary referrals may allow school-based occupational therapists to focus efforts on those children that most need their

services, with therapeutic handwriting intervention offered only for those who have difficulty with handwriting even after intensive practice in the classroom (Feder & Majnemer, 2007).

Research conducted by Case-Smith (2002) demonstrated the improvement of legibility of a child's handwriting through an eclectic occupational therapy intervention. However, this study and others similar have not addressed what type of intervention is most effective for producing the most successful outcomes for handwriting abilities, indicating the necessity for additional research on specific interventions used to improve handwriting intervention. Multisensory programs are often used in school-based occupational therapy programs, but there is a lack of research on these programs as well, further indicating the need to research the effects of this type of intervention (Zwicker & Hadwin, 2009). Furthermore, while there is research illustrating the importance of improving handwriting skills through specific handwriting interventions, little research has been done on the effects of structured handwriting programs using fine motor skill intervention. Research conducted by Winslow (2011) demonstrated a greater increase in mean total point scores received on the Fine Motor Integration Subtest and Manual Dexterity Subtest of the Bruininks–Oseretsky Test of Motor Proficiency-second edition (BOT-2) in children in Head Start who participated in a structured handwriting readiness program when compared to children who received typical Head Start handwriting instruction. Donica, Goins, and Wagner (2012) found that children who participated in either of two different structured handwriting readiness programs showed greater improvements in postural control, hand control, and letter and number formation than children who had received typical Head Start handwriting instruction. Understanding the long-term effects of these curriculums, and other handwriting instruction programs, is important in knowing whether or not these effects will last into kindergarten and subsequent years, helping to ensure that children continually maintain good

handwriting skills throughout the school years. In addition, other studies have addressed the need for research examining the long-term effects of and approaches to handwriting interventions to determine which intervention would be the most successful in teacher-guided classroom instruction (Judkins et al., 2009).

Therefore, the purpose of this follow-up study was to determine if children who had participated in an occupational therapy based handwriting readiness program during Head Start would display greater improvements in handwriting-related skills as evidenced by changes in scores on the VMI (Beery & Beery, 2010) and four subtests of the BOT-2 (Bruininks & Bruininks, 2005) from the end of the intervention year to one year following intervention when compared to a control group and an alternate experimental group. More specifically, the researcher wanted to determine if children who had participated in the Fine Motor and Early Writing Pre-K Curriculum (FMEW) would show greater improvements in scores from the end of the intervention year to one year following intervention when compared to the control group who had received typical Head Start instruction in handwriting and the alternate experimental group who had participated in the Handwriting Without Tears – Get Set For School Curriculum® (HWT), on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005), as these two subtests showed positive results in the initial year of the study. Additionally, the researcher used the Upper-Limb Coordination Subtest and the Fine Motor Precision Subtest of the BOT-2 (Bruininks & Bruininks, 2005) to compare children who had participated in the FMEW experimental group with children who had participated in the HWT alternate experimental group and children in the control group who had received typical Head Start handwriting instruction to determine if these groups would show a difference in change in scores from the end of the intervention year to one year following intervention. Lastly,

the researcher used the Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI; Beery & Beery, 2010) to compare children from the experimental group who participated in the FMEW program with children from the alternative experimental group that participated in the HWT curriculum and the control group who had participated in typical Head Start handwriting instruction to determine if children would demonstrate improved visual-motor skills, related to handwriting success, from the end of the intervention year to one year following intervention between the three groups

CHAPTER 2: LITERATURE REVIEW

The Importance of Good Handwriting Skills

Handwriting is an important functional skill that young children must acquire, since it is used frequently in preschool through elementary grades (Lust & Donica, 2011; Marr, Windsor, & Cermak, 2001). Good handwriting skills are usually defined in terms of legibility and speed (See Appendix A), given that these two factors have been described as the two most important elements in handwriting performance (Feder & Majnemer, 2007). Typically, once handwriting is learned, the skill becomes rapid, accurate, and mechanical, with little need for active conscious control (Longstaff & Heath, 1999). This allows the handwriting process to become almost automatic, keeping the generation of text from interfering with the creative thinking process (Scardamailia, Bereiter, & Goleman, 1982) and serving to increase efficiency and reduce redundancy (Latash, 1998).

Good handwriting skills are important for elementary school-aged children to develop in order to meet the demands of a typical school day (Weintraub & Graham, 1998). The use of paper and a writing utensil has been found to make up over 3 percent of the school day in pre-kindergarten settings, almost 20 percent in kindergarten, and anywhere between 26 and 51 percent of the school day for second through sixth grade (Marr, Cermak, Cohn, & Henderson, 2003; McHale & Cermak, 1992). Therefore, while children in pre-kindergarten settings such as Head Start may not spend a large amount of time on handwriting activities, they need to be prepared to spend significantly more time on these skills during their kindergarten year and subsequent elementary school years.

Handwriting is not simply for completing assignments, but is also a way for children to gather, remember, and share information and to explore, organize, and refine different concepts in many subjects (Judkins, et al., 2009). Handwriting is the primary way for elementary school-aged children to demonstrate their knowledge of learned concepts and to express themselves in written form (Case-Smith, 2002). Handwriting is also strongly connected to academic success, as good handwriting skills have been seen as a prerequisite for academic achievement in later school years (Erhardt & Meade, 2005; Feder & Majnemer, 2007; Graham, Berninger, Abott, Abott, & Whitaker, 1997; Graham & Harris, 2000; Jackman & Stagnitti, 2007), and handwriting difficulties have been shown to cause difficulty with completion of assignments, thereby affecting academic achievement (Berninger, Rutberg, Abbott, Garcia, Anderson-Youngstrum, Brooks, et al., 2006; Christensen, 2005; Feder & Majnemer, 2007; Gregg & Mather, 2002; Medwell & Wray, 2007; Swedler-Brown, 1992). In fact, the World Health Organization (2002) recently included handwriting difficulties as one of the problems thought to cause a barrier to school participation, a significant element in the normal developmental process of the child. Graham (1999) established that children who struggle with handwriting might have increasing difficulties as they progress in school, and those who continually struggle beyond first grade may never fully develop as writers. This fact underlines the importance of ensuring that children develop good handwriting skills before finishing first grade.

In the past, emphasis on writing has been more focused on composition than handwriting legibility and proper production of letters (Medwell & Wray, 2007). Typically, teachers have indicated that if they were able to read the student's writing, it was sufficient. However, research is now suggesting that handwriting skills and handwriting difficulties are a predictor of composition quality and literacy skills (Graham et al, 1997; Medwell & Wray, 2007) and that

handwriting legibility may have an effect on grades received. For example, studies have shown that handwritten school assignments with limited legibility (e.g., spelling tests or creative writing assignments) have been given a lower score than what would have been earned with greater legibility (Briggs, 1980; Chase, 1986; Sweedler-Brown, 1992). Handwriting difficulties may affect academic achievement for many different reasons. First of all, children without handwriting automaticity have been found to spend as much time thinking about handwriting and the actual neatness of their papers as they do on the content of their papers (Graham, Schwartz, & MacArthur, 1993; McCutchen, 1996), leading to shorter and lower quality compositions (Graham et al., 1997; Medwell & Wray, 2007). Studies have shown that when children were able to dictate their texts rather than writing them, the quality of their composition improved significantly (De La Paz & Graham, 1995; McCutchen, 1988, 1996), suggesting that it was the task of handwriting itself that lowered the composition quality.

A lack of handwriting automaticity may also affect composition quality because children who have difficulty with handwriting usually have trouble shifting their attention between the motor process of handwriting and the cognitive process of generating thoughts and ideas (Graham & Weintraub, 1996). These children that lack the necessary automaticity of letter formation tend to forget what they are trying to write, since their attention is consumed by the working memory required to write and produce the letters (Graham, Harris, & Fink, 2000). During the writing process, considerable attention is focused on the mechanics of writing (e.g., letter formation and spatial organization), which may hinder the child's ability to develop ideas and plans (Edwards, 2003; Graham et al., 1997). Children with handwriting difficulties may also be consumed with time spent attempting to spell words or with the process of writing words and punctuating sentences, rather than the composition itself (McCutchen, 1988). Therefore, these

children are unable to use their full cognitive resources to produce more complex compositions, resulting in a decreased ability to express their thoughts and ideas. This may lead to a slower composition rate and shorter written products that are of poorer quality (Graham et al., 1997). In general, the less the transcription process is automatized the harder it is for the writer to concentrate on the text composition processes (Graham et al., 2000; Olive & Kellogg, 2002).

Due to the importance of handwriting as a daily task for children of all ages, the consequences of handwriting difficulties are extensive and can be detrimental not only to academic performance, but also to a child's self-esteem, self-image, attitude, and behavior (Erhardt & Meade, 2005; Feder & Majnemer, 2007; Gregg & Mather, 2002; Jackman & Stagnitti, 2007). The negative effects of handwriting difficulties on a child's academic performance makes these children more likely to avoid writing and give up on written assignments (Berninger, Vaughan, Abbot, Abbot, Rogan, Brooks, et al., 1997), which impedes their ability to express what they know (Medwell & Wray, 2008). This may lead children to feel frustrated, further causing decreased self-efficacy and motivation (Margalit, 1998; Pavri & Monda-Amaya, 2000; Piek, Baynam, & Barrett, 2006). These lowered feelings of confidence may cause arrested writing development (Berninger, Mizokawa, & Bragg, 1991), further affecting academic performance.

In many circumstances, children who have not sufficiently mastered basic writing tasks are forced to move on too quickly to more advanced written assignments, which is likely the cause of many handwriting problems in school-aged children (Asher, 2006; Donica, 2010; Karlsdottir & Stefansson, 2002). Other research suggests that children's early development of fluent handwriting skills may prevent difficulties with writing performance in later grades

(Edwards, 2003). Marr and Cermak (2003) found that 60% of the 93 children studied were consistent (as defined by retaining the same qualitative performance and relative ranking over time) in their handwriting performance from kindergarten to halfway through first grade. This suggests that it is important to have a solid foundation in handwriting skills by kindergarten, since these skills seem to be established by this age. Furthermore, this correlation between scores in kindergarten and first grade presents initial evidence that handwriting performance exists in a moderately consistent pattern (Marr & Cermak, 2003). Therefore, handwriting instruction including pre-writing skills and fine motor development activities may be deemed even more necessary in the pre-kindergarten and kindergarten years to develop a solid foundation of handwriting skills and prevent handwriting difficulties from occurring in the future.

Language arts skills may also be affected by handwriting performance. For example, research has suggested that children may become more accurate spellers through the process of handwriting (Cunningham & Stanovich, 1990). In addition, handwriting difficulties may help predict reading challenges, as success in name writing may predict future success in reading achievement (Berninger et al., 2006; Haney, 2002). Some may believe with the increased availability and use of computers and other technological advances that handwriting is no longer necessary or important. However, handwriting is still the most immediate form of communication, and is necessary for children to be able to complete assignments, take notes during class, and demonstrate their knowledge on tests beginning in elementary school and continuing throughout the school years (Connelly, Gee, & Walsh, 2007). In addition, research suggests that many children who have difficulties with handwriting may also struggle with automatic keyboarding, as difficulty with early automatic handwriting mechanics and speed

correlates with difficulties in subsequent keyboarding skills (Connelly et al., 2007). Therefore, handwriting is still an important aspect in a child's school day as handwriting success correlates with many other school-related tasks.

Good handwriting skills are extremely important, but unfortunately these skills are difficult for children to accomplish (Smits-Engelsman, Niemeijer, & van Galen, 2001; Volman, Schendel, & Jongmans, 2006), and research suggests that handwriting difficulties are common in children at the elementary school level (Medwell & Wray, 2007). It is difficult to estimate just how many children experience handwriting difficulties, as not all children may be recommended to occupational therapy or other services for their handwriting problems. Also, the percentage of children with handwriting difficulties reported depends upon factors such as the extent of teacher awareness, the child's grade, and the selection criteria, type, and availability of evaluation tools and instruments used in research (Hammerscmidt & Sudsawad, 2004; Sudsawad, Trombly, Henderson, & Tickle-Dengen, 2001). However, it is estimated that anywhere between 12 and 27 percent of school-aged children (elementary through high school) in the United States experience handwriting problems (Karlsdottir & Stefansson, 2002) while some estimates have been as high as 44 percent (Alston, 1985; Rubin & Henderson, 1982). Either way, these estimates suggest that the lack of handwriting automaticity is affecting a significant amount of children. Researchers have also noticed a strong gender effect, in that boys are more likely to have handwriting problems than girls (Berninger et al., 1997; Graham et al., 2000; Hamstra-Bletz & Blote, 1993; Rubin & Henderson, 1982) and girls have better handwriting in overall quality and letter formation and demonstrate greater speed than boys (Berninger & Fuller, 1992; Berninger et al., 1997; Biemiller, Regan, & Gang, 1993; Graham et al., 2000; Hamstra-Bletz & Blote, 1993;

Ziviani, 1984; Ziviani & Elkins, 1984). Therefore, boys may require even more handwriting instruction than girls to meet the demands of a typical school day.

The Importance of Formal Handwriting Instruction

Formal handwriting instruction is very important to a child's educational success, and is considered essential to children who do not write instinctively or have underdeveloped foundational skills and produce their letters illegibly (Berninger & Fuller, 1992). Handwriting instruction is believed to be an important aspect in preventing writing difficulties in the elementary grades (Graham et al., 2000). A study done by Judkins, Dague, and Cope (2009) suggested that lower than average handwriting skills, even in typically developing children, could be due to the lack of individualized instruction in the curriculum. Additionally, length and quality of written compositions, affected by the inability to write automatically, can be enhanced through formal handwriting instruction that teaches correct letter formation and legibility (Medwell & Wray, 2007). Other studies suggest that formal handwriting instruction is positively correlated with good reading skills. For example, Berninger et al. (2006) suggested a relationship between direct handwriting instruction and improved reading at the word level for first grade children that had previously been acknowledged as having difficulties with handwriting. Therefore, formal handwriting instruction may not only benefit children in handwriting skills, but in other language arts skills as well.

A child with poor handwriting skills in pre-kindergarten is likely to be behind peers when entering kindergarten. In fact, handwriting skills in preschool have become a predictor of kindergarten handwriting performance, and handwriting demands in kindergarten have increased in the last few years (Fogo, 2008). Other studies have shown a decrease in the handwriting skill

level in children entering kindergarten over the years (Berninger et al., 1997; Pape & Ryba, 2004). Conversations with participating teachers of one such study revealed that this decline might be due to a decrease in sufficient and appropriate classroom instruction and hands-on practice in handwriting (Berninger et al., 1997). Research has also shown that healthy adjustment during the first years of school is a precursor to later success and that individual differences in children's school results remain relatively stable after the first few years in school (Alexandar, Entwisle, & Olson, 2001). Therefore, the importance of developing handwriting skills early on is even more important, which may be achieved through formal handwriting instruction that should begin at the pre-kindergarten level.

Interestingly, despite the evidence that handwriting instruction is so important to a child's academic success, curriculum changes have dramatically decreased the amount of handwriting instruction, teacher training, and practice given during the school day (Hoy, Egan, & Feder, 2011; Pape & Ryba, 2004). This may be what leads many children to develop handwriting problems, thus requiring referral to occupational therapy programs and other services for remediation. With an increasing number of children having handwriting difficulties, it is apparent that handwriting instruction and hands-on handwriting practice need to be reintegrated into the pre-kindergarten and kindergarten curriculums to enhance academic success of children.

Children are expected to gradually improve their handwriting legibility as formal instruction is introduced in the kindergarten and first grade curriculum (Vreeland, 1999). However, while some children are able to write well without having proper handwriting instruction, and others are unable to learn the skill regardless of the interventions used, most fall somewhere in between these two categories and benefit from good teaching strategies for

handwriting instruction (Benbow, 1995). Some educators have suggested that handwriting skill deficits exist because insufficient attention is given to handwriting skill development during school, and not due to specific client factors limiting children's abilities (Asher, 2006). Research that has shown the negative effects of handwriting difficulties on academic achievement has moved attention away from teaching writing through copying and towards emphasizing correct letter formation and legibility (Medwell & Wray, 2007), which may be achieved through formal handwriting instruction including demonstration.

Unfortunately, teachers often vary in their opinion on what age handwriting instruction should be introduced. Asher (2006) found that of thirteen teachers (kindergarten through second grade), seven taught or expected manuscript handwriting to be taught during kindergarten and six expected it to be taught in first grade. Clearly there is inconsistency between teachers about which grade children should begin learning handwriting, which means that some children may miss handwriting instruction altogether. For instance, if a child's kindergarten teacher does not teach handwriting formally because of expecting the first grade teacher to do so, the next year that same child may have a first grade teacher who expected that the kindergarten teacher had taught handwriting. In this case, the child missed a very important part of education and may suffer from this lack of instruction throughout school.

