Abstract

EFFECTS OF A STRUCTURED HANDWRITING READINESS PROGRAM ON THE FINE MOTOR SKILLS OF CHILDREN IN HEAD START

By

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The purpose of this study was to investigate the effectiveness of a structured handwriting readiness program on improving fine motor skills of preschool children attending a rural Head Start. Pre- and post-testing of an experimental classroom and a control classroom was completed using the Fine Manual Control and Manual Coordination composites of the Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2). The experimental classroom was exposed to the Fine Motor and Early Writing curriculum during center time in approximately four, 5-10 minute increments, twice a week for 16 weeks. Data analysis indicated that the experimental class had an increase greater than the control class in mean total point scores between pre-test and post-test in the Fine Motor Integration and Manual Dexterity subtests. The data also supported the use of the Fine Motor and Early Writing curriculum with preschool students with the largest deficit in fine motor skills by indicating an increase in scores for the lower quadrant of scores for the Fine Motor Control, Fine Motor Integration, Manual Dexterity and Upper-Limb Coordination subtests. Overall, data analysis suggests that the Fine Motor and Early Writing

curriculum has a positive effect on the development of fine motor integration and manual dexterity skills in preschool children, and an even greater effect on the students with greater fine motor delay.

EFFECTS OF STRUCTURED HANDWRITING READINESS PROGRAMS ON THE FINE MOTOR SKILLS OF CHILDREN IN HEAD START

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CHAPTER 1: INTRODUCTION

Handwriting is a large part of a child's academic day. As a student, handwriting should be an automatic process that can be executed without concentration on the mechanical aspects of the task. If the skill is not integrated into an automatic process, the student's writing development may suffer (Graham et al, 2007). In order for a student to obtain skills necessary for successful handwriting, the skill must be presented in a way that is conducive to learning. Handwriting instruction is not always provided most effectively for all students which may result in delay in developing the skills needed for successful handwriting. In school systems, handwriting curriculum is often minimally emphasized and when taught it is taught in a manner that does not address the individual needs of young developing writers (Graham & Weintraub, 1996). A survey of kindergarten teachers indicated that almost half of the teachers interviewed taught handwriting daily (Graham et al., 2007). This factor indicates that handwriting is being emphasized, but it does not indicate how handwriting is being taught (Graham et al., 2007). Likewise, the method of how handwriting is taught can vary greatly from one teacher to another. For example, it can be taught actively through direct instruction or passively through seat work. One study suggested that lower than average handwriting skills, even in typically developing children, could be due to the lack of individualized instruction in curriculum (Judkins, Dague, & Cope, 2009). Children of all backgrounds and developmental levels, from typically developing to developmentally delayed, disabled or at risk for developmental dysfunction, may have trouble with fine motor skills and therefore handwriting (Dunn et al., 1988). Gardner (1998) found that along with limited individualized instruction, students are expected to progress through the curricula at the same rate, which may not be conducive to the learning style of all of the children (as cited in Judkins, et.al., 2009). The combination of these factors indicate a need for identifying students at risk for fine motor and handwriting skill delay through early intervention programs (Berninger, 1997). Teaching handwriting skills to students beginning at an early age has the potential to improve writing performance over all (Graham et al., 2007). Addressing the individual needs of these students at the early stages of handwriting development could improve their fine motor skills instrumental to their daily functioning and possibly prevent a later diagnosis of learning disability (Berninger, 1997; Dunn, Campbell, Oetter, Hall & Berger, 1988).

Problem Statement

Handwriting difficulty is one of the most frequent reasons for a student to be referred to occupational therapy. In typically developing children, handwriting difficulty is often seen as lack of student effort (Zwicker & Hadwin, 2007). In fact, Judkins et al. (2009) showed that 25% of typically developing children scored at least 1.5 standard deviations below their age groups norm for handwriting skills, demonstrating that even typically developing children struggle with handwriting skills. This raises the issue of whether school-aged children should be referred to occupational therapy for handwriting skill deficits or if different or more individualized handwriting instruction would be most beneficial? Traditionally, individualized instruction has often been provided by occupational therapists after skill deficits resulted in a referral for services (Asher, 2006). However, if teachers provided more individualized handwriting instruction in the classroom to meet the needs of students, would students improve without occupational therapy referral? Although there is research illustrating the importance of improving handwriting skills through specific handwriting interventions, little research was located on the effects of structured handwriting programs on fine motor skills.

Purpose of the Study

There are several methods available to promote fine motor and handwriting skills in children. The question is if adding a structured handwriting program to the curriculum for students from low-income families would enhance their handwriting readiness skills. The purpose of this study was to determine if students who participated in the use of a structured handwriting readiness program in a classroom setting would demonstrate improved fine skills. Researchers specifically addressed the use of the Fine Motor and Early Writing Pre-K (FMEW) Curriculum with a classroom of preschool-aged children at a local Head Start program. Researchers then statistically compared the Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2) scores from the students in the classroom using the Fine Motor and Early Writing Pre-K Curriculum to students in a control classroom. At the conclusion of the study, researchers hoped to determine if using a structured handwriting readiness program was a successful method for teaching fine motor and handwriting skills necessary for kindergarten readiness. It was hypothesized that incorporating the use of a structured handwriting readiness program would result in a greater increase in Fine Motor Precision, Fine Motor Integration and Manual Dexterity scores assessed by the BOT-2 when compared to a control classroom not receiving implementation of a structured handwriting readiness progra

CHAPTER 2: REVIEW OF LITERATURE

Importance of Handwriting

Handwriting is a crucial part of students' educational experiences starting from the time they can pick up a crayon to scribble. The scribbles, although seemingly random, contain universal features such as linearity and discreteness (Tolchinsky, 2003). A study examining the progression of children's handwriting from scribbling to discrete handwritten language found that children's handwriting skills increase and become more stable between the ages of three and five years (Puranik & Lonigan, 2009). Children will naturally display innate universal and language-specific knowledge of writing even without schooling or structured programs (Puranik & Lonigan, 2009). Since these years are critical in the child's development, this would be the ideal time to accentuate and expand handwriting skills through structured programs. A study by Graham and colleagues indicated that 23% of children entering kindergarten struggle with handwriting, which shows an increase from 21% in past research (Graham & Weintraub, 1996). As children enter kindergarten, handwriting is the primary method students use to demonstrate their knowledge and understanding in all facets of the school day (Case-Smith, 2002). At the beginning of the school year, teachers expect students to successfully write their name on a line at the top of the paper (Pape & Ryba, 2004). In addition to name writing, 42% of the tasks a kindergarten student will participate in on a daily basis are pencil to paper tasks (Marr, et. al, 2003). Handwriting allows students to explore, organize and refine different concepts surrounding a plethora of subjects indicating that handwriting is not simply for completing assignments, but it is a way for students to gather, remember and share information (Judkins, et al., 2009).

When a student has a delay in handwriting skills, many aspects of daily life can be affected. A study by Graham and colleagues found that the thought process during structured handwriting assignments can be limited due to the concentration on the mechanical aspects of the handwriting process (Graham, Harris & Fink, 2000). Students must concentrate so intently on correctly forming letters and pre-writing shapes that they may not be able to pay attention to the actual task at hand (Case-Smith, 2002). For example, having to switch attention between composing a sentence and concentrating on correct letter formation could equate to a student losing one's train of thought from working memory (Graham et al, 2007). Therefore, the combination of poor handwriting and inability to participate in instruction can directly affect the student's performance in academic success and school behavior (Judkins, et al., 2009).

A student with poor handwriting skills in preschool will subsequently be behind when entering kindergarten. A study conducted through the University of Washington and the University of Maryland College Park found that children entering kindergarten have a lower level of handwriting skill then children in the past (Berninger, 1997). Conversations with participating teachers uncovered that this decline may be due to a decrease in sufficient and appropriate classroom instruction and hands-on practice in handwriting (Berninger, 1997). Asher (2006) conducted a survey which uncovered that only 3 of 13 teachers were offering daily explicit handwriting instruction and practice. Along with a decrease in handwriting skill level over the years, teacher training in the subject of handwriting instruction has also decreased over the years (Pape & Ryba, 2004). A survey of primary grade teachers indicated only 12% had received adequate instruction on handwriting through their college courses (Graham et al., 2007). This lack of adequate preparation for handwriting instruction could jeopardize the effectiveness of handwriting instruction these teachers provide to their students (Graham et al., 2007).

Fortunately, teachers have the option to attend professional development workshops on the subject of handwriting to supplement the information they received in their college courses (Graham et al, 2007). Some teachers have received informal instruction by an occupational therapist on handwriting curriculum and/or attended in-service sessions (Vander, Fitzpatrick & Cortesa, 2009). Additionally, three out of five teachers of handwriting have chosen to implement a commercially designed handwriting program to ensure that students are being taught the necessary material for successful handwriting (Graham et al., 2007). Other teachers have expressed that they are less comfortable teaching handwriting to their students due to lack of knowledge on effective teaching strategies (Vander, Fitzpatrick & Cortesa, 2009). A survey of four inner city kindergarten teachers suggested addressing handwriting during reading curriculum then having the occupational therapist teach explicit handwriting instruction during a once-per week, 30-minute occupational therapy instruction block (Vander, Fitzpatrick & Cortesa, 2009).

On a psychosocial level, the student becomes at risk for poor self-esteem due to the social implications of delayed handwriting skills (Judkins et al., 2009). Other students see the at-risk student struggle and may socially isolate him or her due to perceived differences. The student may begin to display a lack of interest and motivation towards handwriting tasks and may rush through written work (Pape & Ryba, 2004). Other underlying factors that could be leading to poor handwriting could also have a hand in decreasing the student's peer interaction. Some of these components could be poor hand-eye coordination, visuomotor integration and in-hand manipulation skills (Judkins, et al., 2009).

With a growing trend towards using technology in the classroom, some teachers are under the assumption that handwriting is not as important as it used to be (Hart, Fitzpatrick &

Cortesa, 2009). The use of computers in place of handwriting is concerning since research has shown that handwriting contributes to the development of literacy and writing skills (Beringer et al, 2000). The neural pathway that is activated during handwriting is more effective in facilitating letter memory and recognition than the neural pathway used for typing (Longcamp et al, 2008). Thus, learning and brain development of students could be negatively affected by replacing handwriting with technology (Longcamp et al, 2008). This effect could be especially seen in students in at-risk populations (Longcamp et al, 2008).

Fine Motor Skills

Addressing the fine motor skill developmental deficit in these students at the preschool level will increase their chance for success in kindergarten. According to the National Educational Goals Panel (1993), there are five dimensions that kindergarten children need to have mastered in order to exhibit learning readiness (Marr et al., 2003). The five dimensions are (1) physical well-being and motor development, (2) social and emotional development, (3) approaches toward learning, (4) language development and (5) cognitive and general knowledge (Marr et. al, 2003). The acquisition of fine motor skills is a component of the first dimension of physical well-being and motor development. Since the development of fine motor skills goes hand-in-hand with the acquisition of handwriting skills in young children, this relationship should be further addressed in preschool curriculum. Practicing the components of handwriting frequently for short periods of time has been determined to produce better results than fewer times for longer duration (Graham et al., 2008). Additionally, practice and repetition with the use of a tool (i.e. pencil or crayon) is instrumental in helping a child develop a skill to the level in which it becomes automatic with increased accuracy (Pape & Ryba, 2004). Implementing structured handwriting readiness programs in preschool will give students the extra practice in a multisensory manner that may aide in mastering the fine motor tasks needed for the larger task of handwriting.

The *Occupational Therapy Practice Framework* uses the definition of motor skills as "skills in moving and interacting with task, objects and environment" (American Occupational Therapy Association, 2008, p.639-640). These motor skills can be further broken down into fine motor skills and gross motor skills. Fine motor skills, as defined by The National Association for the Education of Young Children (NAEYC) panel are the "developmental sequence[s] of manual skills requiring precision and Manual Dexterity" (Marr, et. al, 2003, p. 551). The *Occupational Therapy Practice Framework* also clearly indicates that the development of fine motor skills is an outcome of growth and development (American Occupational Therapy Association, 2008). Even at the preschool level, students spend approximately 37% of their day participating in overall fine motor activities, with 10% of those being actual pencil to paper tasks (Marr, et. al, 2003). Once students enter kindergarten, the time spent engaged in fine motor activities increases to 46% of their school day, with 42% of those activities being pencil to paper tasks (Marr, et. al, 2003). Specific fine motor skills were examined within academic activities and non-academic activities. Fine motor skills with academic content included finger play, writing letters and/or numbers, cutting, gluing, drawing, coloring, pointing to letters/numbers and reading/looking at a book. Non-academic fine motor skills include eating snack, finger play, art, manipulative play, play in centers (i.e. blocks, sand table), hygiene tasks and donning/doffing coats (Marr, et.al, 2003). Marr et al. stated that the development of fine motor skills was essential to a child's success in childhood occupations such as activities of daily living (ADLs), education, play, and social participation (Marr et al., 2003). Unfortunately, around 10% of elementary school children are at risk for challenges with fine motor tasks in at least one of these valued areas of occupation (McHale & Cermak, 1992).

In-hand manipulation is an important fine motor component that preschool students must develop for success with handwriting. If a student has problem with fine motor skills, in-hand manipulation may be clumsy, slow and inefficient resulting in a delayed ability to the use important classroom tools such as pencils, crayons, and scissors (Exner, 1990). The development of the precision necessary to execute fine motor tasks and be able to use tools requires students to establish hand dominance between the ages of 4 and 6 years (Pape & Ryba, 2004). Consistent use of the preferred hand during preschool will encourage the student to develop precision (Pape & Ryba, 2004).

Along with in-hand manipulation, the proper pencil grasp is also necessary for precise, controlled movements used in handwriting (Pape & Ryba, 2004). It is preferred for a child to use a mature dynamic tripod, lateral tripod or dynamic quadropod pencil grasp (Pape & Ryba, 2004). Possessing the proper pencil grasp can be difficult for children, which was confirmed by a survey of teachers where 41% acknowledged that handwriting grasp was a common handwriting burden for their students (Graham et al, 2007). Considering this high percentage, it is interesting to note that there is a lack of monitoring, teaching and/or reviewing pencil grasp in the classroom (Vander, Fitzpatrick & Cortesa, 2009). If a student is not able to master a mature pencil grasp independently, a pencil grip may be placed on a pencil to assist the student in learning the proper positioning for developing the intrinsic muscles of the hand. It is important to choose a pencil grip that is firm, prevents hyper-mobility of the joints of the index finger and thumb, and helps the student maintain proper web-space (Schulkin, 2010).

Multisensory Approach

When considering handwriting, it is not as simple as picking up the pencil and starting to write. It is important to recognize that many different sensory systems work together to create the experience in addition to fine motor skills. These sensory systems include visual-motor coordination, cognitive and perceptual skills, and tactile and kinesthetic sensitivities (Judkins, et al., 2009). If any one of these areas is disorganized in the child's sensory system, then the child can have difficulty with handwriting. Therefore, multisensory approaches may be the most appropriate approach for instructing and enhancing handwriting and fine motor skills.

Multiple studies indicate the use of a multisensory approach to teaching handwriting in young children (Zwicker & Hadwin, 2007; Judkins, et al., 2009). The multisensory approaches used the sensorimotor model of practice which incorporates sensory experience with different media and instructional materials (Zwicker & Hadwin, 2007). The occupational therapist encourages letter construction with various media other than pencil and paper to allow the child to explore pre-writing and handwriting skills with additional tactile and proprioceptive stimulation (Pape & Ryba, 2004). The underlying reasoning behind using a multisensory approach is to help the child's nervous system more efficiently integrate the information at the subcortical level, resulting in a satisfactory motor output (Zwicker & Hadwin, 2007; Pape & Ryba, 2004). Some of the various media used in this context are chalk and chalkboard; shaving cream; and tracing on colored, lined or embossed paper (Judkins et al., 2009). Therapists also combine the multisensory approach with behavioral and motor learning theory and developmental or behavioral approaches (Zwicker & Hadwin, 2007). Sometimes vibration, resistive writing, shaping letters, description of the letter, self-monitoring, and letter formation were used as techniques (Zwicker & Hadwin, 2007). With this approach, children were also encouraged to talk themselves through the letter formation using appropriate learned terminology for each letter (Pape & Ryba, 2004).