State and National Standards for Handwriting

The North Carolina Department of Public Instruction (2004a) has set standards for preschoolers in North Carolina that include foundations for handwriting. In order to meet these standards, a preschooler must begin to use a variety of different writing tools and materials (such as pencils, chalk, markers, crayons, finger paint, clay, and computers), and use a variety of

writing in their play for different purposes (such as lists, messages, stories, etc.). Preschoolers in North Carolina should also begin making marks, scribbles, and letter-like forms, and are expected to practice writing letters and master conventional letter forms, starting with the first letter of their own name and eventually being able to write their full name using letter approximations (North Carolina Department of Public Instruction, 2004a). Therefore, it is important that preschool-aged children in North Carolina have foundations for handwriting, have developed handwriting-related skills, and begin to use those skills to practice writing letters. A curriculum that involves using different writing tools and materials, encourages preschool-aged children to begin writing, and helps them begin to understand the concepts of letter formations and handwriting would be very beneficial for learning the necessary skills that children are expected to achieve throughout the preschool years.

Children moving into kindergarten are expected to continually develop their handwriting-related skills. At the kindergarten level, the North Carolina Department of Public Instruction (2004b) expects children to make connections through the use of written language by applying the strategies and skills they have learned to create written texts. In order to complete this goal, kindergarteners should be able to use new vocabulary in their writing, such as words that name objects, words that tell action, and words that describe color, size, and location, in a variety of simple texts (e.g., written stories, lists, and journal entries of personal experiences). The kindergarten child is also expected to write from left to right and from top to bottom and to write most letters and some words when dictated. Lastly, the curriculum includes being able to write most letters of the alphabet independently, use capital letters to write the word "I" and the first letter in their own name, and use legible manuscript handwriting (North Carolina Department of Public Instruction, 2004b). Therefore, kindergarteners in North Carolina must not only receive

proper instruction in handwriting-related skills before entering their kindergarten year, but these skills must carry-over into and throughout the kindergarten year to provide a foundation for handwriting skills to grow on.

The National Research Council has also issued standards for writing accomplishments that children are expected to meet by the end of kindergarten. These standards are similar to those issued by the North Carolina Department of Public Instruction, in that children are expected to write most letters and some words when dictated, independently write many uppercase and lowercase letters, and write to express meaning (Snow, Burns, & Griffin, 1998). The National Research Council also expects kindergarteners to write their own first and last name and the first names of some of their friends, which is more stringent than that of the North Carolina Department of Instruction, which expects only the first letter of the first name to be written independently (Snow et al., 1998). Thus, at a national level, handwriting-related skills are considered even more important for children to develop before and throughout their kindergarten year.

Handwriting Instruction Programs and Curriculums

Many programs and curriculums have been developed to address handwriting problems, each using a unique method to teach the underlying component skills of handwriting. Lust and Donica (2011) implemented a structured handwriting readiness program in a Head Start classroom aiming to increase handwriting readiness skills for these children. Children who participated in the Handwriting Without Tears® – Get Set for School multisensory program demonstrated significant improvements in handwriting readiness skills (Lust & Donica, 2011). Other multisensory handwriting interventions have been effective in improving handwriting

skills as well (Peterson & Nelson, 2003; Zwicker & Hadwin, 2009). Winslow (2011) conducted a pilot study implementing the Fine Motor and Early Writing Pre-K Curriculum (FMEW) in a rural Head Start classroom. This program is a structured multisensory handwriting readiness program that aims to improve fine motor skills in pre-school aged children in hopes to help prepare the children for the handwriting demands of kindergarten and to develop necessary handwriting-related skills to prevent handwriting problems in the future. The study investigated the program's effectiveness on developing those handwriting skills necessary in order to make the transition into kindergarten easier, and results showed that the curriculum had a positive effect on fine motor skills of the children at Head Start. More specifically, the experimental group demonstrated a greater increase in mean total point scores between pre-test and post-test on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005; Winslow, 2011). Donica, Goins, and Wagner (2012) conducted a study implementing the Handwriting Without Tears – Get Set For School Curriculum® and the Fine Motor and Early Writing Pre-K Curriculum in two different Head Start classrooms in order to investigate the effects of handwriting readiness programs on handwriting-related skills. While both experimental classrooms and the control classroom that had received typical Head Start handwriting instruction all showed an increase in the mean changes in scores, both the experimental classrooms displayed greater improvements than those of the control classroom (Donica, Goins, & Wagner, 2012). The importance of these programs, as well as their carry-over effect throughout subsequent school years, is demonstrated through studies in which the effects of the programs are analyzed in order to provide evidence for the efficacy of direct handwriting intervention.

The Relationship between Fine Motor Skills and Handwriting Difficulties

The mechanisms behind handwriting difficulties are not yet understood, and little is known about why some children have handwriting difficulties while others do not. However, in recent years a great deal of progress has been made in understanding the process of handwriting itself (Graham & Weintraub, 1996). Handwriting is a complex activity that requires the interaction between both motor and cognitive processes (Berninger & Swanson, 1994; Graham & Weintraub; 1996; Van Galen, 1991), and requires performance in perceptual-motor skills, motor planning, eye-hand coordination, visual perception, visual-motor integration, bilateral hand skills, in-hand manipulation, kinesthesia, and the presence of proper biomechanical components for posture and hand grip (Asher, 2006; Cornhill & Case-Smith, 1996; Denton, Cope, & Moser, 2006; Erhardt & Meade, 2005; Feder & Majnemer, 2007; Woodward & Swinth, 2002). Other factors that may come into consideration when evaluating handwriting performance include legibility, speed, tool use, sensory processing, posture, and sustained attention (Roston, 2010). While all of these aspects of handwriting are important, two key aspects of handwriting difficulties identified in research are deficits in fine motor coordination (Smits-Engelsman et al., 2001; Smits-Engelsman & Van Galen, 1997) and deficits in visual-motor integration (Maeland, 1992; Tseng & Murray, 1994; Weintraub & Graham, 2000).

Deficits in visual-motor integration and fine motor control have both been linked with handwriting difficulties, which is why many researchers have suggested that these two skills are strong indicators of handwriting performance (Daly, Kelley, & Krauss, 2003; Ratzon, Efraim, & Bart, 2007; Volman et al., 2006; Weintraub & Graham, 2000). Studies have indicated that, of all perceptual-motor skills, visual-motor integration correlates most with handwriting performance (Daly et al., 2003; Tseng & Chow, 2000). Daly, Kelley, and Krauss, (2003) found strong positive relationships between scores received on the Developmental Test of Visual-Motor

Integration (VMI; Beery, 1997) and children's abilities to legibly copy letterforms, demonstrating that visual-motor integration skills were related to the ability of kindergarten children to copy letters legibly. These results support the conclusion that visual-motor integration is a requisite skill for handwriting legibility (Daly et al., 2003).

Fine motor skills are also an important aspect in handwriting performance. Children of all backgrounds and developmental levels, from typically developing to developmentally delayed, may have trouble with fine motor skills and therefore, handwriting (Dunn, Campbell, Oetter, Hall, & Berger, 1988). When a child's handwriting skills do not improve, or their progress is behind their peers, these children are often referred to occupational therapy for poor fine motor performance, including poor letter formation (Marr & Cermak, 2003). Volman, Schendel, and Jongmans (2006) found that children with handwriting problems scored significantly lower on the Unimanual Dexterity subtest of the Movement ABC test (used to measure fine motor coordination) than children without handwriting problems. This subtest was also significantly correlated with the handwriting quality in children with and without handwriting difficulties. In addition, a study done by Smits-Engelsman, Niemeijer, and van Galen (2001) found that more than half of the children (7 out of 12) with poor handwriting also had problems with fine motor skills. Observation of daily activities in regular elementary school classrooms has revealed that between 30% and 60% of the school day consists of fine motor tasks, such as coloring and cutting, and mainly handwriting activities (Linder, 1986; McHale & Cermak, 1992). More specifically, kindergarteners spend up to 46% of their day completing fine motor activities, of which 42% are paper-and-pencil tasks, and preschoolers spend an average of 37% of their school day engaged in fine motor activities, of which 10% are paper-and-pencil tasks (Marr et al., 2003). Fine motor skill deficits may result in incorrect size and placement of

letters (Feder & Majnemer, 2007) and an inadequate pencil grasp in children who have difficulties with in-hand manipulation skills, which is necessary for the precise and controlled movements used in handwriting (Feder & Majnemer, 2007; Pape & Ryba, 2004).

While many studies have been conducted to identify the relationship between visual-motor integration and handwriting difficulties (Cornhill & Case-Smith, 1996; Hagborg & Aiello-Coultier, 1994; Phelps & Stempel, 1988; Rubin & Henderson, 1982; Sovik, 1981, 1984; Tarnopol & de Feldman, 1987; Tseng & Chow, 2000; Tseng & Murray, 1994), few have been done examining the relationship between handwriting difficulties and fine motor skills. Since the development of fine motor skills correlates with the acquisition of handwriting skills in young children, this relationship should be further addressed in the preschool curriculum, and fine motor skills should be included in handwriting instruction to promote greater handwriting skills. Fine motor skills may be a key component to handwriting performance and an important factor in why some children have difficulties with handwriting. Therefore, studying the effects of fine motor based handwriting instruction programs on the development of these handwriting-related skills would benefit the knowledge base of handwriting difficulties and may help identify how to not only correct these problems, but to prevent them as well. Implementing structured handwriting readiness programs in preschool will give children the needed extra practice in a multisensory manner that may aide in mastering the fine motor tasks needed for the larger task of handwriting. Furthermore, addressing the fine motor skill developmental deficit in children at the preschool level will increase their chance for success in kindergarten. In addition, studies have suggested the need for further research into the practice of directly teaching fine motor skills to children with handwriting difficulties (Weintraub & Graham, 2000).

Winslow (2011) demonstrated that a multisensory handwriting readiness program implemented in a Head Start program had a positive effect on the fine motor integration and manual dexterity skills of children in Head Start. Donica, Goins, and Wagner (2012) demonstrated that two different handwriting readiness programs had a positive effect on the handwriting-related skills of these children. Whether these positive effects would last into subsequent years following intervention is important in understanding the long-term benefits of such handwriting readiness programs. This current study is a follow-up study to investigate the carry-over effect of the Fine Motor and Early Writing Pre-K Curriculum (FMEW) on handwriting-related skills from the end of the intervention year to one year following intervention when compared to a control group who had received typical Head Start handwriting instruction and an alternate experimental group consisting of children who had participated in the Handwriting Without Tears – Get Set For School Curriculum® (HWT).

This follow-up study has three research questions. First, does implementation of the Fine Motor and Early Writing Pre-K Curriculum during Head Start help children to show greater improvements in scores on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005) from the end of the intervention year to one year following intervention when compared to children who participated in typical Head Start instruction for handwriting and to children who participated in the Handwriting Without Tears – Get Set For School Curriculum®? Additionally, does implementation of the Fine Motor and Early Writing Pre-K Curriculum during Head Start help children to show greater improvements in scores on the Upper-Limb Coordination Subtest and the Fine Motor Precision Subtest of the BOT-2 (Bruininks & Bruininks, 2005) from the end of the intervention year to one year following intervention when compared to the control group who participated in typical Head

Start handwriting instruction and an alternate experimental group consisting of children who participated in the Handwriting Without Tears – Get Set For School Curriculum®? Lastly, does implementation of the Fine Motor and Early Writing Pre-K Curriculum in Head Start help children to display greater improvements in scores on visual-motor skills from the end of the intervention year to one year following intervention when compared to children who participated in the Handwriting Without Tears – Get Set For School Curriculum® and to children who had received typical Head Start instruction for handwriting as evidenced using The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (Beery & Beery, 2010)?

CHAPTER 3: METHODS

Design

This study was a follow-up of the initial study conducted during the 2010-2011 school year at the Pitt County Head Start center in Greenville, NC by researchers from the Occupational Therapy Department of East Carolina University (Donica, Goins, & Wagner, 2012; Winslow, 2011). The purpose of the initial study was to examine the effects of two structured handwriting readiness programs on the development of handwriting-related skills in children at Head Start. For the initial study, in September 2010 the Fine Motor & Early Writing Pre-K Curriculum experimental classroom with 16 children, the Handwriting Without Tears – Get Set For School® Program alternative experimental classroom with 18 children, and the control classroom of 15 children were pre-tested using The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI; Beery & Beery, 2010), the Fine Motor Precision, Fine Motor Integration, Manual Dexterity, and Upper-Limb Coordination subtests of the Bruininks–Oseretsky Test of Motor Proficiency-Second Edition (BOT-2; Bruininks & Bruininks, 2005), and the Shore Handwriting Screening (Shore, 2003), administered by qualified and trained East Carolina University occupational therapy graduate students. Afterwards, the Fine Motor & Early Writing Pre-K Curriculum (FMEW) was implemented in the experimental classroom, the Handwriting Without Tears - Get Set For School Curriculum® (HWT) was implemented in the alternate experimental classroom, and the control group received typical Head Start instruction for handwriting, lasting from October 2010 to March 2011.

The FMEW experimental classroom at the Head Start center participated in the curriculum for 32 biweekly sessions led by graduate occupational therapy student researchers.

Toni Schulken, Courtney Enos, and Jordan Rice developed the FMEW curriculum specifically to be used in the intervention year of this study at the Pitt County Head Start center in Greenville, NC, as a pilot study for the curriculum. Children rotated between two instructor-led and two independently-led centers, staying at each about 10 to 15 minutes, for a total of 30 minutes two times per week. Students were not required to go to all four centers, but were encouraged to participate in at least the two researcher-led centers and to complete the activities. All four centers addressed a particular set of fine motor skills, perceptual motor skills, pre-writing skills, and number and capital letter formation. (See Winslow, 2011 for more specific details of this program).

The HWT alternate experimental classroom consisted of a total of 37 one-hour small group sessions using the Handwriting Without Tears – Get Set For School Curriculum®. Graduate occupational therapy student researchers performed intervention twice a week, starting each session with a whole group motor coordination activity, followed by having the children rotate between independent centers and HWT instruction centers (two centers per day), with children remaining at each center for about five to ten minutes of each session. (See Donica, Goins, & Wagner, 2012 for more specific details of this program).

At the end of the intervention period in March 2011, all children were again tested using the VMI (Beery & Beery, 2010), the same four subtests of the BOT-2 (Bruininks & Bruininks, 2005), and the Shore Handwriting Screening (Shore, 2003). (Results from the Shore Handwriting Screening were analyzed for a different study and were not analyzed as part of this study). Change in total point scores from pre-test to post-test of the four BOT-2 (Bruininks & Bruininks, 2005) subtests used were compared between the FMEW experimental group and the

control group. Results identified that the FMEW curriculum had a positive effect on the fine motor skills of the children at Head Start. More specifically, the initial study showed a significant difference between the improvement in mean total point scores of the experimental group and the improvement in mean total point scores of the control group from pre-test to post-test on two of the four BOT-2 (Bruininks & Bruininks, 2005) subtests. (Differences were found on the Fine Motor Integration Subtest and the Manual Dexterity Subtest whereas no significant differences were found on the Upper-Limb Coordination Subtest or the Fine Motor Precision Subtest). Furthermore, the experimental group showed a large increase in mean total point scores on the Manual Dexterity subtest, a measure of fine motor abilities, between pre-test and post-test. This led researchers to believe that the Fine Motor & Early Writing Pre-K Curriculum had a positive effect on fine motor skills of children when compared to the control group (Winslow, 2011).

Results from the VMI (Beery & Beery, 2010) were not analyzed for the initial study, but data had been collected at both pre-test and post-test and was analyzed for the follow-up study in order to compare visual-motor skills of children between all three classrooms from the end of the intervention year to one year following intervention in order to aid in understanding the relationship between visual-motor skills and handwriting abilities. Furthermore, results from the Shore Handwriting Screening were used as part of another study sharing all three groups, and were not analyzed for either the initial study or this follow-up study.

This follow-up study aimed to determine whether the improvements seen in handwriting-related skills during the initial study would persist throughout the year following intervention. More specifically, participants were tested in September 2011 (six months after the post-test

session of the initial study) and in March 2012 (twelve months after the post-test session of the initial study) using the same assessments as the initial studies. The researcher compared the children's scores from the VMI (Beery & Beery, 2010) and the four subtests of the BOT-2 (Bruininks & Bruininks, 2005) between children in the FMEW experimental classroom, the HWT alternate experimental classroom, and the control classroom, from the end of the intervention year to one year following intervention.

This study was a time series longitudinal design with four total data collection points (two during the initial study and two during the follow-up study). During the initial study children were tested in September 2010 (testing session one), intervention was implemented, and children were again tested in March 2011 (testing session two). During this follow-up study children were tested in September 2011 (testing session three) and again in March 2012 (testing session four), with no intervention given as part of the follow-up study. The dependent variables for this follow-up study were the scores received on the VMI (Beery & Beery, 2010) and the four subtests of the BOT-2 used (Bruininks & Bruininks, 2005). The VMI (Beery & Beery, 2010) yielded one score and four subtests of the BOT-2 (Bruininks & Bruininks, 2005) provided four scores. These subtests were Fine Motor Precision (Subtest 1), Fine Motor Integration (Subtest 2), Manual Dexterity (Subtest 3), and Upper-Limb Coordination (Subtest 7), the same four subtests used in the initial study. The independent variable in this study was the classroom handwriting instruction program in which the child participated during the initial study; the control group, the FMEW experimental group, or the HWT alternate experimental group.