Research conducted by Case-Smith illustrated the improvement of legibility of a child's handwriting through an eclectic occupational therapy intervention (Case-Smith, 2002). The study found that 14.2% of the students receiving direct occupational therapy services increased in legibility, whereas only 5.8% of students who did not receive direct occupational therapy services increased in legibility (Case-Smith, 2002). However, this study did not indicate what type of program or intervention was most effective in producing optimal success (Case-Smith, 2002). Therefore, additional research is necessary to determine specific interventions to improve the student's handwriting readiness. As a part of an eclectic approach, multisensory techniques are often used in school-based occupational therapy programs thus necessitating a strong need to research the effects of this type of intervention (Zwicker & Hadwin, 2007). Studies have addressed the need for research examining long-term effects and approaches to handwriting interventions to determine which multisensory technique would work best in a teacher-guided classroom instruction (Judkins et al, 2009).

Structured Handwriting Readiness Programs

The Fine Motor and Early Writing Pre-K Curriculum (FMEW) (Schulken, 2008) is a recent handwriting readiness program developed by an occupational therapist. This program incorporates the important acquisition of fine motor skills into its multisensory approach. The philosophy of the program is that "handwriting and written expression are complex, physical, emotional and cognitive tasks which have many underlying components that must be carefully considered and integrated into [the] products" (Schulken, 2010, ¶3). The workbooks Schulken designed that are incorporated into the program teach capital letters in a non-sequential order. Some letters of the alphabet can be easily confused, so teaching them in groups based on the character of the letter rather than in ABC order can be more successful (Troia & Graham, 2003). The workbooks allow for corrective feedback through repetition of the letters which can encourage students to make progress towards forming their letters correctly (Troia & Graham, 2003). The workbooks are also designed to reward the students for their hard work by offering a badge to cut out and paste on a certificate for completion of each group of letters. Giving tangible praise can also be an encouragement for proper letter formation (Troia & Graham, 2003).

Some of the products included in FMEW are the use of a Grotto Grip®, wikisticks, and fine motor tools such as pop beads for finger strengthening and coordination (Schulken, 2008). The Grotto Grip® is an ergonomic pencil grip designed by pediatric occupational therapists used in conjunction with the program that helps the child develop muscle strength and fine motor control used to write (Pathways for Learning, 2010). The Grotto Grip® is firm and has a finger guard and specialized angles that position the fingers for a mature tripod grasp while also maintaining the arches of the hand for dynamic finger movements (Pathways for Learning, 2010). This grip also facilitates an open web space between the thumb and index finger and prevents hyper-mobility of the joints at the index finger and thumb (Pathways for Learning, 2010). Pop beads are used to encourage the tripod grasp pattern and increase finger strength by having the children pop the beads together using the tip of their thumb, pointer finger and side of their middle finger (Schulken, 2008). There are three different resistances offered to allow grading of the activity (Schulken, 2010). They have been used by occupational therapists to develop fine motor foundations and build skilled hand use through control of isolated movement of individual digits (Case-Smith, 1996). These types of intervention tools have also been used by occupational therapists in other studies examining fine motor outcomes in preschool children receiving occupational therapy (Case-Smith, 1996). One researcher found that the use of small manipulatives, like the pop beads, helped improve the use of intrinsic hand muscles (Case-Smith, 1996). The manipulation of small objects could then be generalized to improve the functional ability to use a tool. This particular study determined that there were significant improvements in the speed and accuracy of in-hand manipulation tasks, such as writing. There were also improvements in motor accuracy as measured by tracing along a curved line (Case-Smith, 1996). Tracing and copying are skills frequently used in a preschool setting and these skills are addressed in the Fine Motor and Early Writing curriculum workbooks.

Fine Motor Skills of Students Attending Head Start

Head Start is a federally, funded educational program that caters to the needs of children falling in the lower socioeconomic status (Marr, et al., 2003). A study showed that children attending preschool at Head Start, due to their socioeconomic status, fell into the category of low-scoring fine motor skills once reaching kindergarten compared with other children who were not economically disadvantaged (Marr, et al., 2003). These children from low income families are at risk for overall decreased performance in their academic setting, which makes them ideal candidates for enhanced instruction from a structured handwriting curriculum (West, Denton & Germino-Hausken, 2000; Marr, et al., 2003). Furthermore, researchers at Pennsylvania State University found that success in kindergarten had a direct, positive correlation to the child's pre-kindergarten growth (Welsh et. al., 2010). In the areas of emergent literacy and numeracy skills, the learning a child acquires during the preschool years indicates a positive impact on the potential for kindergarten success. With this under consideration, specific, high-quality programming and curriculum in preschool settings is essential. The enhancement of quality classroom instruction is noted to be particularly important in Head Start programs for children from low-income families who are already at risk for delayed kindergarten readiness (Welsh et. al., 2010).

A family's socioeconomic status may have a tremendous effect on a child's development due to multiple factors (Bowman & Wallace, 1990). Marr et al. (2003) indicated that low-income families tend to have limited resources, which puts the child at risk for delayed fine motor skills and decreased kindergarten readiness. They determined 44% of kindergarten children who were members of a family using Assistance to Families with Dependent Children (AFDC) fell one or more standard deviations below average in the category of fine motor skills. Another study showed that children of an upper or middle class have demonstrated higher level skills and kindergarten readiness (Bowman & Wallace, 1990). Peterson and Nelson (2003) performed a study to determine if at-risk children of low socioeconomic history would improve academically with direct occupational therapy intervention. Children in an experimental group and control group were pre-tested and post-tested for handwriting legibility, letter and word spacing, line placement and letter size, form and speed (Peterson & Nelson, 2003). After the experimental group received a 30-minute occupational therapy session twice a week for ten weeks, the data revealed that they had substantial increases in scores over their peers in the control group (Peterson & Nelson, 2003). All of these factors combined indicate the need to target children of lower socioeconomic status specifically in order to increase their chances for success.

Summary

The review of literature produced a wealth of information regarding handwriting and fine motor skills for kindergarten readiness. From this review, it is evident that the development of fine motor skills in preschool age children is highly impactful on their development of handwriting skills. In conjunction with the importance of fine motor and handwriting skills, research showed that a greater number of kindergarten children are struggling with handwriting in the classroom. The literature review also indicated that the quality of handwriting instruction in the classroom could be improved upon, as well as the way that classroom teachers are educated in their college curriculum related to handwriting instruction. In review of techniques for educating young children handwriting skills, the literature showed the importance of using a multisensory approach to develop these skills most effectively. When combining these overarching themes, it became evident that developing the fine motor and handwriting skills in preschool age children could be beneficial for reversing the decline in handwriting skills among kindergarten children. The Fine Motor and Early Writing Pre-K curriculum was developed as a structured way for classroom teachers to teach fine motor and handwriting skills to preschool children using a multisensory approach. The curriculum was designed to be implemented in a preschool classroom which is ideal for children of low socioeconomic status since research has shown decreased fine motor skills in this population. The purpose of the study was to see if implementation of the Fine Motor and Early Writing Pre-K curriculum would increase fine motor skills in the Head Start preschool aged population.

CHAPTER 3: METHODOLOGY

Design

For this study a non-equivalent control type design was used. The study was quasi-experimental since it had control and manipulation, but no randomization. The non-equivalent control type design worked the best for this study since graduate research investigators pre-tested and post-tested the children in the study. The subjects being used in this study came from two classrooms within the Head Start program; a Fine Motor and Early Writing Pre-K Curriculum (FMEW) experimental group and a control group. Letters of consent and support were (see Appendix A) obtained by the Head Start director in order to test both classrooms and to implement the FMEW curriculum in the experimental classroom. There were originally 15 students in the control group and 16 students in the experimental group. The control class received the standard handwriting readiness activities as taught by Head Start while the experimental class received the FMEW curriculum within the classroom in addition to the standard handwriting activities.