The researcher hypothesized that the positive effects on handwriting-related skills that the experimental group displayed after the initial year would have a carry-over effect throughout the

year following intervention. More specifically, the researcher believed that children who had participated in the Fine Motor and Early Writing Pre-K Curriculum (FMEW) would show greater improvements in scores on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005) between the end of the intervention year (test two) and one year following intervention (test four) when compared to children in the control group who had received typical Head Start instruction for handwriting and compared to those children in an alternate experimental group who participated in the Handwriting Without Tears – Get Set For School Curriculum® (HWT). Furthermore, the researcher hypothesized that children who had participated in the FMEW experimental classroom would display greater improvements in scores on both the Fine Motor Precision Subtest and the Upper-Limb Coordination Subtest of the BOT-2 (Bruininks & Bruininks, 2005) from the end of intervention to one year following intervention when compared to children who had participated in the control group and the alternate experimental group. Lastly, the researcher hypothesized that the experimental group that had participated in the FMEW curriculum would display greater improvements in scores on the VMI (Beery & Beery, 2010) from the end of the intervention year to one year following intervention when compared to the control group that had received typical Head Start handwriting instruction and the alternate experimental group that had participated in the HWT program.

Subjects

The subjects of this follow-up study were 16 children that had been enrolled in one of the three classrooms in the Pitt County Head Start center in Greenville, NC during the 2010-2011 school year that had participated in the initial study. Six children from the FMEW experimental

group, six children from the HWT alternate experimental group, and four children from the control group were reached and willing to participate in this follow-up study. During the 2011-2012 school year, most of the children attended kindergarten at various schools, except for three from the HWT alternate experimental group and one from the control group that attended Head Start again due to their age level. Inclusion criteria were having submitted a signed parent/guardian permission slip and having transportation to East Carolina University for the two follow-up testing sessions. Exclusion criteria were not having been a part of the initial year of the study or not completing all of the assessments at the two testing sessions of this follow-up study (test three and test four). This study used convenience sampling as parents/guardians volunteered to allow their children to participate and no additional recruitment was used other than selection of children from the initial year of the study.

Instrumentation

Beery-Buktenica Developmental Test of Visual-motor Integration – Sixth Edition.

The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI; Beery & Beery, 2010) is an individually administered, standardized form-copying test developed for individuals 2- to 100-years-old. This test assesses visual-motor integration by having individuals copy 24 geometric shapes presented in a developmental sequence that becomes progressively more complex and challenging to copy. Individuals complete the test at their own pace with the paper form and a pencil and are asked to copy the shape in the space provided below, with three shapes presented on each page. The test is terminated when the individual fails to accurately copy three successive shapes. For this follow-up study, the VMI was administered to children as instructed by the VMI manual (Beery & Beery, 2010). The

researcher scored the VMI following stringent guidelines and instructions specified in the manual where each shape was scored as either pass or fail and, if passing, awarded a score of one. The final scores were obtained by adding the point scores for the shapes correctly copied, with a possible high score of 30 and low score of 0 for each child. The VMI yielded a raw score that was converted to one standardized score, which may then be converted to an age equivalent, percentile score, and scaled score. The instructions include examples of images with appropriate scoring, as well as specific criteria for measuring and scoring the images drawn by the individual (Beery & Beery, 2010).

The VMI (Beery & Beery, 2010) was chosen as a measurement tool for this study because it is identified as a useful evaluation tool when screening for handwriting difficulties (Daly et al., 2003; Ratzon et al., 2007) and is used primarily as a screening tool to identify proficiency in visual-motor integration (Beery & Beery, 2010). Furthermore, the FMEW curriculum incorporates visual-motor activities in its multisensory approach to handwriting instruction. Therefore, the researcher of this follow-up study felt that adding this test to the study would allow another important aspect of handwriting to be investigated. In addition, the VMI (Beery & Beery, 2010) follows the typical developmental sequence of lines and shapes that children are able to draw, and is therefore a good measurement of a child's developmental age in terms of handwriting skills. Lastly, the VMI has acceptable levels of both reliability and validity in typically developing children with high content reliability, ranging from 0.96 to 1.00, good internal consistency, ranging from 0.76 to 0.91, high interrater reliability, ranging from 0.93 to 0.98, and high test-retest reliability of 0.92 over a two-week period (Beery & Beery, 2010). The VMI was correlated with the Copying Subtest of the Developmental Test of Visual Perception (DTVP-2) and the Drawing Subtest of the Wide Range Assessment of Visual Motor Abilities

(WRAVMA) and has high measures of construct validity, ranging from 0.84 to 0.89 (Beery & Beery, 2010).

Bruininks–Oseretsky Test of Motor Proficiency-Second Edition.

The Bruininks–Oseretsky Test of Motor Proficiency – Second Edition (BOT-2; Bruininks & Bruininks, 2005) is an individually administered, standardized test designed to quantify the motor skills of individuals ages 4- to 21-years-old. It includes four composites of two subtests each. For this study, only the Fine Manual Control Composite, including Fine Motor Precision (Subtest 1) and Fine Motor Integration (Subtest 2), and the Manual Coordination Composite, including Manual Dexterity (Subtest 3) and Upper-Limb Coordination (Subtest 7) were administered. The Fine Motor Precision Subtest includes bilateral hand skills and accuracy with cutting, folding paper, and coloring. The Fine Motor Integration Subtest measures visual-motor skills determined by copying various shapes. Both subtests evaluate the individual's skills in integrating visual perception with hand and finger motor movements. The Manual Dexterity Subtest is timed and involves being able to quickly manipulate small items and materials such as pennies, cards, small beads, and pegs. The Upper-Limb Coordination Subtest uses tasks such as catching a ball (with one hand and both hands), dribbling a ball (with one hand and alternating hands), and throwing a ball at a target to measure a child's upper-limb coordination. All of the subtests require the examiner to follow stringent guidelines and instructions for administration and scoring of the subtest items, as well as pictures and examples of how to administer and score (Bruininks & Bruininks, 2005).

The BOT-2 (Bruininks & Bruininks, 2005) was used for this study because it is widely used to assess motor skills for both clinical and research purposes due to its moderate to high

test-retest and inter-rater reliabilities in healthy children (Wuang, Lin, & Su, 2009). For the composite scores for Fine Manual Control the mean test-retest reliability for the group of 4- to 7-year olds is 0.81, and for Manual Coordination is 0.62. For inter-rater reliability, the 4- to 7-year old age group has a mean reliability of 0.91 for Fine Manual Control and 0.98 for Manual Coordination, demonstrating that the inter-rater reliability was very consistent (Bruininks & Bruininks, 2005). Furthermore, measures of internal consistency reliability are also high for the BOT-2. For Fine Manual Control, the age group including ages 4- to 7-years-old has a mean reliability of 0.88, and for Manual Coordination a mean reliability of 0.89, indicating that the subtest and composite scores used are highly accurate. Validity measures for the group consisting of 4- to 7-year-olds are also good. Fine Manual Control has a mean validity ranging from 0.31 to 0.87 (depending on what composites and subtests are being evaluated) and Manual Coordination ranging from 0.31 to 0.83 (Bruininks & Bruininks, 2005). Overall the BOT-2 is considered to have good validity when measured for item fit, as well as good test content validity and internal structure validity (Bruininks & Bruininks, 2005). Furthermore, the assessment is moderately correlated with other measures of motor performance, such as the Peabody Developmental Motor Scales 2nd Edition (correlations ranging from 0.47 to 0.59 for 4- to 5-year olds on the skills tested in this study) as well as with the Test of Visual-Motor Skills-Revised (correlations ranging from 0.55 to 0.74 for 4- to 13-year olds on the skills tested in this study). The BOT-2 total point scores are also quantitative and can be converted to standard scores, percentiles, and age equivalencies (Bruininks & Bruininks, 2005).

Procedure

For this follow-up study the researcher gained approval from East Carolina University's University & Medical Center Institutional Review Board (UMCIRB), as well as approval from the director of the Pitt County Head Start center to distribute consent forms. At the end of the 2010-2011 school year, letters and consent forms were given to the teachers of all three classrooms from the initial study to give to parents/guardians of the children with information about the follow-up study and their obligation to arrange for transportation to the testing site (the Allied Health Sciences building at East Carolina University) should they and their child choose to participate (See Appendix B**).** The letters also informed parents/guardians that they would receive a $25 Wal-Mart gift card for attending each testing session, as well as an additional $25 gift card for completing all assessments, for a total of up to $75 in gift cards. Contact information for the principal researcher was given to parents/guardians as well. The teachers in both the experimental classroom and the alternate experimental classroom had parents/guardians sign the consent forms when picking up their child at the end of the 2010-2011 school year, and gave them the information sheet to keep for themselves. Parents/guardians also gave their own contact information to be reached to schedule testing sessions and to provide a reminder call prior to each testing session. (Because most of the children eligible for the study did not return in the fall to the Head Start, individual contact was required to schedule them for the sessions of this follow-up study). In the control group classroom, consent forms and information sheets were sent home with children, and no signed consent forms were returned. The researcher got approval from the UMCIRB and received permission from the director of the Head Start program to call all of these parents/guardians from the Head Start center and let them know about the study during August 2011. Consent forms and information sheets were then mailed to these parents/guardians from the Head Start center in order to maintain privacy, in an addressed

and stamped envelope asking for return of the consent forms as soon as possible. While only one consent form was received by mail, the researcher was able to schedule appointments with parents/guardians of three more control group children via phone call, and consent forms were signed at the beginning of the first follow-up testing session as necessary. All information received from all parents/guardians was kept private and confidential and only shared with those necessary, such as the UMCIRB and its staff, and other ECU staff who oversaw this research.

In August 2011, parents/guardians of all children who had participated in the initial study were contacted by email, phone, and/or text, as indicated by parent, to schedule times for their children to be brought to ECU to implement the assessments for testing session three at a time that accommodated the schedules of the children, parents/guardians, and the researcher. Multiple phone calls, emails, and/or texts were sent to set up appointments and remind the parents/guardians of their appointments in an attempt to get as many children as possible to take place in this follow-up study. When the researcher was unable to schedule appointments via phone calls, emails, and/or texts, postcards were sent to all of the parents/guardians that had not yet brought their child in for testing but had given permission to be contacted by indicating their address on the consent form. By the end of September 2011, 20 children (seven from the FMEW experimental classroom, nine from the HWT alternate experimental classroom, and four from the control classroom) had completed the third testing session (first testing session of this follow-up study). The $25 Wal-Mart gift cards had not arrived by the time testing began, so parents/guardians were called, emailed, and/or texted in October 2011 to let them know that the gift cards had arrived and could be picked up at the Occupational Therapy Department office at East Carolina University. Sixteen of the twenty parents/guardians picked up their gift cards, and the others were saved for distribution at the last testing session.

During the month of September 2011 (test three) each of the 20 children came to the Allied Health Sciences Building at East Carolina University to be tested individually, which lasted about one hour per child. All children were tested on the VMI (Beery & Beery, 2010), four subtests of the BOT-2 (Bruininks & Bruininks, 2005), and the Shore Handwriting Screening (Shore, 2003). (Again, all three groups were being shared with another study using the Shore Handwriting Screening and the researcher wanted to eliminate possible limitations by having all children take the same three assessments. However, results from the Shore Handwriting Screening were not addressed in this follow-up study). Trained East Carolina University occupational therapy graduate students administered the assessments under the supervision of occupational therapy faculty, all of which were blinded to what group (control, experimental, or alternate experimental) each child had participated in during the initial study. The tests were given in random order to avoid any order effects and all tests were coded using numbers instead of children's names to ensure that the researcher was blinded to what child completed the test and what group they had participated in during the intervention year. A parent/guardian was required to remain at the testing site during testing and able to observe if desired. Parents/guardians were also asked to update their contact information to ensure that the researcher could contact them again in February 2012 to schedule the last testing session. At the end of this testing session (test three), once all children had completed all assessments, the researcher, again blinded to the children's names and group assignment (control, experimental, or alternate experimental) scored the assessments. Results were recorded and all test score information was locked to ensure confidentiality.

In February 2012, parents/guardians of the 20 children were again contacted by email, phone, and/or text to set up times for their children to be brought to the Allied Health Sciences

Building at East Carolina University to implement the last testing session at a time that accommodated the schedules of the children, parents/guardians, and the researcher. Multiple phone calls, emails, and texts were sent to set up appointments and remind the parents/guardians of the appointments in an attempt to get as many of the 20 children as possible to complete the last testing session. When the researcher could not schedule appointments via phone calls, emails, and/or texts, postcards were again sent to those parents/guardians that had not yet brought their child in for the last testing session but had given permission to be contacted by indicating their address on the consent form. By the end of March, 16 of the initial 20 children had been scheduled to complete the last testing session (six from the experimental classroom, six from the alternate experimental classroom, and four from the control classroom).

During March 2012 (test four) each child came to the Allied Health Sciences Building at East Carolina University to be retested individually on the same three assessments by trained East Carolina University occupational therapy graduate students under occupational therapy faculty supervision. The test administers were again blinded to what group each child had participated in during the initial study by coding each assessment with the child's number instead of their name. Testing took place two or three days a week, at the convenience of the parents/guardians, throughout the month of March 2012. Again, assessments were administered in random order to avoid any order effects. Efforts were also made to ensure a similar testing environment to that of the first follow-up session (test three) by completing assessments in the same room. A parent/guardian was again required to remain at the testing site and was able to observe the testing if desired. The $25 Wal-Mart gift cards were given to the parents/guardians at the end of their child's testing session, including a third gift card if their child had completed all three tests at both testing sessions. If the parent/guardian had not received their first gift card,

that was also given at this time. All 16 children completed all of the testing requirements at both follow-up testing sessions and received the full amount of Wal-Mart gift cards ($75 total). At the end of the last testing session when all children had completed all assessments, the researcher, again blinded to the names and group assignments of the children, scored the assessments. Results were recorded and all test score information was locked to ensure confidentiality.

The BOT-2 Assist program was used for data entry for the BOT-2 data from the four subtests used (Fine Motor Precision, Fine Motor Integration, Manual Dexterity, and Upper-Limb Coordination). This data was then put into the IBM SPSS Statistics 19 (Statistical Package for the Social Sciences) Software, as was the VMI data. SPSS Software was used for both the BOT-2 (Bruininks & Bruininks, 2005) and the VMI (Beery & Beery, 2010) for data entry and data analysis.

When all assessments were completed and scored, the researcher compared scores received on the four subtests of the BOT-2 (Fine Motor Precision, Fine Motor Integration, Manual Dexterity, and Upper-Limb Coordination; Bruininks & Bruininks, 2005) by children in the control classroom, the experimental classroom, and the alternate experimental classroom. Scores received after the intervention period in March 2011 (test two) were compared to scores received at the end of the follow-up study in March 2012 (test four) to examine the carry-over effects of the FMEW handwriting readiness program on the fine motor skills of the children in the experimental group as compared to the children in the control group and the alternate experimental group. Scores from all four testing sessions over the period of both the initial and follow-up studies were also compared using line plots to examine the individual overall effects

on the fine motor skills of children in the experimental group when compared to children in the control group and the alternate experimental group.

Next, the researcher compared scores received on the VMI (Beery & Beery, 2010) at the end of the follow-up study in March 2012 (test four) to those received at the end of the intervention period in March 2011 (test two) to examine the carry-over effects of the FMEW handwriting readiness program on the visual-motor skills of the children in the experimental group as compared to children in the control group and the alternate experimental group. Scores from all four testing sessions over the period of both the initial and follow-up studies were also compared using a line plot to examine individual overall effects on visual-motor skills of children in the experimental group when compared to children in the control group and the alternate experimental group.

CHAPTER 4: RESULTS

Description of the Sample

The initial study that took place during the 2010-2011 school year had a total of 49 children that were included in the data analysis (16 from the FMEW experimental classroom, 18 from the HWT alternate experimental classroom, and 15 from the control classroom). This follow-up study therefore had the potential to have up to 49 participants. Of those 49, the researcher was able to get 20 children (41%) to complete the first follow-up testing session in September 2011 (7 from the FMEW experimental classroom, 9 from the HWT alternate experimental classroom, and 4 from the control classroom). Of these 20 children, 16 (80%) returned for the last testing session and therefore these 16 were the subjects used for data analysis (6 from the FMEW experimental classroom, 6 from the HWT alternate experimental classroom, and 4 from the control classroom). Due to the small sample size of each of the three groups, no formal inference calculations were performed as part of the data analysis for this follow-up study, as a much larger sample size is needed to obtain significant results and the small sample size decreases both the generalizability of test results to the population, as well as the power of the statistical analysis.

The control group had four children total, all of which were males. The HWT alternate experimental group had six children total, with four males (67%) and two females (33%). The FMEW experimental group had six children total, with two males (33%) and four females (67%).

The FMEW experimental group was considerably older than the other two groups, with a median age six months older than the HWT alternate experimental group and eight months older

than the control classroom. In Spring 2012, the control group had a median age of 67 months, the HWT alternate experimental group had a median age of 69 months, and the FMEW experimental group had a median age of 75 months. See Figure 1.