Setting

This study was completed at a rural Head Start program. The Head Start Program had certain constraints and scheduling that had to be taken into consideration when planning the implementation. Each classroom had its own schedule and the classroom teachers were responsible for keeping the students on the set schedule. Implementation of the FMEW curriculum occurred in the experimental classroom before the students ate lunch. When graduate research investigators arrived at Head Start, the students in the experimental classroom were participating in recess. This allowed time for graduate research investigators to set up for that day's session. When the students returned to the classroom, they were asked by their teachers to line up at the restroom, wash their hands, and go to their first choice for center time. The classroom had designated centers, or educational free-play stations, such as sand tables, paint, building blocks, creative play, and puzzles. In addition to the designated classroom centers, graduate research investigators had set up two FMEW teacher-led centers and two FMEW independent learning centers. The students were expected to progress through as many centers as they wanted to during the 50-minute center time with only a designated number of students allowed at each center at a given time. Once center time was over, the students were asked to clean up and gather at the front of the room for the gross motor activity led by the graduate research investigators.

Sample

Convenience sampling was used to collect the subjects to be used in the intervention and data collection. The Head Start program in Greenville, NC was chosen due to a preexisting relationship between East Carolina University's Occupational Therapy program and the organization. Additionally, prior research and data collection had been conducted at this location. The classrooms used in the study were chosen on a basis of teacher interest and program director's recommendation.   The inclusion criteria for this study included: parental permission for data collection at pre-testing and post-testing, completion of both the pre-test and post-test assessments, and inclusion within one of the two identified classrooms. The exclusion criteria for the study included: parental permission not given, delayed entry or transfer out of the class, and missing more than 33% of intervention sessions for the students in the experimental classroom. Attendance records for the experimental group were kept during the intervention days to see if there was a correlation between attendance and progress. This provided understanding to the data and assisted in determining if a child met the inclusion criteria for the study. If a child was absent during pre-testing or post-testing, rescheduling was attempted.

When initiating data analysis, the attendance records for the experimental classroom were reviewed. It was noted that one participant was absent for over 33% of the curriculum implementation, therefore that student's data was excluded resulting in 15 experimental group participants. The gender distribution was different between the two classes. The control classroom had 10 males and 5 females, whereas the experimental class had 4 males and 11 females. In regard to age, the experimental classroom started the program with a mean age of 49.13 months, or 4 years, 1 month. The control classroom started the program at 57.06 months, or 4 years, 9 months. This indicates that the experimental class was 7.93 months older than the control class before the Fine Motor and Early Writing Pre-K curriculum was implemented.

Instrumentation

The instrument used for data collection during the course of the study was the Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2) (Bruininks & Bruininks, 2005). This assessment was chosen based on its ability to assess for fine motor skills using two different composites: Fine Manual Control and Manual Coordination. The Fine Manual Control composite includes Fine Motor Precision and Fine Motor Integration. The Manual Coordination composite includes Manual Dexterity and Upper-Limb Coordination. The Fine Motor Precision subtest assesses precise finger control through five drawing tasks, a paper folding task, and a cutting task. This subtest is untimed in order to place emphasis on precision. The Fine Motor Integration subtest assesses the ability to integrate visual stimuli with motor control. There are a set of geometric shapes the student must replicate without additional visual aids or cues. Scoring of the geometric shapes is based on basic shape, closure, edges, orientation, overlap, and overall size. The Manual Dexterity subtest assesses reaching, grasping, and bimanual coordination through timed, goal-directed activities. The dexterity activities include filling in circles, transferring plastic pennies into a box, putting pegs into a pegboard, sorting cards and stringing blocks. The inclusion of timing for this subtest aids in determining varying levels of dexterity. The Upper-Limb Coordination subtest assesses visual tracking along with coordination of arm and hand movements. The activities the student must perform are catching, dribbling and throwing a tennis ball, some of which are using one hand and other times using both hands together.

The BOT-2 has many different components that make up its reliability and validity. Evaluation of the inter-rater reliability produced high coefficients in the areas of Manual Coordination composite coefficient of r=0.98 and its components with coefficients from r=0.98 to r=0.99 (Bruininks & Bruininks, 2005). The coefficients for inter-rater reliability for the Fine Manual Control composite were also high with the composite coefficient of r=0.92 and the components ranged from r=0.86 to r=0.93. This showed that the inter-rater reliability was consistent. For test-retest reliability, the coefficients are generally high, with subtest correlation coefficient scores of r=0.75 for Fine Motor Precision, r=0.76 for Fine Motor Integration, r=0.63 for Manual Dexterity, and r=0.73 for Upper-Limb Coordination with children ages 4-7 years. The reliability coefficients for the internal consistency reliability were all high. The statistics showed means ranging from high 0.80's to low 0.90's for the participating age group, indicating that the subtest and composite scores used are highly accurate (Bruininks & Bruininks, 2005). The BOT-2 was also found to be valid based on evidence in four areas: test content, internal structure, clinical group differences and relationships with other tests of motor skills such as the

Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), the Peabody Developmental Motor Scales Second Edition (PDMS-2), and the Test of Visual-Motor Skills Revised (TVMS-R) (Bruininks & Bruininks, 2005).

Intervention Tools

The specific tools used during the intervention included individual student kits for each of the 15 students in the experimental class, the Fine Motor and Early Writing Curriculum (FMEW) classroom, and a teacher kit to be used with the whole classroom (See Appendix B. Additional materials required for intervention activities were typical pre-school classroom materials which included paint, glue, scissors, etc. These materials were used during center time in four centers, two times a week with the experimental class.

In the control classroom, the students did not have any additional handwriting instruction. They were exposed to handwriting in the way that the teacher chose in accordance to guidelines set by Head Start.

Procedure

Pre-test. The procedure for conducting this study began with receiving University and Medical Center Institutional Review Board (UMCIRB) approval to conduct the research (See Appendix C). After receiving approval, the approved parental permission form was signed by a parent/guardian of each participant involved in the study prior to testing. After receiving parent permission, graduate research investigators administered pre-tests for all four of the subtests of the BOT-2 to both the experimental classroom and the control classroom. Six qualified and trained Occupational Therapy graduate students and an Occupational Therapy professor (identified as the graduate research investigators) individually administered the BOT-2 to each of the 31 subjects. Each student was given an ID number at pre-testing that remained consistent at post-testing. The pre-testing was done over the course of approximately two weeks. The BOT-2 was administered individually by subtest stations. Some students completed all of the components of the BOT-2 in one day while others required two testing sessions to complete the necessary subtests.

Intervention. Upon completion of the pre-testing, the FMEW handwriting readiness program was introduced the experimental classroom. The interventions began on September 29, 2010 and took place twice a week with centers available for approximately 50-minutes each session over the course of six months from October to March totaling 32 sessions. The activities available at each center required approximately five to ten minutes for a student to complete. The last session took place on March 3, 2011. Center time was designed as a daily time for the students to explore their interests. On the days of intervention, graduate research investigators set up four centers in addition to the typical classroom centers which were available. Specifically, there were two teacher-led centers that the graduate research investigators administered, and two independent centers that were monitored by the classroom teachers or research professor. Approximately three sessions were facilitated by two additional trained Occupational Therapy graduate students who implemented the curriculum in their place.

The four centers each addressed a particular fine motor skill, perceptual motor skill, pre-writing skill and/or number and capital letter formation skill. Each pencil and colored pencil was equipped with a Grotto Grip® for encouragement of a mature pencil grasp throughout the curriculum. The centers were designed so that the tasks at the independent centers required minimal direction and minimal supervision while the teacher-led centers required more individualized attention and multiple-step directions. The students were not required to visit the centers as per the Head Start policies, but they were encouraged by the graduate research investigators and classroom teachers to attend all stations. They were especially encouraged to attend the teacher-led stations due to explicit instruction being offered. Because of the structure of the classroom, full-class instruction was not possible regarding the independent stations prior to center time. Therefore, the independent centers were poorly attended unless another graduate research investigator was present leading the session. At the conclusion of the hour session, the students participated in a gross motor or sequencing activity led by the graduate research investigators for 5-10 minutes to end the session as a whole classroom unit before transitioning to the next classroom activity. The gross motor portion was designed by the creators of the curriculum to be held at the beginning of the intervention session to get the students' bodies and minds ready for fine motor tasks. Due to the nature of the classroom structure, it worked better for the classroom teacher if we did these activities at the conclusion of the session. This piece was inconsistent, because oftentimes the classroom teacher had another activity planned for the end of the session which did not allow for the researchers to implement the gross motor activities.