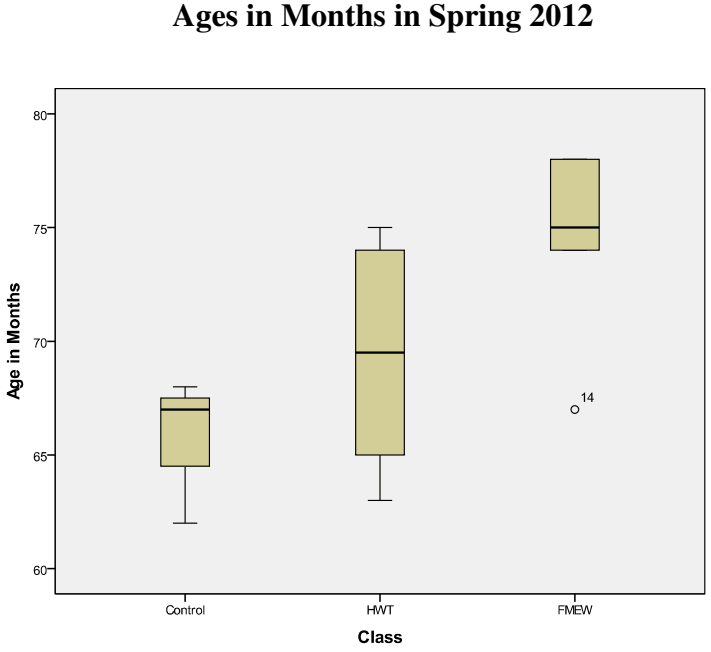

Figure 1. Differences in ages was noted, with the FMEW experimental classroom having an average age that was considerably higher than the other two groups.

Data Analysis

Data analysis took place at the end of the initial study in March 2011. Winslow (2011) analyzed the data for the FMEW experimental group and the control group using the four subtests of the BOT-2 (Bruininks & Bruininks, 2005). Data from the BOT-2 was gathered from the HWT alternate experimental group but not analyzed as part of that study. Also, VMI (Beery & Beery, 2010) data was collected for all three groups but was not analyzed as part of Winslow's (2011) study.

Data analysis for this follow-up study took place when all testing was complete in March 2012. The independent variable was the program in which the child had participated during the intervention year (control group, HWT alternate experimental group, or FMEW experimental group) and the dependent variables were the scores received on the VMI (Beery & Beery, 2010) and the BOT-2 subtests (Fine Motor Precision, Fine Motor Integration, Manual Dexterity, and Upper-Limb Coordination; Bruininks & Bruininks, 2005).

Researchers first used line plots to compare the different data collection points, in which the independent variable was time (the four data collection points) and the dependent variable was the test scores received. (The tests were ordered from test one to test four, however the time between the tests was not the same). One line plot for each test score (one for the VMI [Beery & Beery, 2010] raw scores and four for the BOT-2 [Bruininks & Bruininks, 2005] subtests total point scores) was displayed with the three groups being represented using a different color for each group (control, HWT alternate experimental group, and FMEW experimental group), for a total of five line plots. Each participant had four points connected with a line so that individual results were displayed to make individual differences visually aware to the researcher. The slope of the line segment indicates the size of the change from one testing session to another. This allowed the researcher to see changes in performance within and between the control group, the experimental group, and the alternate experimental group at each testing point.

Next the researcher displayed changes in scores received on the VMI (Beery & Beery, 2010) and the four subtests of the BOT-2 (Bruininks & Bruininks, 2005) using side-by-side box plots in order to determine if outliers were present and to visualize the variability and location of the data. Each graph had three box plots, one for the control group, one for the FMEW

experimental group, and one for the HWT alternate experimental group, that displayed the changes in scores from test two to test four for each of the BOT-2 subtests (Fine Motor Precision, Fine Motor Integration, Manual Dexterity, and Upper-Limb Coordination; Bruininks & Bruininks, 2005) and the VMI (Beery & Beery, 2010). By examining the difference in change in scores between the three groups from test two (end of the intervention period) to test four (one year following intervention), the researcher was able to analyze the carry-over effect that the FMEW curriculum had on the handwriting-related skills of children when compared to those who had received typical Head Start instruction in the control group and those who had participated in the HWT program in the alternate experimental group, for each of the assessment scores. This aided the researcher in better understanding whether effects of this handwriting readiness program would last into the kindergarten year, thereby helping pre-kindergarten children to better prepare for the greater handwriting demands in kindergarten.

The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (VMI) Results

VMI line plot. The VMI raw scores line plot (Figure 2) displays that very few children showed an increase in raw scores from each testing session to the next, even though most children showed an overall increase in raw scores from the second testing session to the last. In fact, many children had decreases in scores from one testing session to the next, with the transition from test two to test three showing the most children with a decrease in scores, as evidenced by a negative slope.

VMI mean scores. Table 1 displays the mean raw scores for each of the groups at each of the four testing sessions. For the HWT alternate experimental group, the mean score went

from 11.83 on test two to 14.33 on test four (see Table 1), with an increase in mean change in scores of 2.50 (see Table 2). The FMEW group had an increase from a mean score of 14.33 on test two to 16.00 on test four (see Table 1), an increase of 1.67 (see Table 2), which was the lowest of all three groups. The mean raw score on the VMI for the control group increased from 11.00 (see Table 1) on test two to 14.00 on test four, with the greatest mean change in scores of 3.00 (see Table 2).

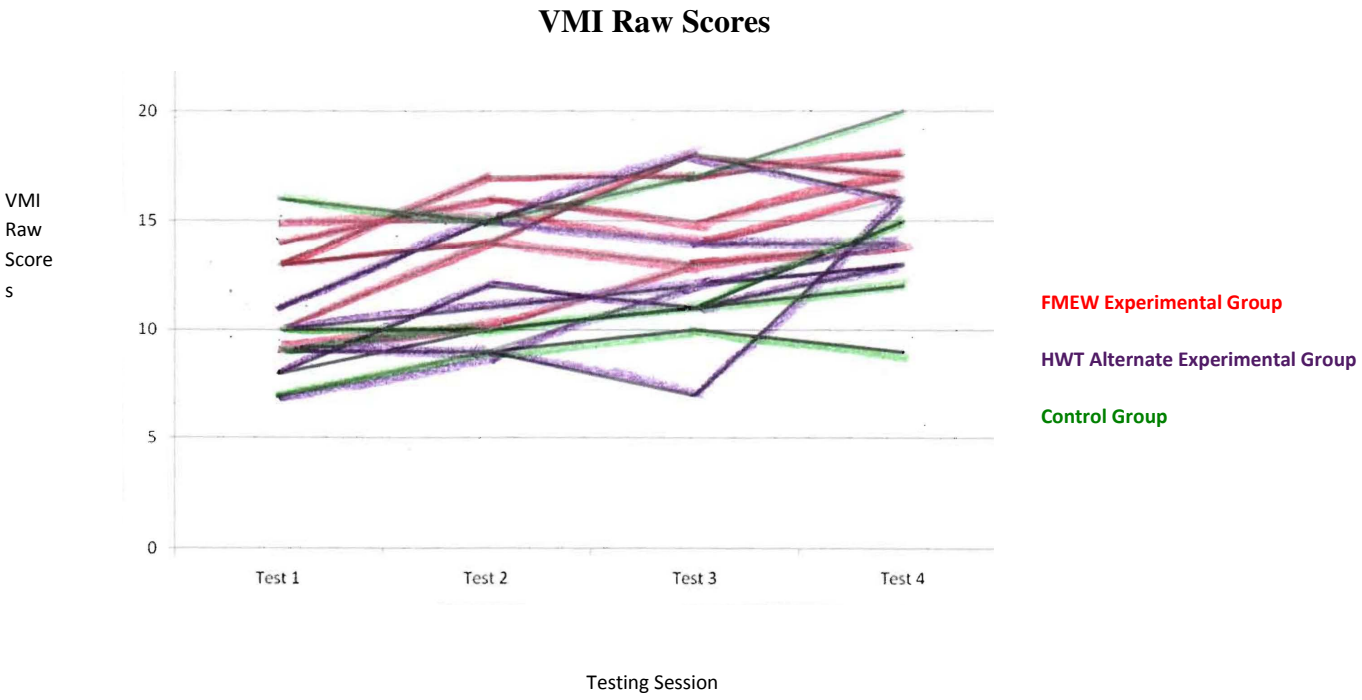

Figure 2. Individual differences noted between the four testing sessions.

Table 1. VMI Raw Scores of All Groups for All Testing Sessions

	FMEW Group		HWT Group		Control Group	
	M	(SD)	M	(SD)	M	(SD)
Test Session						
Test 1	12.33	(2.338)	9.33	(1.633)	10.25	(4.031)
Test 2	14.33	(2.422)	11.83	(2.714)	11.00	(2.708)
Test 3	15.00	(2.098)	12.33	(3.615)	12.25	(3.202)
Test 4	16.00	(1.673)	14.33	(1.366)	14.00	(4.69)

Table 2. VMI Mean Change in Raw Scores from Test 2 to Test 4

FMEW Group		HWT Group		Control Group	
M	(SD)	M	(SD)	M	(SD)
1.67	(1.506)	2.50	(2.950)	3.00	(2.449)

VMI side-by-side box plot. The VMI raw score changes from Test 2 to Test 4 box plot (see Figure 3) displayed a higher median for the control group when compared to the HWT alternate experimental group and the FMEW experimental group. The median change in scores for the control group was 3.50, for the HWT alternate experimental group was 1.50, and for the FMEW experimental group was 1.00. See Table 3.

VMI Raw Score Changes from Test 2 to Test 4

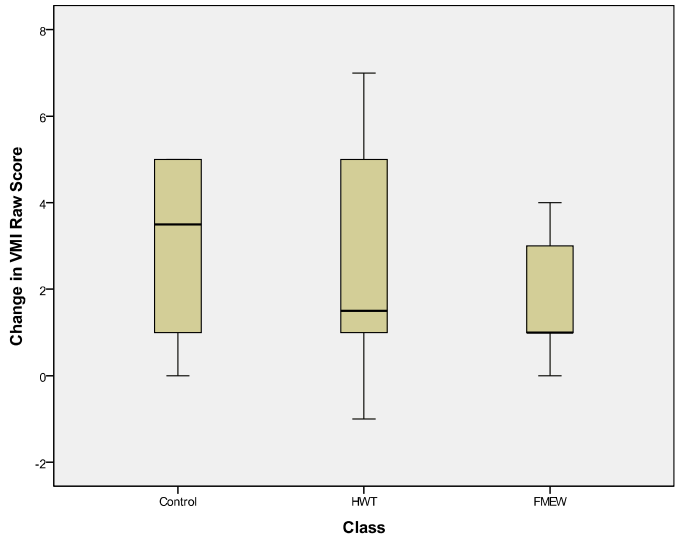

Figure 3. Greatest median change in scores noted for the control group.

Table 3. VMI Median Change in Raw Scores from Test 2 to Test 4

FMEW Group	HWT Group	Control Group
Median	Median	Median
1.00	1.50	3.50

The Bruininks-Oseretsky Test of Motor Proficiency – Second Edition (BOT-2) Results

Fine Motor Precision line plot. The BOT-2 Fine Motor Precision Subtest total point scores line plot (see Figure 4) displayed that the lowest increase in scores for most children was from the first testing session to the second testing session, with four children showing a decrease in scores and two children showing no change in scores. The line plot also shows that for most children the period of greatest increase in scores was between test three and test four. However, more children from the FMEW experimental group showed a greater increase between test two

and test three. All children showed an increase in scores from the second testing session to the last.

Fine Motor Precision mean scores. The HWT alternate experimental group displayed an increase in mean scores from 9.33 on testing session two to 21.17 on testing session four (see Table 4), an increase in mean score of 11.84 (see Table 5). The FMEW experimental group showed the greatest mean change in raw scores from testing session two to testing session four with a change in mean scores of 13.67 (see Table 5), from 15.33 on testing session two to 29.00 on testing session four (see Table 4). The control group had a mean total point score increase from 10.00 at the second testing session to 21.25 at the fourth testing session (see Table 4), a change in mean score of 11.25 (see Table 5), which was the lowest when compared to the other two groups.

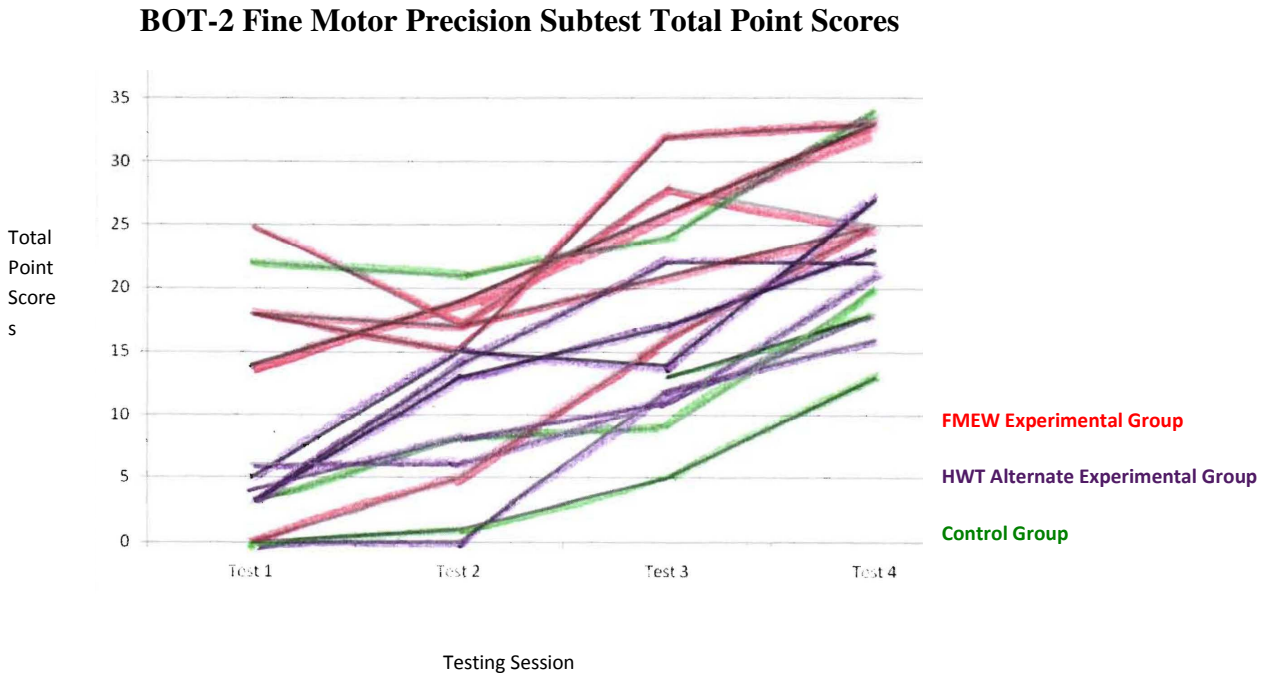

Figure 4. Individual differences noted between the four testing sessions.

Table 4. BOT-2 Fine Motor Precision Subtest Total Point Scores of All Groups for All Testing Sessions

	FMEW Group		HWT Group		Control Group	
	M	(SD)	M	(SD)	M	(SD)
Test Session						
Test 1	14.83	(8.305)	3.50	(2.074)	6.25	(10.595)
Test 2	15.33	(5.279)	9.33	(5.785)	10.00	(10.149)
Test 3	24.83	(5.601)	14.50	(4.324)	12.75	(8.180)
Test 4	29.00	(4.382)	21.17	(3.869)	21.25	(8.995)

Table 5. BOT-2 Fine Motor Precision Subtest Mean Change in Total Point Scores from Test 2 to Test 4

FMEW Group		HWT Group		Control Group	
M	(SD)	M	(SD)	M	(SD)
13.67	(4.577)	11.84	(2.714)	11.25	(.577)

Fine Motor Integration line plot. The BOT-2 Fine Motor Integration Subtest total point scores line plot (see Figure 5) displayed that all children showed an increase in scores from test one to test two, and for most children the greatest increase in scores was from test three to test four. However, four children showed a decrease in scores from test three to test four, while only two children decreased in scores from test two to test three. All children showed an increase in scores from the second testing session to the last. Some children showed very large increases from one testing session to the next. One child from the control group showed the greatest increase of any children between any two testing sessions, which was noted between test three

and test four. Another child from the control group showed a large increase from test three to test four. Lastly, a child from the FMEW experimental group showed a large increase from test two to test three.

Fine Motor Integration mean scores. The FMEW group displayed a mean of 18.50 at test two and a mean of 27.00 at test four (see Table 6), showing a change in mean scores of 8.50 (see Table 7), the lowest of all three groups for this subtest. Children from the HWT alternate experimental group displayed a change in mean scores of 12.33 (see Table 7) with a mean of 12.00 at test two and a mean of 24.33 at test four (see Table 6). The control group displayed the greatest change in mean scores of 16.08 (see Table 7), increasing from a mean of 11.67 at test two to 27.75 at test four (see Table 6).