Post-test. In March of 2011, graduate research investigators began post-testing each classroom using the same subtests of the BOT-2 used during pre-testing. The post-testing took 3 weeks due to student absences during post-testing. The researchers implementing the FMEW program in the experimental classroom did not participate in the post-testing of those students. Instead, these graduate research investigators post-tested the students in the control classroom, and student researchers not involved in implementation of the FMEW program post-tested the students in the experimental class. This was done to reduce potential bias during the post-test sessions due to familiarity and relationships that had been formed with the students in the experimental classroom. Attendance records of the experimental classroom students were reviewed to see if any of the students' data should be eliminated from the study due to excess absences. One student in the experimental classroom was absent from more than 33% of the intervention sessions which excluded her from the study and brought the total number of participants in the experimental classroom to 15 students.

Data Analysis

Researchers collected data from the BOT-2 pre-testing and post-testing session. The data was input by this author into BOT-2 ASSIST™ Scoring and Reporting System by Pearson for accurate and efficient data calculation. The data was then imported from the BOT-2 ASSIST™ software into IBM SPSS Statistical Software Version 19. Each student had an independent record and was identified in the SPSS software by a randomly assigned ID number. The independent variable was the program in which the subjects participated (as reflected by their classroom assignment) and the dependent variable was the outcome, or the scores, of the two different composites of the BOT-2 assessment and their respective subtests. Comparisons were initially done between the experimental and control classroom to determine the ratio of male to female participants and the difference in mean age in months. Next, a comparison was done between the pre-test and post-test total point scores for each of the four subtests: Fine Motor Precision, Fine Motor Integration, Manual Dexterity and Upper-Limb Coordination. For each of the four subtests, a box plot of the total point scores separated by experimental and control class was constructed. For the subtests, a scale score can be calculated (mean=15, SD=5) and a standard score is calculated for the composites (mean=5, SD=10). However, for this study, total point scores were used instead of scale scores for the subtests in order to see an increase or decrease in scores for demonstration of skill. The composites used the standard scores for statistical analysis. The scale and standard scores are calculated based upon age ranges. Some of the students were in one age range at pre-test and another at post-test which could have been conflicting when analyzing gains of skills. Therefore, by using the total point scores for the subtest reporting, graduate research investigators could plainly see the change in scores. Then by finding the difference between the pre-test and post-test scores, a box plot of the improvements in total point scores separated by experimental and control class was constructed (see Figures 1-8). Independent samples *t*-tests were used to compare means of the outcome measures between the control and treatment classrooms. Paired samples *t*-tests were used to compare the means of the pre-test and post-test scores within each classroom. These analyses of data would help determine the overall implications of the data collected.

Ethical Concerns

An ethical issue associated with the study was the chance students could miss classroom instruction while they were completing pre- and post-test activities outside of the classroom. In anticipation of this potential ethical issue, the teachers approved the times students were removed from the classroom for testing. This allowed the researchers to work around critical classroom instruction times and only take the children away from the classroom environment during teacher approved time slots (i.e. center time and recess). This study was identified by the Institutional Review Board as minimal risk.

CHAPTER 4: RESULTS

After completion of post-testing with the BOT-2 assessment, the data was analyzed and formatted into a series of results. The subtests of the BOT-2 used for the study (Fine Motor Precision, Fine Motor Integration, Manual Dexterity and Upper-Limb Coordination) were calculated and reported by improvement in total point scores from pre-test to post-test. Change in composte standard scores for Fine Manual Control and Manual Coordination are also reports. Therefore, an increase in score identifies an improvement in skill whereas a decrease in score identifies a decline in skill.

Fine Manual Control

The Fine Manual Control composite is composed of two subtests: Fine Motor Precision and Fine Motor Integration. The composite scores are presented as standard scores, whereas the subtest scores are presented as total point scores. Table 1 shows the descriptive statistics of mean and standard deviation at pre-test and post-test for the Fine Manual Control composite. The control class increased in mean standard score from 34.42 ± 13.260 to 37.86 ± 11.135 (mean ± standard deviation). The experimental class decreased in mean standard score from 41.50 ± 9.445 to 38.50 ± 8.254. Although there was a decrease in the experimental class, the class started out a mean of 7.08 standard score points higher than the control class and only ended up 0.64 standard score points lower.

Fine Motor Precision

Table 2 shows the descriptive statistics in the form of mean pre-test and post-test total point scores for the Fine Motor Precision subtest. The range of total points possible is 0 to 41. The table reports an increase in mean total point score for the control class from 4.47 ± 5.939 to 6.57 ± 5.571. In the FMEW experimental class we see a slight decrease in mean total point scores from 14.81 ± 6.863 to 14.44 ± 4.844. Mean scores include outliers in the data set, which indicated the need to further analyze the data through the use of box plots showing median scores and quartile ranges.

The Fine Motor Precision subtest identified an increase in median total point scores for both the experimental and control classrooms. The mean difference in total point scores between the two classes was 10.346 at pre-test and 7.866 at post-test, which are both significant at a 0.05 significance level. Figure 1 provides a visual representation of the total point score for Fine Motor Precision between pre-test and post-test for the experimental and control classes. The box plot shows the control class scoring on a wider range, with slight improvement in the median, and a large improvement in the maximum value. There are significant outliers in the control class, which indicates that these two students were performing on a level well higher than their peers. The FMEW experimental class also had a slight improvement in the median total point score. The range for the FMEW experimental class decreased, showing an increase in minimum total point scores and a decreased in maximum score from pre-test to post-test.

Figure 2 and Table 3 both show the improvements in total point scores for both the control and FMEW experimental classes. The control classroom increased in mean total point improvement score by 1.79 ± 3.49. The experimental classroom increased by 0.13 ± 4.941. This indicated that overall the control class had a larger improvement in total point scores from pre-test to post-test compared to the FMEW experimental class. With a p-value of 0.306, the difference in mean improvement is not statistically significant at a 0.05 significance level. Table 4 shows results from an analysis of the improvement between the classrooms to determine whether the mean improvements in the mean are significant for each classroom. The analysis identified a p-value of 0.078 for the control class and 0.776 for the FMEW experimental class, which both also indicate a lack of statistical significance. The FMEW class did have one subject demonstrating a large improvement in total point score as indicated by the outlier.

Fine Motor Integration

Table 2 shows the descriptive statistics in the form of mean pre-test and post-test total point scores for the Fine Motor Integration subtest. The range in total points for this subtest is from 0 to 40. The table reports an increase in mean total point score for the control from 3.07 ± 6.464 to 8.79 ± 7.116. In the FMEW experimental class we also see an increase in mean total point scores from 10.75 ± 6.159 to 16.87 ± 5.35. Mean scores include outliers in the data set, which indicates the need to further analyze the data through the use of box plots showing median scores and quartile ranges.

The Fine Motor Integration subtest identified an increase in median total point scores for both the experimental and control classrooms. The mean difference in total point scores between the classes was 7.683 at pre-test and 8.089 at post-test, which are both significant at a 0.05 significance level. Figure 3 provides a visual representation of the total point score for Fine Motor Integration between pre-test and post-test for both classrooms. The box plot shows the control class with a small range at pre-test, and a large increase in range at post-test. The minimum total point score remained approximately the same, but the median and maximum values increased considerably. Figure 3 shows three outliers that far exceeded the class averages. For the experimental class, the range decreased, with overall higher scores. The minimum value at pre-test was slightly higher than 0 with an increase in total point score to slightly higher than 10. The median and maximum values also increased, with one outlier scoring far above the rest of the class.