BOT-2 Fine Motor Integration Subtest Total Point Scores

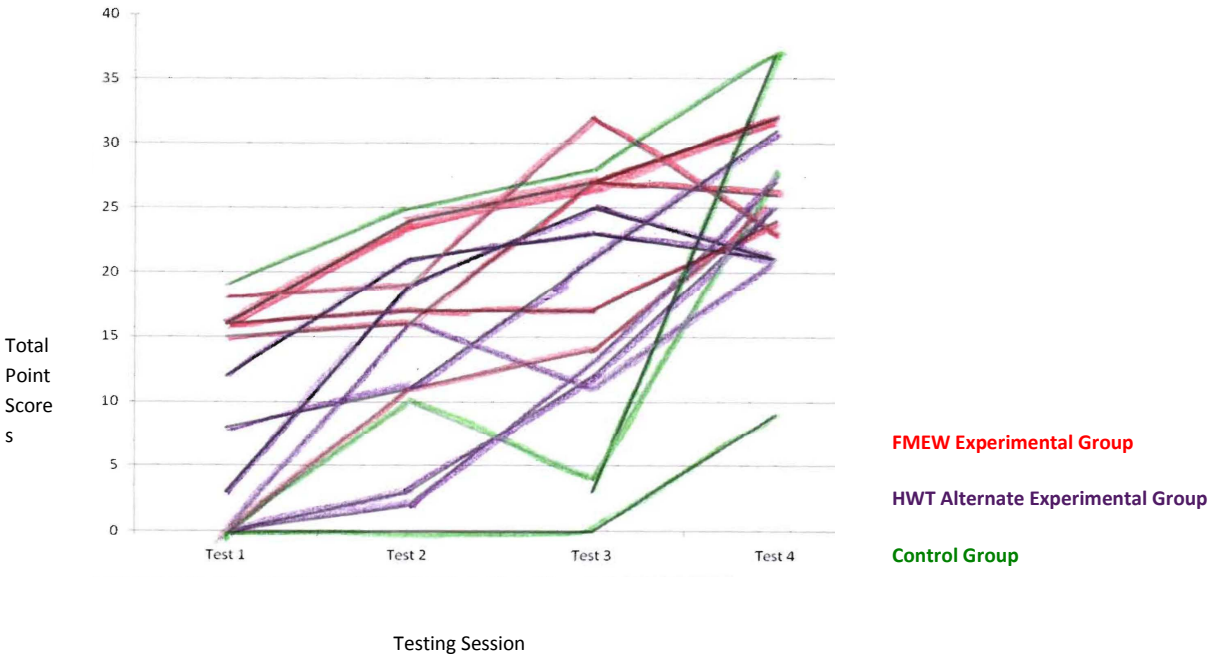

Figure 5. Individual differences noted between the four testing sessions.

Table 6. BOT-2 Fine Motor Integration Subtest Total Point Scores of All Groups for All Testing Sessions

	FMEW Group		HWT Group		Control Group	
	M	(SD)	M	(SD)	M	(SD)
Test Session						
Test 1	13.50	(6.686)	3.83	(5.076)	4.75	(9.50)
Test 2	18.50	(5.010)	12.00	(8.099)	11.67	(12.583)
Test 3	24.00	(6.928)	17.50	(6.189)	8.75	(12.945)
Test 4	27.00	(4.00)	24.33	(4.131)	27.75	(13.20)

Table 7. BOT-2 Fine Motor Integration Subtest Mean Change in Total Point Scores from Test 2 to Test 4

FMEW Group		HWT Group		Control Group	
M	(SD)	M	(SD)	M	(SD)
8.50	(3.047)	12.33	(5.402)	16.08	(4.583)

Manual Dexterity line plot. The BOT-2 Manual Dexterity Subtest total point scores line plot (see Figure 6) displayed that the greatest increase in scores for most children was between testing session two and testing session three. Between test one and test two, and between test three and test four, many children showed little or no increase in scores, and a few children actually showed a decrease in scores. From testing session two to testing session four all children showed an increase in scores.

Manual Dexterity mean scores. The FMEW group had a mean of 12.83 at test two and 20.50 at test four (see Table 8), with an increase in mean score of 7.67 (see Table 9). The HWT group had a mean of 10.67 at test two and 16.33 at test four (see Table 8), showing the lowest increase in mean score of 5.66 (see Table 9). The mean total point score for the control group was 7.00 at test two and 15.50 on test four (see Table 8), displaying the greatest increase in mean score of 8.50 (see Table 9).

BOT-2 Manual Dexterity Subtest Total Point Scores

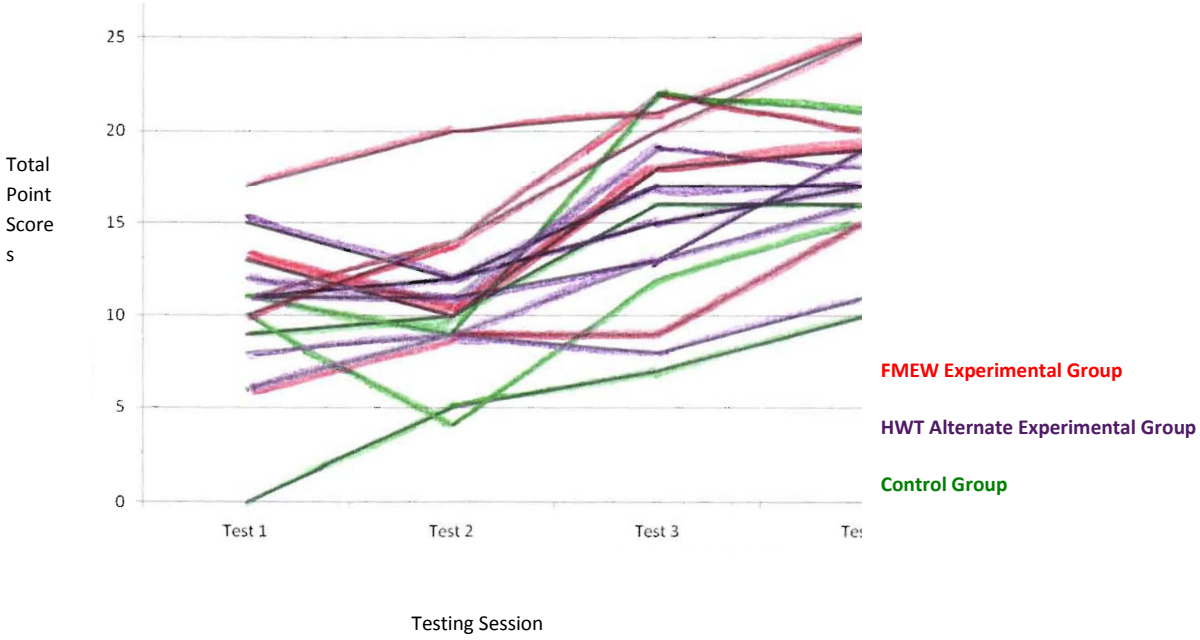

Figure 6. Individual differences noted between the four testing sessions.

Table 8. BOT-2 Manual Dexterity Subtest Total Point Scores of All Groups for All Testing Sessions

	FMEW Group		HWT Group		Control Group	
	M	(SD)	M	(SD)	M	(SD)
Test Session						
Test 1	11.67	(3.67)	10.50	(3.146)	7.50	(5.066)
Test 2	12.83	(4.119)	10.67	(1.366)	7.00	(2.944)
Test 3	18.00	(4.69)	14.17	(3.817)	14.25	(6.344)
Test 4	20.50	(3.886)	16.33	(2.805)	15.50	(4.509)

Table 9. BOT-2 Manual Dexterity Subtest Mean Change in Total Point Scores from Test 2 to Test 4

FMEW Group		HWT Group		Control Group	
M	(SD)	M	(SD)	M	(SD)
7.67	(2.338)	5.66	(2.302)	8.50	(3.51)

Upper-Limb Coordination line plot. Lastly, the BOT-2 Upper-Limb Coordination Subtest total point scores line plot (see Figure 7) displayed that many children showed decreases in scores from one testing session to the next, more so than any other subtest. More children decreased in scores between test one and test two than between any other testing periods. For most children, the greatest period of increase in scores was between test two and test three, and not all children showed an increase in scores between test two and test four. Furthermore, this line plot shows that this subtest showed the greatest variability between children in scores on each of the testing sessions, as some children displayed considerably higher scores throughout all

four testing sessions when compared to other children, and some children displayed considerably lower scores throughout all four testing sessions. Initially two children were outliers in that they scored very high on the first test in comparison to the other children. These two children displayed the highest scores on each of the four testing sessions.

Upper-Limb Coordination mean scores. The mean total point score for the control group increased from 6.50 at the second testing session to 15.75 (see Table 10) at the fourth testing session, an increase of 9.25 (see Table 11), which was the highest for this subtest. The HWT alternate experimental group decreased in mean score by 0.50 (see Table 11), from a mean of 12.50 at test two to 12.00 at test four (see Table 10), showing the only decrease in mean score of all tests. The FMEW experimental group increased from 14.83 at test two to 21.33 at test four (see Table 10), showing an increase in mean score of 6.50 (see Table 11). Interestingly, the FMEW experimental group had a higher mean at test two than the HWT alternate experimental group had at test four (see Table 10).

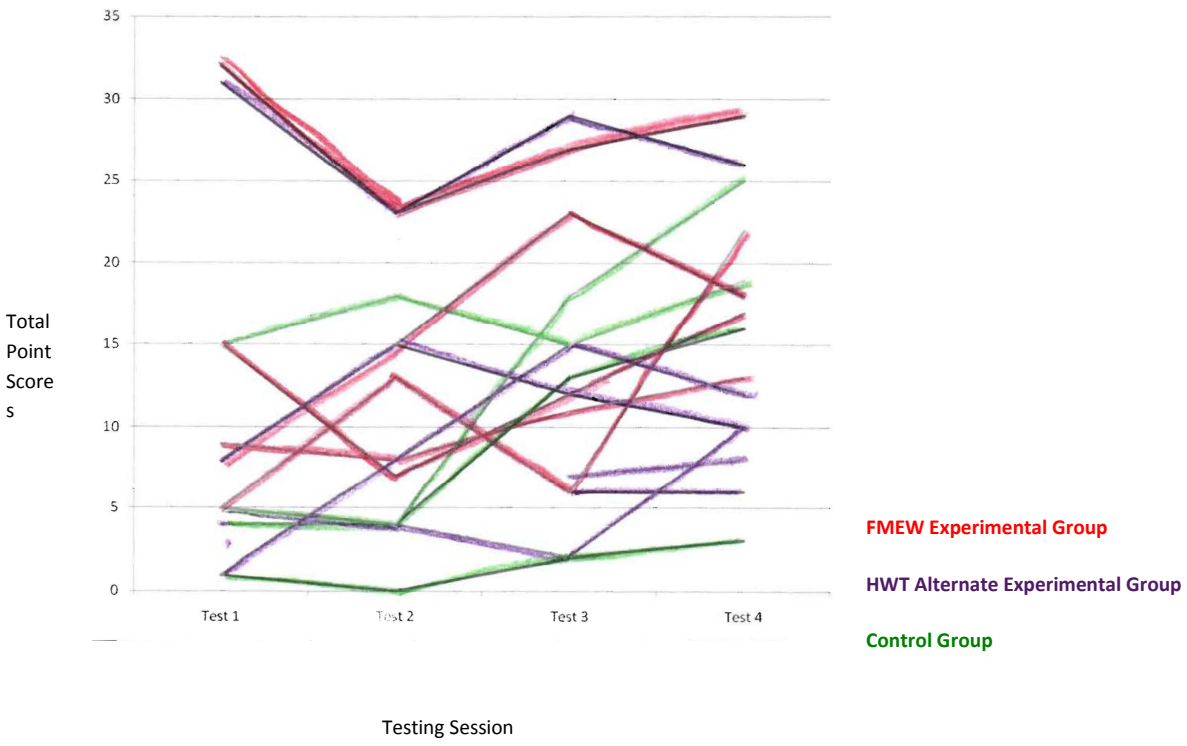

Figure 7. Individual differences noted between the four testing sessions.

Table 10. BOT-2 Upper-Limb Coordination Subtest Total Point Scores of All Groups for All Testing Sessions

	FMEW Group		HWT Group		Control Group	
	M	(SD)	M	(SD)	M	(SD)
Test Session						
Test 1	16.83	(12.189)	8.67	(11.183)	6.25	(6.076)
Test 2	14.83	(6.998)	12.50	(8.347)	6.50	(7.895)
Test 3	17.67	(9.114)	11.83	(9.579)	12.00	(6.976)
Test 4	21.33	(6.593)	12.00	(7.155)	15.75	(9.287)

Table 11. BOT-2 Upper-Limb Coordination Subtest Mean Change in Total Point Scores from Test 2 to Test 4

FMEW Group		HWT Group		Control Group	
M	(SD)	M	(SD)	M	(SD)
6.50	(2.588)	-0.50	(4.932)	9.25	(9.179)

Fine Motor Precision side-by-side box plot. The BOT-2 Fine Motor Precision Subtest scaled score changes from Test 2 to Test 4 box plot (see Figure 8) showed that the greatest median change in scores of all three groups was in the FMEW experimental group. The median change in scores in the FMEW experimental group was 7.00, with the control group next at 4.00, and a median change in scores of 3.00 in the HWT alternate experimental group. See Table 12.

BOT-2 Fine Motor Precision Subtest Scaled Score Changes from Test 2 to Test 4

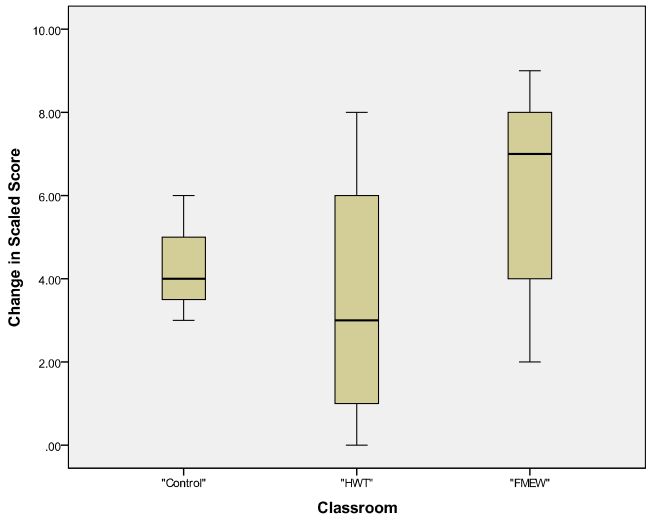

Figure 8. Greatest median change in scores noted for the FMEW experimental group.

Fine Motor Integration side-by-side box plot. The BOT-2 Fine Motor Integration Subtest scaled score changes from Test 2 to Test 4 box plot (see Figure 9) displayed that the greatest median change in scores when compared to the other two groups was in the control group, followed by the HWT alternate experimental group. The control group had a median change of 4.00, the HWT alternate experimental group displayed a median change of 2.50, and the FMEW experimental group showed no median change (0.00). See Table 12.

BOT-2 Fine Motor Integration Subtest Scaled Score Changes from Test 2 to Test 4

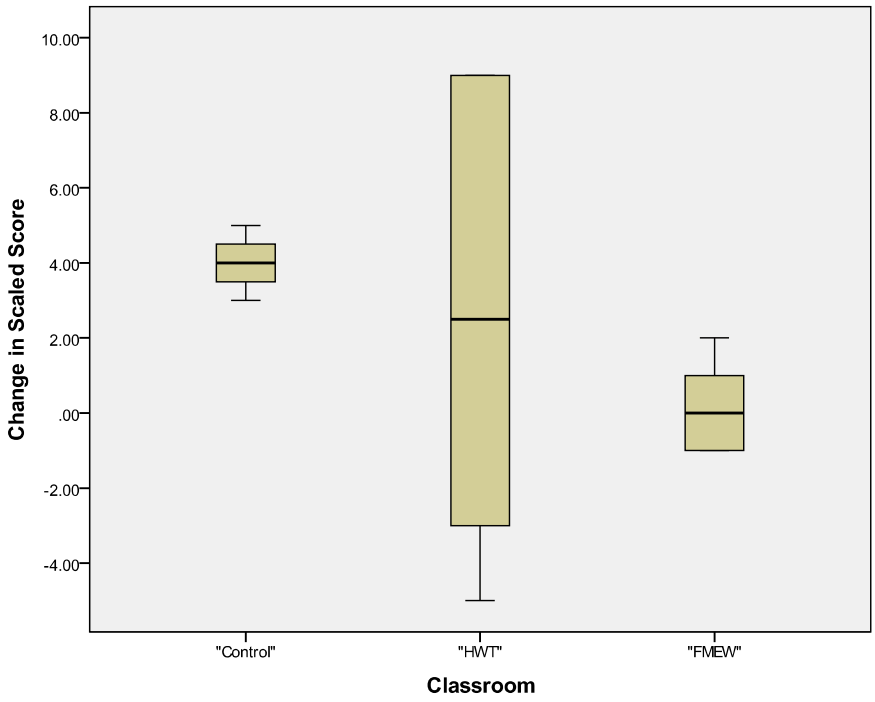

Figure 9. Greatest median change in scores noted for the control group.

Manual Dexterity side-by-side box plot. The BOT-2 Manual Dexterity Subtest scaled score changes from Test 2 to Test 4 box plot (see Figure 10) showed the FMEW experimental group with the greatest median change in scores when compared to the other two groups. The FMEW experimental group median change in scores was 5.50, followed by the control group

with a median change in scores of 4.00, and lastly the HWT alternate experimental group with a median change in scores of 2.00. See Table 12.

BOT-2 Manual Dexterity Subtest Scaled Score Changes from Test 2 to Test 4

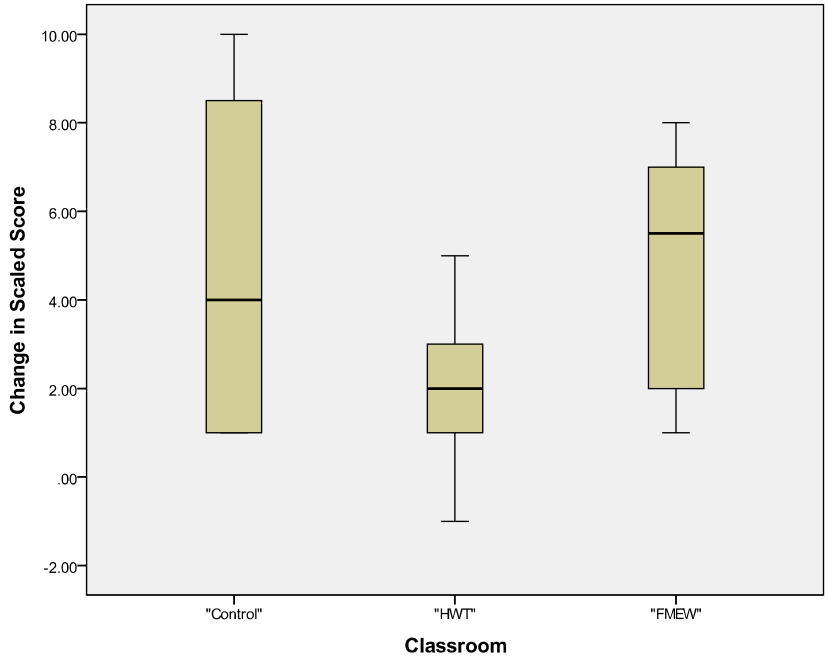

Figure 10. Individual differences noted between the four testing sessions.

Upper-Limb Coordination side-by-side box plot. The BOT-2 Upper-Limb Coordination Subtest scaled score changes from Test 2 to Test 4 box plot (see Figure 11) displayed that the greatest median change in scores was in the control group when compared to the other two groups, both of which actually had a decrease in median change of scores. The control group displayed a median change of 2.50. Both the FMEW experimental group and the HWT alternate experimental group displayed a median change of -1.00. See Table 12.

BOT-2 Upper-Limb Coordination Subtest Scaled Score Changes from Test 2 to Test 4

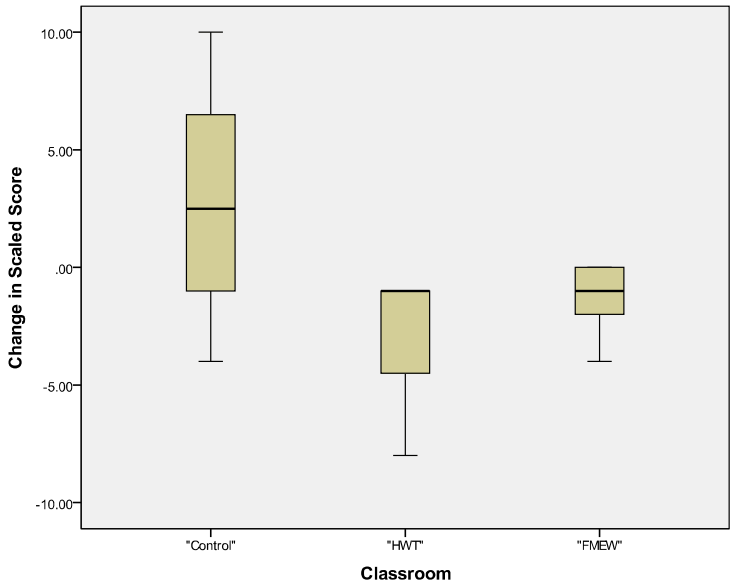

Figure 11. Greatest median change in scores noted for the control group.

Table 12. BOT-2 Subtests Median Change in Scaled Scores from Test 2 to Test 4

	FMEW Group	HWT Group	Control Group
BOT-2 Subtest	Median	Median	Median
Fine Motor Precision	7.00	3.00	4.00
Fine Motor Integration	0.00	2.50	4.00
Manual Dexterity	5.50	2.00	4.00
Upper-Limb Coordination	-1.00	-1.00	2.50

CHAPTER 5: DISCUSSION

Due to the small sample size of this follow-up study and the lack of randomization between the three groups, it is difficult to draw conclusions about the FMEW Pre-K curriculum and its effects on handwriting-related skills on children one year following intervention. The lack of randomization led to groups that differed in age and gender. The age difference was a significant issue, as the FMEW experimental classroom began with relatively higher test scores when compared to the other two groups, and the control group began with relatively lower test scores when compared to the other two groups. The small sample size was also a significant issue, as any outliers greatly affected the mean and median changes in scores for each group on each of the assessments. The control group demonstrated greater median improvements in scores on three of the five measurements, however the researcher does not believe that the lack of handwriting instruction demonstrated more positive impacts on the handwriting-related skills of children than the handwriting instruction programs. Instead, it is noted that the control group began with lower scores, and therefore had more room to improve. The control group also had less children than the other two groups, meaning that any outliers had a greater effect on the median and mean changes in scores for the control group than that of the other two groups. Furthermore, maturation likely had an effect on the skills of all the children participating in the study. In fact, it would be expected that children would show the most improvements after the intervention was implemented, which was between testing session one and testing session two. However, many of the five measurements showed greater improvement in scores between test two and test three and between test three and test four, suggesting that the data was skewed negatively due to limitations of both the initial study and the follow-up study, and therefore

conclusions should not be drawn from this data alone about the initial and carry-over effects of the FMEW curriculum.

The first research question asked if implementation of the FMEW Pre-K Curriculum during Head Start would help children show greater improvements in scores on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005) from the end of the intervention year to one year following intervention when compared to children who participated in typical Head Start instruction for handwriting and to children who participated in the Handwriting Without Tears – Get Set For School Curriculum®. While children in the FMEW experimental classroom did display a greater median change in scores on the BOT-2 Manual Dexterity Subtest (Bruininks & Bruininks, 2005), the control group displayed a greater mean change in scores on this subtest, as well as a greater median and mean change in scores on the Fine Motor Integration Subtest (Bruininks & Bruininks, 2005). Therefore, this study did not demonstrate greater improvements in scores on the Fine Motor Integration Subtest and the Manual Dexterity Subtest of the BOT-2 (Bruininks & Bruininks, 2005) in the FMEW experimental group when compared to the control group or the alternate experimental group participating in the HWT program. However, on both subtests the FMEW experimental group displayed the highest mean scores at test two. Furthermore, the Fine Motor Integration line plot demonstrated that the greatest increase in scores for most children was from test three to test four, which may suggest that maturation had more of an effect on the visual-motor skills of children than what handwriting instruction they had received. The line plot also illustrates that two children from the control group showed very large increases in scores, one between test three and test four and another between test two and test three. As there were only four children total in the control group, this illustrates that these two children had a large effect on the mean

change in scores for the control group, skewing the data to favor the control group when analyzing changes in scores. The Manual Dexterity line plot displayed that the greatest increase in scores for most children was between test two and test three, which was the period of summer break in which children were likely not receiving instruction on handwriting-related skills. However, the skills used on this subtest of the BOT-2 are meant to correlate with recreational activities such as playing cards, which may be activities that children engaged in more during the summer than during the school year. Interestingly, the control group decreased in mean scores from test two to three, and was the only group to do so. Furthermore, children from the control group showed a decrease in mean change in scores following intervention (between testing session one and testing session two), yet displayed the greatest mean increase during the follow-up year (between testing session three and testing session four). This further iterates that maturation and other limitations of the study likely had a greater effect on these results than the handwriting readiness programs themselves.

The second research question asked if use of the FMEW Pre-K Curriculum during Head Start helped children to show greater improvements in scores on the Upper-Limb Coordination Subtest and the Fine Motor Precision Subtest of the BOT-2 (Bruininks & Bruininks, 2005) from the end of the intervention year to one year following intervention when compared to the control group who participated in typical Head Start handwriting instruction and compared to children who participated in the Handwriting Without Tears – Get Set For School Curriculum®. The Fine Motor Precision Subtest of the BOT-2 (Bruininks & Bruininks, 2005) displayed the greatest mean and median change in scores in the FMEW experimental classroom from test two to test four when compared to the other two groups, as well as the highest mean score at both the second testing session and the last testing session. Furthermore, the line plot displayed that the

lowest increase in scores for most children was from the first testing session to the second, and the greatest increase in scores was from test three to test four, suggesting that the increase in scores seen in the follow-up year may have been due to maturation more than to the effects of the handwriting instruction programs, and the fact that children in the experimental classroom were considerably older than the children from the control and HWT alternate experimental groups. The Upper-Limb Coordination Subtest of the BOT-2 (Bruininks & Bruininks, 2005) displayed the control group with both the highest median and mean change in scores from test two to test four when compared to the other two groups. It is important to note that the FMEW experimental group again displayed the highest mean scores at both test two and test four, and in fact had a higher mean at test two than the HWT alternate experimental group had at test four. Therefore, even though this group did not have the greatest change in scores, they did have the highest mean scores by far which affected the median and mean change in scores. Again, this is likely due to the fact that the children in the FMEW experimental classroom were considerably older than the children in the other two groups. In addition, the Upper-Limb Coordination line plot displayed that many children showed decreases in scores between testing sessions, which may suggest an issue with difficulties of the assessment in either administration or performance. Therefore, this study did not demonstrate that the FMEW curriculum helped children to show greater improvements in scores on the Upper-Limb Coordination Subtest and the Fine Motor Precision Subtest of the BOT-2 when compared to the other two groups.

The third research question asked if implementation of the FMEW Pre-K Curriculum in Head Start helped children to display greater improvements in scores on visual-motor skills from the end of the intervention year to one year following intervention when compared to children who participated in the Handwriting Without Tears – Get Set For School Curriculum® and

compared to children who had received typical Head Start instruction for handwriting as evidenced using The Beery-Buktenica Developmental Test of Visual-Motor Integration – Sixth Edition (Beery & Beery, 2010). Children who had participated in the control group and had received typical Head Start instruction during the intervention year demonstrated the greatest mean and median change in scores from the end of the intervention year to one year following intervention on the VMI (Beery & Beery, 2010) when compared to the other two groups. Those children who had participated in the FMEW experimental classroom demonstrated the lowest mean and median change in scores when compared to the other two groups, although they demonstrated the highest mean scores at both the second and the fourth testing sessions, yielding a smaller change in scores between the two testing sessions. The higher mean scores displayed by the FMEW experimental group are again likely due to the fact that these children were considerably older than those children in the other two groups, as the shapes being copied on the VMI are presented in a developmental sequence. Analyzing the changes in scores made a negative impression of the FMEW experimental group, when in fact they demonstrated the highest scores on this subtest. Furthermore, the VMI line plot displayed that little change was made between each testing session for most children, suggesting that maturation may have had more of an effect on the scores than the type of handwriting instruction the children had received during Head Start. In fact, some children showed decreases in scores between testing sessions, bringing into question whether there were difficulties with this assessment, either in administration or performance. Therefore, this study did not demonstrate that the FMEW curriculum helped children to display greater improvements in scores of visual-motor skills from the end of the intervention year to one year following intervention when compared to the other two groups.

Limitations of this study include the small sample size and the convenience sampling, which inadvertently led to a lack of randomization. All three groups were small samples, which decreases both the generalizability of test results to the population, as well as the power of statistical analysis. The lack of randomization also led to unequal groups as far as age and gender, with the FMEW experimental group having more females and a higher mean age, and the control group being all male and considerably younger. These factors strongly influenced the results, especially age, since this affects the scaled and standard scores and the development of handwriting-related skills.

During the follow-up year the children were in different schools and classrooms, and therefore were receiving different handwriting instruction. This influenced their abilities in handwriting-related skills and therefore the assessment scores. Another limitation is that maturation naturally affects the handwriting-related skills of children, as these skills naturally develop as children age, effecting the accuracy of the results.

The researcher put forth every effort to get as many children from the initial year of the study to participate in this follow-up study, including multiple phone calls, emails, postcards, and text messages to parents/guardians to attempt to schedule testing sessions and reschedule when parents/guardians and children did not show for their scheduled testing times. Parents were given up to $75 in gift cards as an incentive to participate in the study as well. Given the many limitations of this study, including the failed attempts to get a sample size large enough to yield generalizable and reliable results, a replicated study is not recommended in the future. Working with a Head Start in which the classrooms were randomly assigned to the intervention program (rather than being able to ensure that gender and age were more equal between the three groups)

makes it difficult to yield reliable results. Furthermore, having no control over the handwriting instruction each of the children was receiving during the follow-up year was another limitation that is difficult to control. Given that many of these factors cannot be addressed in real-life situations, it is not recommended that this study be repeated in the future, as the researcher was unable to draw conclusions from this data. However, a study in which many of these limitations could be addressed may yield valuable information about handwriting readiness programs. For instance, a study could be performed at a school in which all children from a Pre-K setting will be going to the same school for their kindergarten year. Although the children may still be in different handwriting classrooms, they would at least be in the same school and therefore more about their handwriting instruction received during that year could be made aware to the researcher, or even controlled as part of the research. Furthermore, this type of setting would increase the likelihood that more children would participate in the research throughout both the intervention year and the follow-up year. Furthermore, researchers could go to this school to administer assessments for both of the post-testing sessions, which again would likely increase the amount of participants for the follow-up study. Lastly, more control needs to be given to the researchers in order to make each classroom more representative of the population, and to ensure that the classrooms are more equal as far as gender and age.

Due to the small sample size of this study, further research with a larger sample size and a more representative sample is needed to support these findings. One conclusion that can be drawn from this study is the differences between children in their ability to gain and maintain different handwriting-related skills. All 16 children demonstrated different strengths and weaknesses in handwriting-related skills, which demonstrates the need for multisensory

handwriting instruction programs that address a variety of different learning styles, such as the FMEW curriculum, to ensure that as many children as possible are learning from the program.

REFERENCES

Alexander, K. L., Entwisle, D. R., & Olson, L. S. (2001). Schools, achievement, and inequality: A seasonal perspective. *Educational Evaluation and Policy Analysis*, *23*, 171–191.

Alston, J. (1985). The handwriting of seven to nine year olds. *British Journal of Special Educational Needs*, *12*, 68-72.

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

Beery, K. E. (1997). *The Beery-Buktenica developmental test of visual-motor integration* (Rev. 4th ed.). Parsippany, NJ: Modern Curriculum Press.

Beery, K. E., & Beery, N. A. (2010). *The Beery-Buktenica developmental test of visual- motor integration - sixth edition: Administration, scoring, and teaching manual*. Bloomington, MN: Pearson, Inc.

Benbow, M. D. (1995). Principles and practices of teaching handwriting. In A. Henderson & C. Pehoski (Eds.), *Hand function in the child, foundations for remediation* (pp.255-281). St. Louis, MO: Mosby.

Berninger, V., & Fuller, E. (1992). Gender differences in orthographic, verbal, and compositional fluency: Implications for diagnosis of writing disabilities in primary grade children. *Journal of School Psychology*, *30*, 363-382.

Berninger, V. W., Mizokawa, D. T., & Bragg, R. (1991). Theory-based diagnosis and remediation of writing disabilities. *Journal of School Psychology*, *29*, 57-79.

Berninger, V., Rutberg, J., Abbott, R., Garcia, N., Anderon-Youngstrom, M., Brooks, A., et al. (2006). Tier 1 and tier 2 early intervention for handwriting and composing. *Journal of School Psychology*, *44*, 3-30.

Berninger, V. W., & Swanson, H. L. (1994). Modifying Hayes and Flower's model of skilled writing to explain beginning and developing writers. In J.S. Carlson (Series Ed.) & E.C. Butterfield (Vol. Ed.), *Advances in cognition and educational practice: Vol. 2 Children's writing: Toward a process theory of the development of skilled writing* (pp. 57-81). Greenwich, CT: JAI Press.

Berninger, V. W., Vaughan, K., Abbot, R., Abbot, S., Rogan, L., Brooks, A., et al. (1997). Treatment of handwriting problems in beginning writers: Transfer from handwriting to composition. *Journal of Educational Psychology*, *89*, 652-666. doi: 10.1037/0022-0663.89.4.652

Biemiller, A., Regan, E., & Gang, B. (1993). *Studies in the Developmental of Writing Speed: Age, Task, and Individual Differences.* University of Toronto, ON, Canada, Unpublished manuscript.

Briggs, D. (1980). A study of the influence of handwriting upon grades using examination scripts. *Educational Review, 32*, 185-193.