Figure 4 and Table 3 show the improvements in total point scores for both the control and experimental classes. The control classroom increased by a mean of 5.50 ± 5.100. The experimental classroom increased by 6.47 ± 5.939. This indicates that in the area of Fine Motor Integration, the experimental class had a greater total point score mean improvement over the control class, but with a p-value of 0.641 the difference in the mean improvements is not statistically significant at a 0.05 significance level. Table 4 shows results from an analysis of the improvement within the classrooms to determine whether the mean improvements are significant for each classroom. P-values obtained through this analysis give a p-value of 0.001 for the control class and for the experimental class. These p-values do indicate that the improvement in Fine Motor Integration was statistically significant in both classrooms. There were some students in the experimental class that had a greater improvement over the control class, as well as a student outlier in the experimental class that improved far beyond peers.

Manual Coordination

The Manual Coordination composite is also composed of two subtests: Fine Manual Dexterity and Upper-Limb Coordination. The composite scores are presented as standard scores, whereas the subtest scores are presented as total point scores. Table 1 shows the descriptive statistics of mean and standard deviation at pre-test and post-test for the Manual Coordination composite. The control class decreased in mean standard score from 52.92 ± 12.124 to 47.00 ± 10.850. The experimental class decreased in mean standard score from 49.06 ± 12.492 to 43.69 ± 10.719. Although both classes had a decrease in mean standard score, the experimental class had less of a decrease with a 5.37 drop in mean standard score, whereas the control class had a decrease of 5.92 mean standard score.

Manual Dexterity

Table 2 shows the descriptive statistics in the form of mean pre-test and post-test total point scores for the Manual Dexterity subtest. This subtest has a range of total points from 0 to 45. The table reports an increase in mean total point score for the control class from 8.07 ± 4.131 to 9.40 ± 4.718. The FMEW experimental class also demonstrated an increase in mean total point scores from 11.56 ± 3.098 to 13.50 ± 2.805. Mean scores include outliers in the data set, which indicates the need to further analyze the data through the use of box plots showing median scores and quartile ranges.

The Manual Dexterity subtest identified an increase in median total point scores for both the experimental and control classrooms. The mean difference in total point scores between the classes was 3.496 at pre-test and 4.100 at post-test. Figure 5 provides a visual representation of the total point score for Manual Dexterity between pre-test and post-test. The box plot shows a slight increase in median total point score in the control class, and a large increase in median total point score in the experimental class. The range of scores in the control class stayed approximately the same, with an increase in minimum values. The FMEW experimental class had a decrease in range of total point scores, with an increase in minimum values and little change in the maximum values. Both classes had children who had total point scores above their class which are indicated as outliers.

Figure 6 and Table 3 shows the improvements in total point scores for both the control and FMEW experimental classes. The control classroom increased by a mean total point score improvement of 1.33 ± 2.968. The experimental classroom increased by a mean total point score improvement of 1.87 ± 2.722. This indicates that in the area of Manual Dexterity, the experimental class had a greater mean total point score improvement over the control class, but with a p-value of 0.612 the difference in mean improvements is not statistically significant on a 0.05 significance level. Table 4 shows results from an analysis using paired sample t-test to determine if the mean improvement is statistically significant in each classroom. P-values obtained through this analysis give a p-value of 0.104 for the control class, which is not statistically significant on a 0.05 significance level. The experimental class had a p-value of 0.01, which does indicate statistical significance.

Upper-Limb Coordination

Table 2 shows the descriptive statistics in the form of mean pre-test and post-test total point scores for Upper-Limb Coordination subtest. This subtest has a range of total points from 0 to 39. The table reports a decrease in mean total point score for the control class from 9.73 ± 10.951 to 8.67 ± 7.116. In the experimental class we also see a slight decrease in mean total point scores from 11.56 ± 10.558 to 10.44 ± 7.393. Mean scores include outliers in the data set, which indicates the need to further analyze the data through the use of box plots showing median scores and quartile ranges.

The Upper-Limb Coordination subtest identified a decrease in mean total point scores for both the experimental and control classrooms. The mean difference in total point scores between the classes was 1.829 at pre-test and 1.77 at post-test. Neither value is significant at a 0.05 significance level. Figure 7 provides a visual representation of the total point score for Upper-Limb Coordination between pre-test and post-test. The box plot shows a slight increase in the median score of the control class, and an even smaller increase in median total point score in the experimental class. The range of scores in the control class decreased slightly with a decline towards lower minimum and maximum total point scores. The experimental class had a slight increase in minimum values, but a large decline in maximum values at post-test.

Figure 8 and Table 2 show the improvements in total point scores for both the control and experimental classes. The control classroom decreased in mean total score by 1.07 ± 5.812. The experimental classroom mean total point score also decreased by 1.13± 6.66 points. This indicates that in the area of Upper-Limb Coordination, both classes had a decline in total point scores from pre-test to post-test. The corresponding p-value for the relationship for total point score improvement for Upper-Limb Coordination was very high, p=0.977 indicating that the difference in improvements is not statistically significant. Table 4 shows results from an analysis of the improvement between the classrooms to determine whether the mean improvements in the mean are significant for each classroom. P-values obtained through this analysis was 0.489 for the control class and 0.495 for the experimental class, which both also indicate a lack of statistical significance.