Bruininks, R.H., & Bruininks, B.D. (2005). *Bruininks-Oseretsky test of motor proficiency second edition: Manual*. Circle Pines, MN: AGS Publishing.

Case-Smith, J. (2002). Effectiveness of school-based occupational therapy intervention on handwriting. *American Journal of Occupational Therapy*, *56*, 17-25.

Chase, C. (1986). Essay test scoring: Interaction of relevant variables. *Journal of Educational Measurement*, *23*, 33-41.

Christensen, C. (2005). The role of orthographic-motor integration in the production of creative and well-structured written text for students in secondary school. *Educational Psychology*, *25*, 441-453.

Connelly, V., Gee, D., & Walsh, E. (2007). A comparison of keyboarded and handwritten compositions and the relationship with transcription speed. *British Journal of Educational Psychology*, *77*, 479-492.

Cornhill, H., & Case-Smith, J. (1996). Factors that related to good and poor handwriting. *American Journal of Occupational Therapy*, *50*, 732-739.

Cunningham, A., & Stanovich, K. (1990). Early spelling acquisition: Writing beats the computer. *Journal of Educational Psychology*, *82*, 159-162.

Daly, C., Kelley, G., & Krauss, A. (2003). Brief report – Relationship between visual-motor integration and handwriting skills of children in kindergarten: A modified replication study. *American Journal of Occupational Therapy*, *5*, 459-462.

De La Paz, S., & Graham, S. (1995). Dictation: applications to writing for students with learning disabilities. In T. Scruggs & M. Mastropieri (Eds.), *Advances in Learning and Behavioral Disorders Vol. 9* (pp.227-247). Greenwich, CT: JAI Press.

Denton, P. L., Cope, S., & Moser, C. (2006). The effects of sensorimotor-based intervention versus therapeutic practice on improving handwriting performance in 6- to 11-year-old children.. *American Journal of Occupational Therapy*, *60*, 16–27. doi: 10.5014/ajot.60.1.16

Donica, D. (2010). A historical journey through the development of handwriting instruction (Part 2): The occupational therapists' role. *Journal of Occupational Therapy, Schools, & Early Intervention*, *3*, 32-53. doi: 10.1080/19411241003683995

Donica, D., Goins, A., & Wagner, L. (2012, in review). *Effectiveness of handwriting readiness programs on postural control, hand control, and letter and number formation in head start classrooms.*

Dunn, W., Campbell, P. H., Oetter, P. L., Hall, S., & Berger, E. (1988). Occupational therapy services in early intervention and preschool services (position paper). *American Journal of Occupational Therapy*, *42*, 793-794.

Edwards, L. (2003). Writing instruction in kindergarten: Examining an emerging area of research for children with writing and reading difficulties. *Journal of Learning Disabilities*, *36*, 136-148.

Erhardt, R. P., & Meade, V. (2005). Improving handwriting without teaching handwriting: The consultative clinical reasoning process. *Australian Occupational Therapy Journal*, *52*, 199–210. doi: 10.1111/j.1440-1630.2005.00505.x

Feder, K. P., & Majnemer, A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine and Child Neurology*, *49*, 312–317. doi: 10.1111/j.1469-8749.2007.00312.x

Feder, K. P., Majnemer, A., & Synnes, A. (2000). Handwriting: Current trends in occupational therapy practice. *Canadian Journal of Occupational Therapy*, *76*, 197-204.

Fogo, J. (2008). Writing in preschool. Unpublished doctoral dissertation, Purdue University, West Lafayette, IN.

Graham, S. (1999). The role of text production in writing development. *Learning Disability Quarterly*, *22*, 75-77.

Graham, S., Berninger, V. W., Abott, R. D., Abott, S., & Whitaker, D. (1997). The role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology*, *89*, 170-182.

Graham, S., & Harris, K. R. (2000). The role of self-regulation and transcription skills in writing and writing development. *Educational Psychologist*, *35*, 3-12.

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

Graham, S., Schwartz, S., & MacArthur, C. (1993). Knowledge of writing and composing process, attitude toward writing, and self-efficacy for students with and without learning disabilities. *Journal of Learning Disabilities*, *26*, 237-249.

Graham, S., & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980-1994. *Educational Psychology Review*, *8*, 7-87.

Gregg, N., & Mather, N. (2002). School is fun at recess: Informal analysis of written language for students with learning disabilities. *Journal of Learning Disabilities*, *35*, 7-22.

Hagborg, W., & Aiello-Coultier, M. (1994). The Developmental Test of Visual-Motor Integration-3R and teachers' ratings of written language. *Perceptual and Motor Skills*, *79*, 371-374.

Hammerscmidt, S. L., & Sudsawad, P. (2004). Teachers' survey on problems with handwriting: Referral, evaluation and outcomes. *American Journal of Occupational Therapy*, *58,*185–192.

Hamstra-Bletz, L., & Blote, A. (1993). A longitudinal study on dysgraphic handwriting in primary school. *Journal of Learning Disability*, *26*, 689-699.

Haney, M. R. (2002). Name writing: A window into the emergent literacy skills of young children. *Early Childhood Education Journal*, *30*, 101–105. doi: 10.1023/A:1021249218339

Holtzinger, L. J., & Hight, V. P. (2005). How satisfied are OTs in the schools? *Advance for Occupational Therapists*, *21*, 35-41.

Hoy, M. M. P., Egan, M. Y., & Feder, K. P. (2011). A systematic review of interventions to improve handwriting. *Canadian Journal of Occupational Therapy*, *78*, 13-25.

Jackman, M., & Stagnitti, K. (2007). Fine motor difficulties: The need for advocating for the role of occupational therapy in schools. *Australian Occupational Therapy Journal*, *54*, 168–173. doi: 10.1111/j.1440-1630.2006.00628.x

Judkins, J., Dague, H., & Cope, S. (2009). Handwriting in the schools: Challenges and solutions. *Special Interest Section Quarterly: Early Intervention & School*, *16*, 1- 4.

Karlsdottir, R., & Stefansson, T. (2002). Problems in developing functional handwriting. *Perceptual Motor Skills*, *94*, 623-662.

Latash, M. L. (1998). Automation of movements: Challenges to the notions of the orienting reaction and memory. In M. L. Latash (Ed.), *Progress in motor control* (pp. 51-88). Champaign, IL: Human Kinetics.

Linder, K. J. (1986). Transfer to motor learning: From formal discipline to action systems theory. In L. D. Zaichkowsky & C. Z. Fuches (Eds.), *The psychology of motor behavior: Development, control, learning and performance* (pp. 65–87). Ithaca, NY: Movement Publications.

Longstaff, M. G., & Heath, R. A. (1999). A nonlinear analysis of the temporal characteristics of handwriting. *Human Movement Science*, *4*, 485–524.

Lust, C. A., & Donica, D. K. (2011). Research Scholars Initiative—Effectiveness of a handwriting readiness program in Head Start: A two-group controlled trial. *American Journal of Occupational Therapy*, *65*, 560–568. doi: 10.5014/ajot.2011.000612

Maeland, A. F. (1992). Handwriting and perceptual-motor skills in clumsy, dysgraphic and "normal" children. *Perceptual and Motor Skills*, *75*, 1207-1217.

Margalit, M. (1998). Loneliness and coherence among preschool children with learning disabilities. *Journal of Learning Disabilities*, *31*, 173–180.

Marr, D., & Cermak, S. (2003). Consistency of handwriting in early elementary students. *American Journal of Occupational Therapy*, *57*, 161-167.

Marr, D., Cermak, S., Cohn, E., & Henderson, A. (2003). Fine motor activities in Head Start and kindergarten classrooms. *American Journal of Occupational Therapy*, *57*, 550-557. doi: 10.5014/ajot.57.5.550

Marr, D., Windsor, M., & Cermak, S. (2001). Handwriting readiness: Locatives and visuomotor skill in the kindergarten year. *Early Childhood Research and Practice*, *34*, 1-28.

McCutchen, D. (1988). "Functional automaticity" in children's writing: A problem of metacognitive control. *Written Communication*, *5*, 306-324.

McCutchen, D. (1996). A capacity theory of writing: Working memory in composition. *Educational Psychology Review*, *8*, 299-325.

McHale, K., & Cermak, S. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, *46*, 898-903.

Medwell, J., & Wray, D. (2007). Handwriting: What do we know and what do we need to know? *Literacy*, *41*, 10-15.

Medwell, J., & Wray, D. (2008). Handwriting – A forgotten language skill? *Language and Education*, *22*, 34-47. doi: 10.2167/le722.0

Missiuna, C., Pollack, N., Egan, M., DeLaat, D., Gaines, R., & Soucie, H. (2008). Enabling occupation through facilitating the diagnosis of developmental coordination disorder. *Canadian Journal of Occupational Therapy*, *75,* 26-34.

North Carolina Department of Public Instruction (2004a). *Foundations: Early Learning Standards for North Carolina Preschoolers and Strategies for Guiding Their Success*, 28. Retrieved from http://www.ncprek.nc.gov/Foundations/ToDownload.asp.

North Carolina Department of Public Instruction. (2004b). *North Carolina Standard Course of Study*, 18-21. Retrieved from http://www.ncpublicschools.org/curriculum/languagearts/scos/2004/15gradek.

Olive, T., & Kellogg, R. T. (2002). Concurrent activation of high and low-level production processes in written composition. *Memory & Cognition*, *30*, 594-600.

Olsen, J. (2012). *How to Assess Handwriting*. Retrieved from http://www.hwtears.com/newsletter/may2012/tools.

Pape, L., & Ryba, K. (2004). Practical considerations for school-based occupational therapists. Bethesda, MD: The American Occupational Therapy Association.

Pavri, S., & Monda-Amaya, L. (2000). Loneliness and students with learning disabilities in inclusive classrooms: Self-perceptions, coping strategies, and preferred interventions. *Learning Disabilities Research and Practice*, *15*, 22–33.

Peterson, C. Q., & Nelson, D. L. (2003). Effect of an occupational intervention on printing in children with economic disadvantages. *American Journal of Occupational Therapy*, *57*, 152–160. doi: 10.5014/ajot.57.2.152

Phelps, J., & Stempel, L. (1988). The Children's Handwriting Evaluation Scale for Manuscript Writing. *Reading Improvement*, *25*, 247-255.

Piek, J. P., Baynam, G. B., & Barrett, N. C. (2006). The relationship between fine and gross motor ability, self-perceptions, and self-worth in children and adolescents. *Human Movement Science*, *25*, 65-75. doi: 10.1016/j.humov.2005.10.011

Ratzon, N. Z., Efraim, D., & Bart, O. (2007). A short-term graphomotor program for improving writing readiness skills of first-grade students. *American Journal of Occupational Therapy*, *61*, 399–405.

Roston, K. (2010). A Frame of reference for the development of handwriting skills. In E. Lupash & L. Francis (Eds.), *Frames of reference for pediatric occupational therapy* (3rd ed.) (pp. 425-460). Philadelphia, PA: Lippincott Williams & Wilkins.

Rubin, N., & Henderson, S. E. (1982). Two sides of the same coin: Variation in teaching methods and failure to learn to write. *Special Education*: *Forward Trends*, *9*, 17-24.

Scardamailia, M., Bereiter, C., & Goleman, H. (1982). The role of production factors in writing ability. In M. Nystrand (Ed.), *What writers know: The language process and structure of written discourse* (pp. 173-210). New York: Academic Press.

Schneck, C. M., & Amundson, S. J. (2010). Prewriting and handwriting skills. In J. Case- Smith & J. C. O'Brien (Eds.), *Occupational therapy for children* (6th ed., pp. 555–580). Maryland Heights, MO: Mosby Elsevier

Shore, L. (2003). Shore Handwriting Screening [Examiner's Manual]. Chaska, MN: Harcourt Assessment, Inc.

Smits-Engelsman, B. C. M., Niemeijer, A. S., & Van Galen, G. P. (2001). Fine motor deficiencies in children diagnosed as DCD based on poor grapho-motor ability. *Human Movement Science*, *20*, 161-182.

Smits-Engelsman, B. C. M., & Van Galen, G. P. (1997). Dysgraphia in children: Lasting psychomotor deficiency or transient developmental delay? *Journal of Experimental Child Psychology*, *67*, 164-184.

Snow, C. E., Burns, S., & Griffin, P. (1998). (Eds.). *Preventing reading difficulties in young children.* Washington, DC: National Academy Press.

Sovik, N. (1981). An experimental study of individualized learning/instruction in copying, tracking, and handwriting based on feedback principles. *Perceptual and Motor Skills*, *53*, 195-215.

Sovik, N. (1984). The effects of a remedial tracking program on the writing performance of dysgraphic children. *Scandinavian Journal of Educational Research*, *28*, 129-147.

Sudsawad, P., Trombly, C. A., Henderson, A., & Tickle-Dengen, L. (2001). The relationship between the evaluation tool of children's handwriting (ETCH) and teachers' perception of handwriting legibility. *American Journal of Occupational Therapy*, *55*, 518–523.

Sweedler-Brown, C. O. (1992). The effects of training on the appearance bias of holistic essay graders. *Journal of Research and Development in Education*, *26*, 24-29.

Tarnopol, M., & de Feldman, N. (1987). Handwriting and school achievement: A cross-cultural study. In J. Alston & J. Taylor (Eds.), *Handwriting. Theory, research and practice* (pp.189-215). New York: Nichols.

Tseng, M. H., & Chow, S. M. K. (2000). Perceptual-motor function of school-age children with slow handwriting speed. *American Journal of Occupational Therapy*, *54*, 83-88.

Tseng, M. H., & Murray, E. (1994). Differences in perceptual-motor measures in children with good and poor handwriting. *Occupational Therapy Journal of Research*, *14*, 19-36.

Van Galen, G. P. (1991). Handwriting: Issues for a psychomotor theory. *Human Movement Science*, *10*, 165-191.

Volman, M., van Schendel, B., & Jongmans, M. (2006). Handwriting difficulties in primary school children: A search for underlying mechanisms. *American Journal of Occupational Therapy*, *60*, 451-460.

Vreeland, E. (1999). Teaching teachers to teach handwriting. *OT Week*, *13*, 8-9.

Weintraub, N., & Graham, S. (1998). Writing legibly and quickly: A study of children's ability to adjust their handwriting to meet common classroom demands. *Learning Disabilities Research and Practice*, *13*, 146-152.

Weintraub, N., & Graham, S. (2000). The contribution of gender, orthographic, finger function, and visual-motor processes to the prediction of handwriting status. *Occupational Therapy Journal of Research*, *20*, 121-140.

Winslow, B. (2011). Effects of a structured handwriting readiness program on the fine motor skills of children in head start (Master's thesis). Retrieved from http://thescholarship.ecu.edu/

Woodward, S., & Swinth, Y. (2002). Multisensory approach to handwriting remediation: Perceptions of school-based occupational therapists. *American Journal of Occupational Therapy*, *56*, 305–312. doi: 10.5014/ajot.56.3.305

World Health Organization. (2002). International checklist of functioning, disability and health: *ICF (Version 2.1a).* Geneva, Switzerland: Author.

Wuang, Y. P., Lin, Y. H., & Su, C. Y. (2009). Rasch analysis of the Bruininks–Oseretsky Test of Motor Proficiency-Second Edition in intellectual disabilities. *Research in Developmental Disabilities, 30,* pp. 1132-1144.

Ziviani, J. (1984). Some elaborations on handwriting speed in 7- to 14-year-olds. *Perceptual and Motor Skills*, *58*, 535-539.

Ziviani, J., & Elkins, J. (1984). An evaluation of handwriting performance. *Educational Review*, *36*, 249-261.

Zwicker, J. G., & Hadwin, A. F. (2009). Cognitive versus multisensory approaches to handwriting intervention: A randomized controlled trial. *OTJR: Occupation, Participation and Health*, *29*, 40–48. doi: 10.3928/15394492-20090101-06

APPENDIX A: DEFINITIONS OF TERMINOLOGY

Legibility: The extent to which handwriting can be read or deciphered. Legibility is made up of eight components, including:

Memory: The ability to remember and write letters and numbers when dictated to the individual

Orientation: Facing letters and numbers in the correct direction

Placement (also known as alignment): Placing the letters and numbers on the baseline

Size: The size of the letters and numbers in comparison to the provided lines and to each other

Start: Beginning the letter or number in the correct place

Sequence: Writing the letter or number in the correct order with the correct stroke directions of each of its parts

Control: The neatness and proportion of the letters and numbers

Spacing: The amount of space between each letter in a word and between each word in a sentence

Speed: The rate at which written text is produced, usually measured in comparison to peers

(Olsen, 2012)

APPENDIX B: PARENTAL/GUARDIAN CONSENT FORMS AND LETTERS

Informed Consent to Participate in Research

Title of Research Study: Effects of Handwriting Readiness Programs on 4 to 6-year-old Children in Eastern North Carolina

Investigators: Dr. Denise Donica, DHS, OTR/L, BCP
Anna Call, OTS
Whitney Lear, OTS
Institution/Department or Division: East Carolina University, Department of Occupational Therapy
Email: donicad@ecu.edu
Telephone #: 252-744-6197

East Carolina University, Department of Occupational Therapy is planning to continue collecting information on the handwriting research project that your child participated in during the 2010-2011 school year at the Pitt County Head Start. This project will help us continue to look at the impacts of participation in a handwriting readiness program long-term. The goal of this program is to see if those who participated in the programs offered at the Head Start continue to demonstrate gains as they move on to Kindergarten. The decision to take part in this research is yours to make.