Figure 1. Fine Motor Precision Total Point Score between Pre-Test and Post-Test

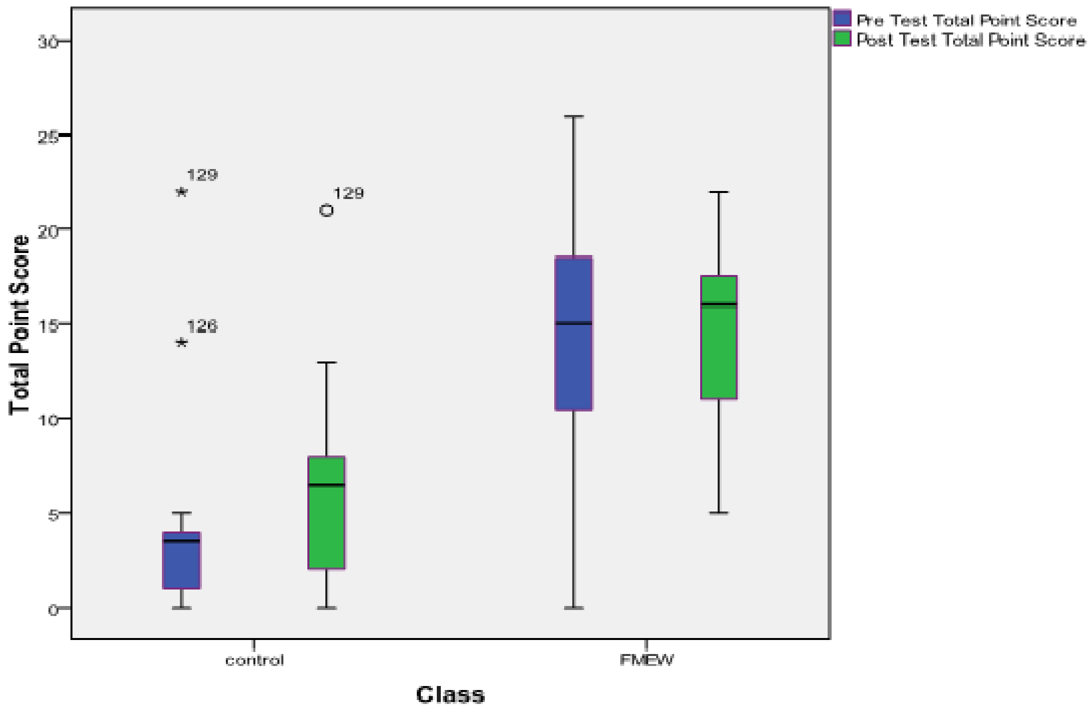


Figure 2. Improvement in Fine Motor Precision Total Point Score between Classes

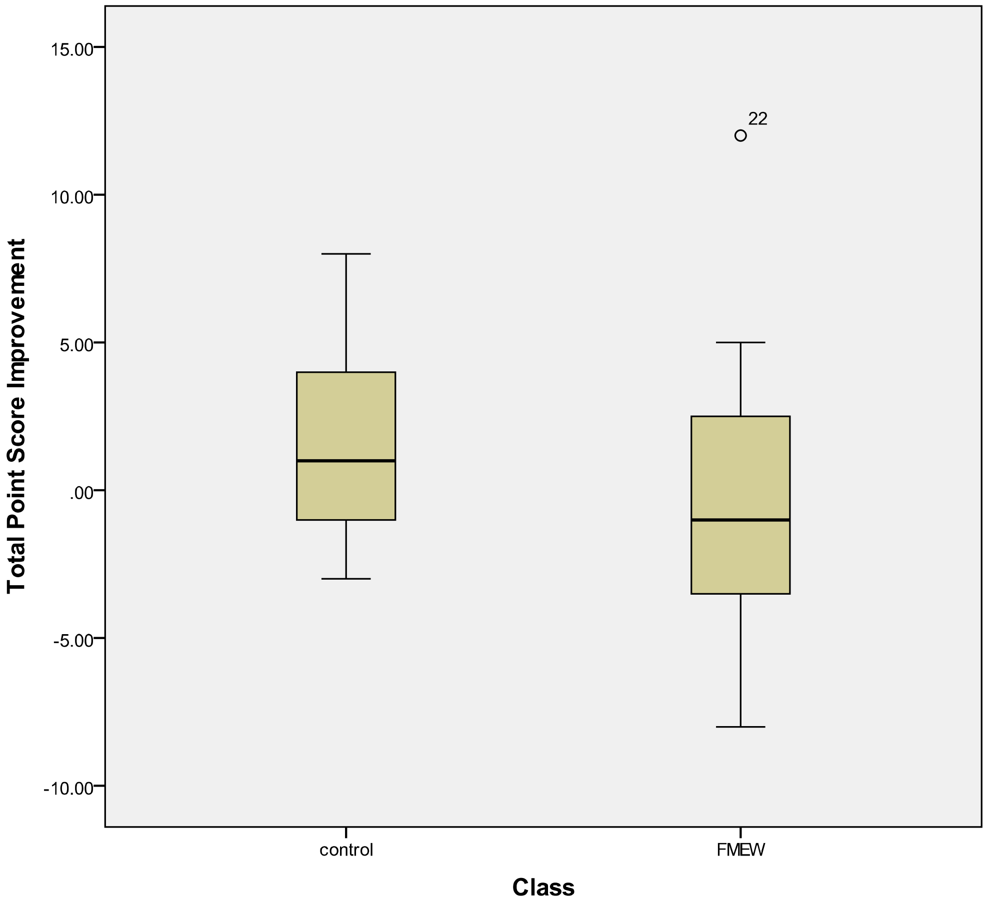


Figure 3. Fine Motor Integration Total Point Score between Pre-Test and Post-Test

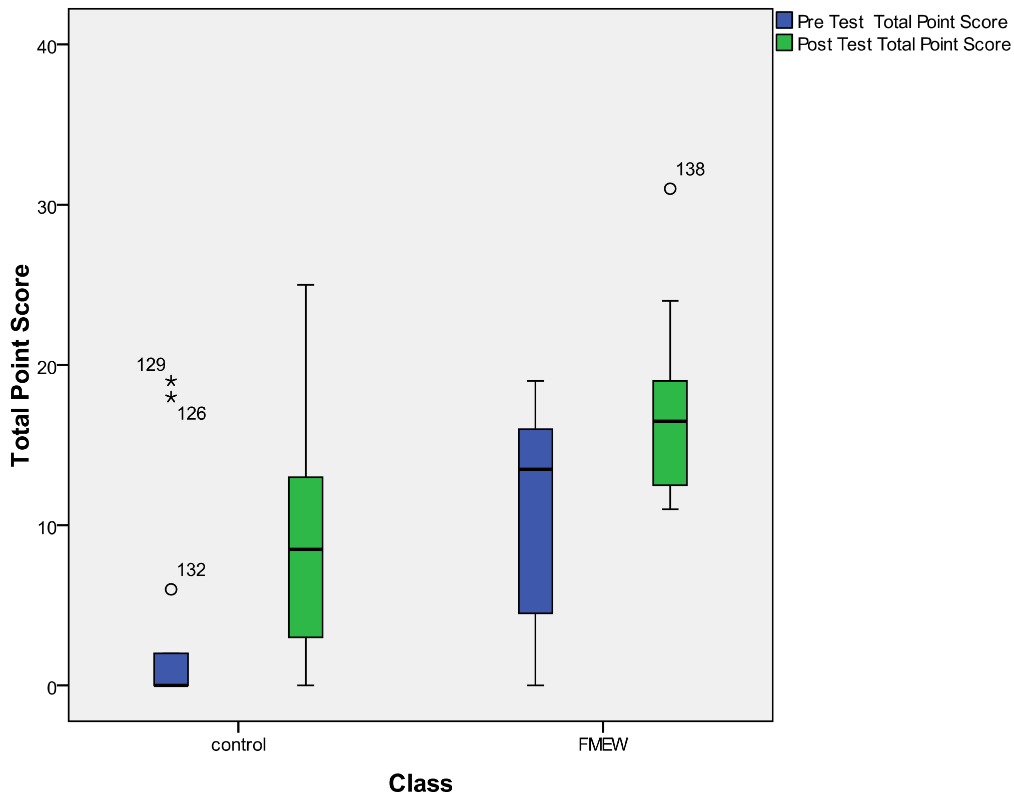


Figure 4. Improvement in Fine Motor Integration Total Point Score between Classes