You are being invited to take part in this research because your child participated in this study during the 2010-2011 school year at the Pitt County Head Start. In order to conduct a follow-up study with the children during the 2011-2012 school- year, we need volunteers who are willing to take part in the research. We are now asking if you would be willing to give consent for your child's participation and to provide your contact information so that we will be able to contact you to schedule 3 testing sessions (approximately 1 hour each) with your child at East Carolina University's Health Science Building. The building is located off of 5th street near Pitt County Memorial Hospital in Greenville, NC. These sessions will occur one time in each of the following months: August 2011, December 2011, and April 2012. The testing sessions will involve your child completing 3 assessments involving writing, coloring, copying, cutting, and manipulating objects.

You and your child's participation would be appreciated and rewarded with a **$25 Wal-Mart gift card** at **EACH** visit and an **additional $25 gift card for your child** at the end of the study if the child attends ALL 3 sessions and completes all assessments. Please understand that your participation in the study is entirely voluntary, and you are free to discontinue the study at any

time. You will be responsible for transporting your child to and from the testing location at the Health Science Building on the date/time you agree on, and you are required to remain at the testing center for the duration of each session. All testing material will be kept confidential and personal information will only be seen by study investigators. If you have any questions or concerns, please feel free to contact Dr. Denise Donica at ECU at 252-744-6197 or by emailing her at donicad@ecu.edu. If you have any questions about the rights of your child as a research participant, you may contact *The University and Medical Center Institutional Review Board* at 252-744-2914.

Please complete the attached information and return by FRIDAY May 20, 2011. Thank you for your interest in this exciting educational research study!!

Sincerely,
Anna Call, OTS and Whitney Lear, OTS
Dr. Denise Donica, DHS, OTR/L, BCP
Researcher/Principal Investigator

As the parent or guardian of _____,

(write your child's name)

☐ **YES,** I grant my permission for Dr. Donica to contact me by the means I indicate below to schedule 3 additional data collection times with my child during the 2011-2012 school-year. I understand I need to take my child to the Health Sciences Building where these sessions will occur and I will be given a **$25 Wal-Mart card** for **EACH** session my child attends and an **additional $25 card for my child** at the end of the study if the child attends all 3 sessions. I understand this information will not be shared with my child's school and will be kept confidential being used only for the purposes of the above research study.

- ☐ Home phone:_____
- ☐ Address:_____

  _____
- ☐ Cell phone:_____
  - ☐ Check here if texting is ok
- ☐ Email: _____
- ☐ Other contact person's name and information: _____

  _____

  Preferred contact method and time:_____

☐ **NO,** I do NOT grant my permission for Dr. Donica to use my child's data in the educational research project regarding handwriting instruction. I do not want my child to participate in the follow-up study.

Signature of
Parent/Guardian:_____Date:_____

Parent/Guardian's Name
Printed:_____

APPENDIX C: IRB APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building• 600 Moye Boulevard • Greenville, NC 27834
Office **252-744-2914** • Fax **252-744-2284** • **www.ecu.edu/irb**

TO: Denise Donica, DHS, OTR/L, Dept. of Occupational Therapy, ECU—Health Sciences Building--3305

FROM: UMCIRB

DATE: May 10, 2011

RE: Expedited Continuing Review of a Research Study

TITLE: "Long- Tern Effects of Handwriting Readiness Programs on 4 to 6 Year Old Children in Eastern North Carolina"

UMCIRB #10-0447

The above referenced research study was initially reviewed and approved by expedited review on 8.27.10. This research study has undergone a subsequent continuing review using expedited review on 5.6.11. This research study is eligible for expedited review because it is a 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.)
The Chairperson (or designee) deemed this **unfunded** sponsored study **no more than minimal risk** requiring a continuing review in **12 months**. Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **5.6.11** to **5.5.12**. The approval includes the following items:

- Continuing Review Form (date 5.2.11)
- Protocol Summary (dated 4.28.11)
- Presentations
- Packet of Pictures
- Test of Handwriting Skills
- Parent Survey (dated 4.28.11)
- Informed Consent (dated 4.28.11)

The Chairperson (or designee) does not have a conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.

UMCIRB #: 10-0447

RECEIVED

MAY 03 2011

UMCIRB

UNIVERSITY AND MEDICAL CENTER INSTITUTIONAL REVIEW BOARD
REVISION FORM

UMCIRB #: 10-0447 **Date this form was completed:** May 3, 2011
Title of research: Long-term Effects of Handwriting Readiness Programs on 4 to 6-year-old Children in Eastern North Carolina
Principal Investigator: Denise Donica, DHS, OTR/L, BCP
Sponsor: NA

Fund number for IRB fee collection (applies to all for-profit, private industry or pharmaceutical company sponsored project revisions requiring review by the convened UMCIRB committee). If you are a non-ECU entity payment is required at the time of submisison:

Fund	Organization	Account	Program	Activity (optional)
		73059		

Version of the most currently approved protocol: August 24, 2010
Version of the most currently approved consent document: August 24, 2010

CHECK ALL INSTITUTIONS OR SITES WHERE THIS RESEARCH STUDY WILL BE CONDUCTED:

- ☒ East Carolina University
- ☐ Pitt County Memorial Hospital, Inc
- ☐ Heritage Hospital
- ☐ Other
- ☐ Beaufort County Hospital
- ☐ Carteret General Hospital
- ☐ Boice-Willis Clinic

The following items are being submitted for review and approval:

- ☒ Protocol: version or date 4/28/11
- ☒ Consent: version or date 4/28/11
- ☒ Additional material: version or date 4/28/11

Complete the following:

1. Level of IRB review required by sponsor: ☐ full ☒ expedited
2. Revision effects on risk analysis: ☐ increased ☒ no change ☐ decreased
3. Provide an explanation if there has been a greater than 60 day delay in the submission of this revision to the UMCIRB. NA
4. Does this revision add any procedures, tests or medications? ☒ yes ☐ no If yes, describe the additional information: Two additional assessment sessions will occur for each child whose parent gives consent. These additional assessment sessions will continue to assess handwriting and motor skills as a follow-up to the original study in the initial 10-0447 proposal. Additionally, a parent survey will be administered to the parent both times while the child is being tested. The new consent form, parent survey, and additional testing materials are attached for review.
5. Have participants been locally enrolled in this research study? ☒ yes ☐ no
6. Will the revision require previously enrolled participants to sign a new consent document? ☒ yes ☐ no

Briefly describe and provide a rationale for this revision The current participants in the original study are being asked to complete two additional testing sessions during the 2011-2012 school year in order to determine more long-term effects of the intervention provided during the 2010-2011 school year. The testing location will be at East Carolina University at the Health Sciences Building in lab rooms not designated for research purposes. The parent will be completing a consent form before the conclusion of the 2010-2011 school year which consents not only to their participation in the study but also consent to contact the parent in the 2011-2012 school-year to schedule the the follow-up sessions. The new consent form is attached. In addition, a parent survey will be completed about the parent's perceptions of the child's handwriting abilities which will be administered at both testing sessions. This survey is attached. An additional assessment may be used during the two testing sessions for the child which is attached called the Test of Handwriting Skills-Revised. Payment by gifticard will also be issued to the parents which is outlined in the attached protocol .

Denise K Donica | Denise K. Donica | 5/3/11

Principal Investigator Signature | **Print** | **Date**

UMCIRB #: 10-0447

Box for Office Use Only

The above revision has been reviewed by:
☐ Full committee review on _____ ☑ Expedited review on 5·6·11

The following action has been taken:
☑ Approval for period of 5·6·11 to 5·5·12
☐ Approval by expedited review according to category 7
☐ See separate correspondence for further required action.

Signature	Print	Date
Susan McCammon, PhD (CCC)	Susan McCammon	5·10·11

UMCIRB #: 10-0447

RECEIVED

MAY 03 2011

UMCIRB

UNIVERSITY AND MEDICAL CENTER INSTITUTIONAL REVIEW BOARD
INVESTIGATOR REVISION FORM

UMCIRB #: 10-0447 **Date this form was completed:** May 3, 2011
Title of research: Long-term Effects of Handwriting Readiness Programs on 4 to 6-year-old Children in Eastern North Carolina
Principal Investigator: Denise Donica, DHS, OTR/L, BCP
Sponsor: None

Revision submission requested for:
☐ **Principal Investigator**
☒ **Subinvestigator**

List the duties of any new research team members and describe the qualifications of each member to perform their duties, including the completion date of the human protections modules located on the UMCIRB web site.

Anna Call – November 20, 2010
Whitney Lear – December 8, 2010
Simone Cowan – January 20, 2011
Anne Thomas – April 5, 2011

The subinvestigators will be responsible for assisting with obtaining consent, administering assessments and surveys as identified in the protocol summary, data analysis and interpretation, and writing of the research. All subinvestigators will be trained on the administration and scoring of the assessment tools. All subinvestigators have completed an introduction to research course within the occupational therapy curriculum. Whitney and Anna have additionally taken a statistics course to assist with data analysis. All subinvestigators have completed 2 semesters in the graduate occupational therapy program.

Investigator Signature	Print	Date
Anna Call	Anna Call	5/3/11
Whitney Lear	Whitney Lear	5/3/11
Simone Cowan	Simone M. Cowan	5/3/11
Anne Thomas	Anne Thomas	5/3/11
Denise K Donica	Denise K. Donica	5/3/11

Investigator Signature **Print** **Date**
Investigator Signature **Print** **Date**
Investigator Signature **Print** **Date**
Investigator Signature **Print** **Date**
Principal Investigator Signature **Print** **Date**

DEPARTMENT CHAIR APPROVALS STATEMENT IF CHANGE IN PRINCIPAL INVESTIGATOR (IF YOU DO NOT HAVE A DEPARTMENT CHAIR, SUBMIT 1 COPY OF YOUR CURRENT CV FOR REVIEW)

I have reviewed this project. I believe that the research is sound, the goals are scientifically achievable, and does not involve any significant human rights issues. There are appropriate departmental resources (financial and otherwise) available to conduct the research. The investigator is qualified to conduct all aspects of this research project based on education, training or experience, and has the necessary authorizations or privileges to conduct all outlined procedures. I endorse the investigator and outlined research project as indicated by my signature below.

UMCIRB #: 10-0447

I have reviewed the UMCIRB Conflict of Interest Disclosure Form and evaluated the principal investigator of this project for risk related to conflict of interest according to the UMCIRB Standard Operating Procedure Manual. I endorse the investigator and the attached plan (if required) for managing conflict of interest related to this research study as indicated by my signature below.

NOTE: A department chair may not sign this statement if listed as an investigator, and should seek the signature of the division chair/dean.

Signature of Chief of Service/Department Chair | Leonard G Trujillo (Print) | 5-3-11 (Date)

Box for Office Use Only

The above revision has been reviewed by:
☐ Full committee review on _____ ☑ Expedited review on 5.6.11

The following action has been taken:
☑ Approval for period of 5.6.11 to 5.5.12
☑ Approval by expedited review according to category 45 CFR 46.110
☐ See separate correspondence for further required action.

Susan McCanna PhD (RK) | 5.10.11
Signature | Print | Date

1907-2007
CENTENNIAL
East Carolina University

University Health Systems
of Eastern Carolina

Informed Consent to Participate in Research

Title of Research Study: Long-term Effects of Handwriting Readiness Programs on 4 to 6-year-old Children in Eastern North Carolina

Principal Investigator: Denise Donica, DHS, OTR/L, BCP
Institution/Department or Division: East Carolina University/Occupational Therapy
Address: 3305-G Health Science Building Greenville, NC 27834
Telephone #: 252-744-6197

Why is this research being done?
East Carolina University Department of Occupational Therapy continuing to collect information on the handwriting research project that your child participated in during the 2010-2011 school year at the Pitt County Head Start. This project will help us continue to look at the impacts of participation in a handwriting readiness program long-term.

Why am I being invited to take part in this research?
You are being invited to take part in this research because your child was in the initial study during the 2010-2011 year at Head Start.

What other choices do I have if I do not take part in this research?
You can choose not to participate.

Where is the research going to take place and how long will it last?
The research procedures will be conducted at East Carolina University Allied Health Sciences Building located off of 5th street near Pitt County Memorial Hospital in Greenville, NC. You will come to room 3305 (directions will be provided upon request). You will only need to bring your child to **2** sessions (one in August/September 2011 and one in March/April 2012) that will last **about one hour** each. You will be required to stay in the building while your child is testing.

What will I be asked to do?
We are now asking if you would be willing to give consent for your child's participation **and** to provide your contact information so that we can contact you to schedule these 2 testing sessions. The testing sessions will involve your child completing assessments involving writing, coloring, cutting, and manipulating objects. You will need to arrange transportation to the testing location for both sessions. While your child is completing the testing, we will ask you to complete a brief survey related to your child's fine motor skills.

What possible harms or discomforts might I experience if I take part in the research?
There are no more risks with participation than you would experience in everyday life.

What are the possible benefits I may experience from taking part in this research?
The goal of this program is to see if those who participated in the programs offered at the Head Start continue to demonstrate gains as they move on to Kindergarten.

Will I be paid for taking part in this research?
YES! You will receive a **$25 gift card at each session** for attending that testing session (maximum of 2 cards). In addition, you will receive another $25 gift card at the completion of the two sessions.

UMCIRB
APPROVED
FROM 5·6·11
TO 5·5·12

_____
Participant's Initials

Title of Study: *Long-term Effects of Handwriting Readiness Programs on 4 to 6-year-old Children in Eastern North Carolina*

Who will know that I took part in this research and learn personal information about me?
Your information will be kept private and will only be shared with those necessary such as The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research. All information will be locked and names will be removed. When the information is no longer needed, it will be shredded.

What if I decide I do not want to continue in this research?
You may stop your participation at any time. You will not be penalized or criticized for stopping.

Who should I contact if I have questions?
You may contact the Principal Investigator, Denise Donica, at 252-744-6197 or email at donicad@ecu.edu. If you have questions about your rights as someone taking part in research, you may call the Office for Human Research Integrity (OHRI) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the OHRI, at 252-744-197.

I have decided I want to take part in this research. What should I do now?
Fill out the information below:

As the parent or guardian of _____.
(Write your child's name)
I grant my permission for Dr. Donica to contact me by the means I indicate below to schedule 2 testing times with my child during the 2011-2012 school-year. I understand I need to take my child to the Health Sciences Building where these sessions will occur and I will be given a **$25 gift card** for **EACH** session my child attends and an **additional $25 card for my child** at the end of the study if the child completes both sessions. I understand this information will not be shared with my child's school and will be kept confidential being used only for the purposes of the above research study.

- ☐ Home phone:_____
- ☐ Mailing address:_____
  _____
- ☐ Cell phone:_____
  - ☐ Check here if texting is ok
- ☐ Email: _____
- ☐ Other contact person's name and information: _____
  _____
  Preferred contact method and time:_____

_____ _____ _____
Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____ _____ _____
Person Obtaining Consent (PRINT) **Signature** **Date**

_____ _____ _____
Principal Investigator (PRINT) **Signature** **Date**

UMCIRB Number:_10-0447_____

Consent Version # or Date:_4-28-11____
UMCIRB Version 2010.05.01

UMCIRB
APPROVED
FROM 5.6.11
TO 5.5.12

_____
Participant's Initials

**********IMPORTANT INFORMATION**********

Continuing and Final Review Obligations

As Principal Investigator, you are required to submit a continuing or final review form to the Office for Human Research Integrity for IRB review. This is a federal requirement to continue or close your research study before the date of expiration as noted on the attached approval letter. This information is required to summarize the research activities since it was last approved. The regulations do not permit any research activity outside of the IRB approval period. Additionally, the regulations do not permit the UMCIRB to provide a retrospective approval during a period of lapse.

You must submit this form even if there has been no activity, no participants enrolled or you do not wish to continue the activity any longer. Research studies that are allowed to be expired will be reported to the Vice Chancellor for Research and Graduate Studies, along with relevant other administration within the institution. The continuing or final review form is located on our website at http://www.ecu.edu/rgs/irb/ along with our meeting submission deadlines. Please contact the UMCIRB office at 252-744-2914 if you have any questions regarding your role or requirements with continuing review.

Required Approval for Any Changes to IRB-Approved Research

As Principal Investigator, you are required, prior to making any changes in your research study must have those changes reviewed and approved by the IRB. The only exception is when those changes are to eliminate an immediate apparent hazard to the participant. In the case when changes must be immediately undertaken to prevent a hazard to the participant and there is no opportunity to obtain prior IRB approval, the IRB must be informed of the changes as soon as possible via a protocol deviation form.

Reporting Unanticipated Problems to the IRB that Affect Participants or Others

As Principal Investigator, you are required to report to the IRB all unanticipated problems that have occurred in your research within the time frame specified in the UMCIRB rule for reporting Unanticipated Problems Involving Risks to Participants or Others.

Version 5/5/11