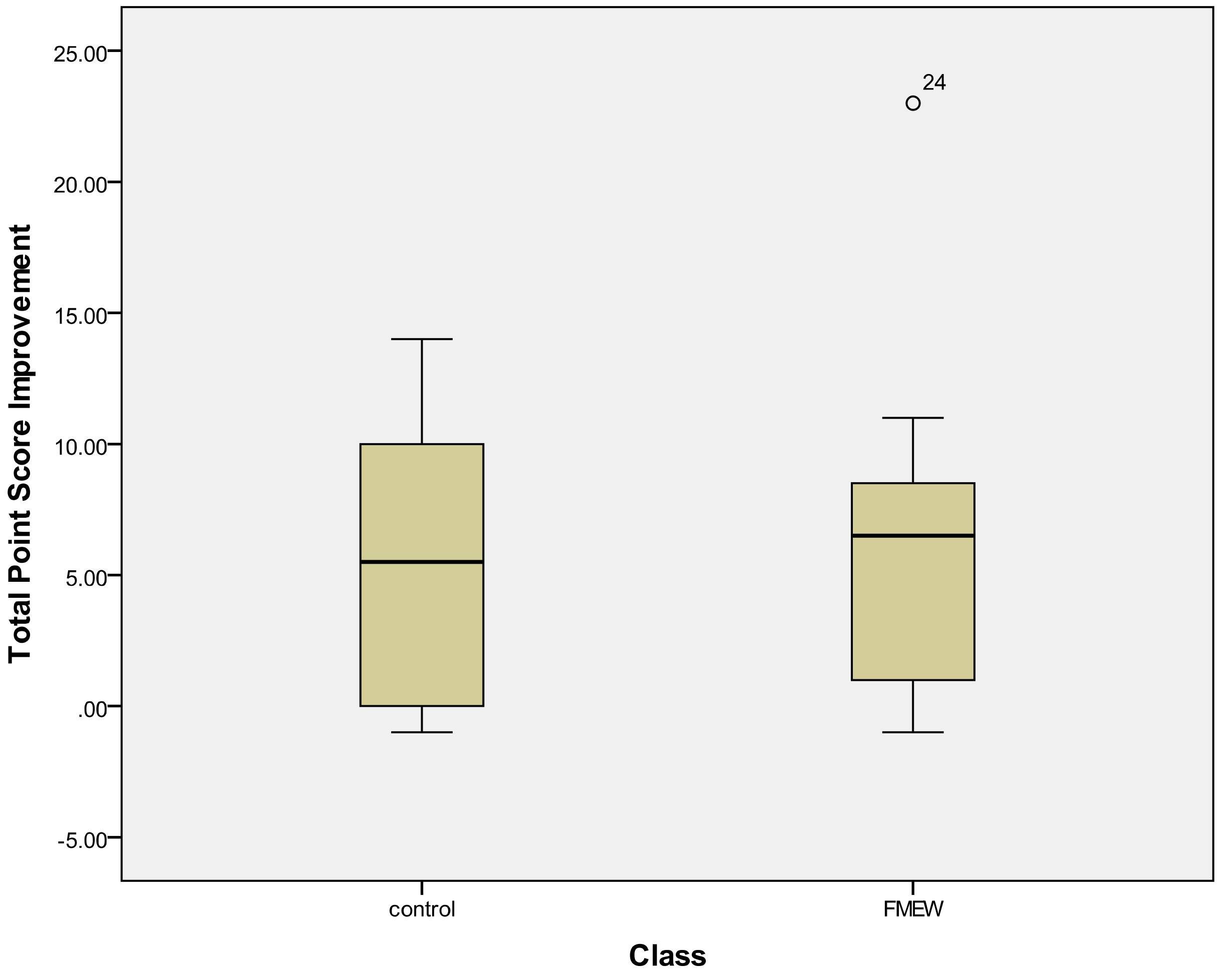


Figure 5. Manual Dexterity Total Point Score between Pre-Test and Post-Test

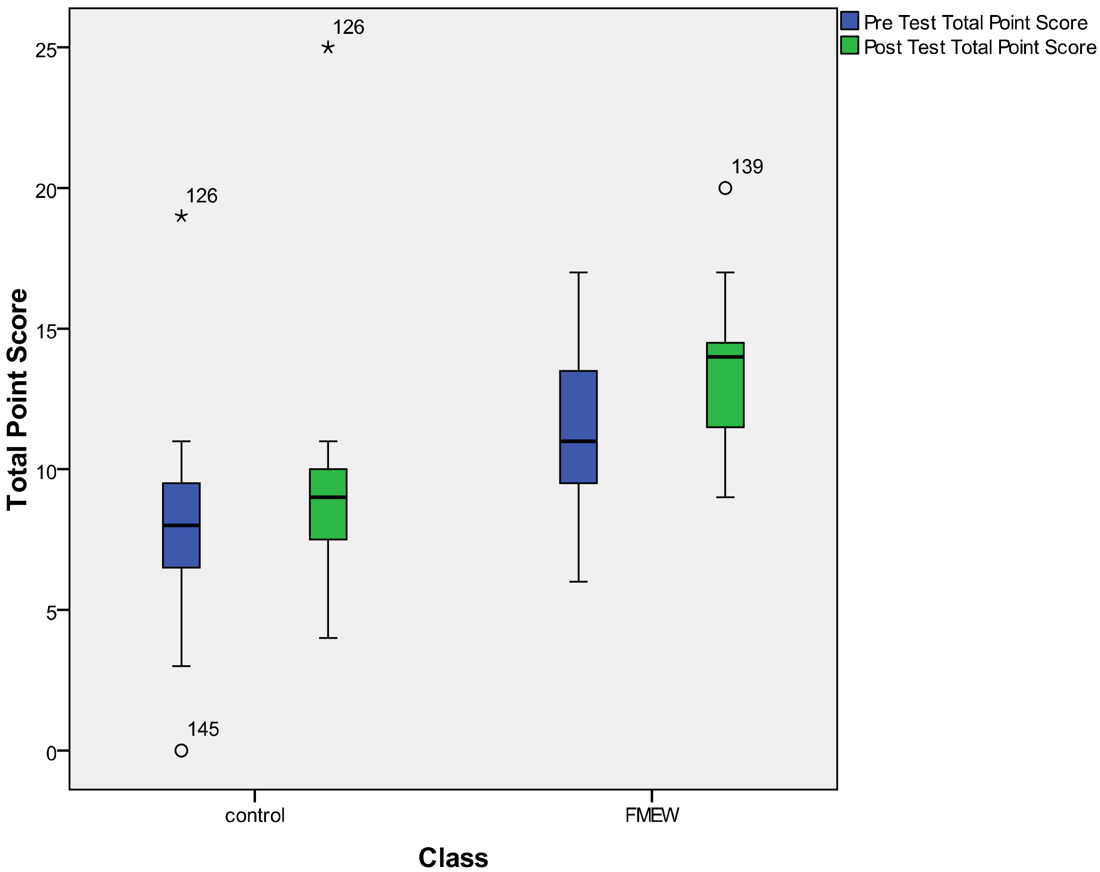


Figure 6. Improvement in Manual Dexterity Total Point Score between Classes

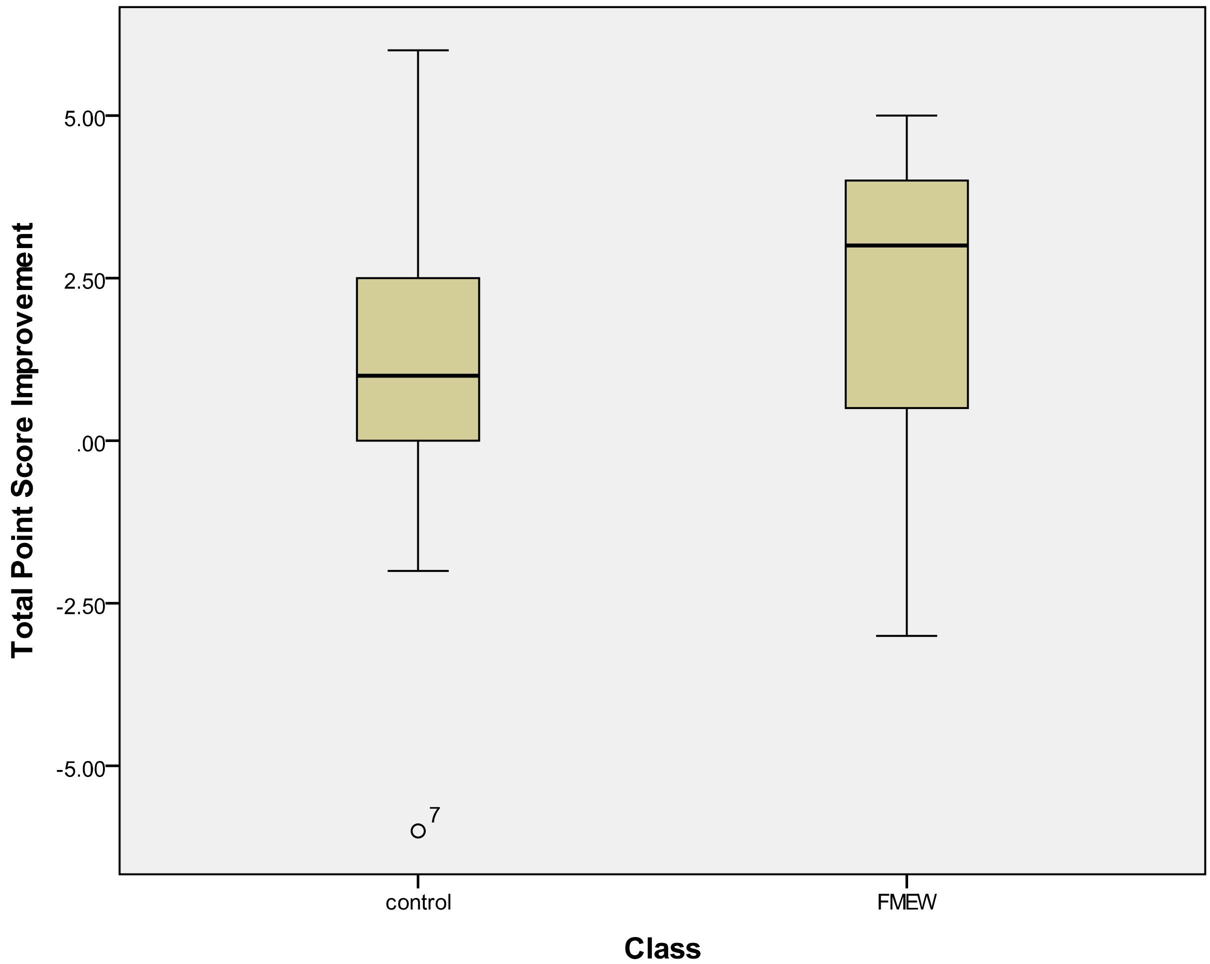


Figure 7. Upper-Limb Coordination Total Point Score between Pre-Test and Post-Test

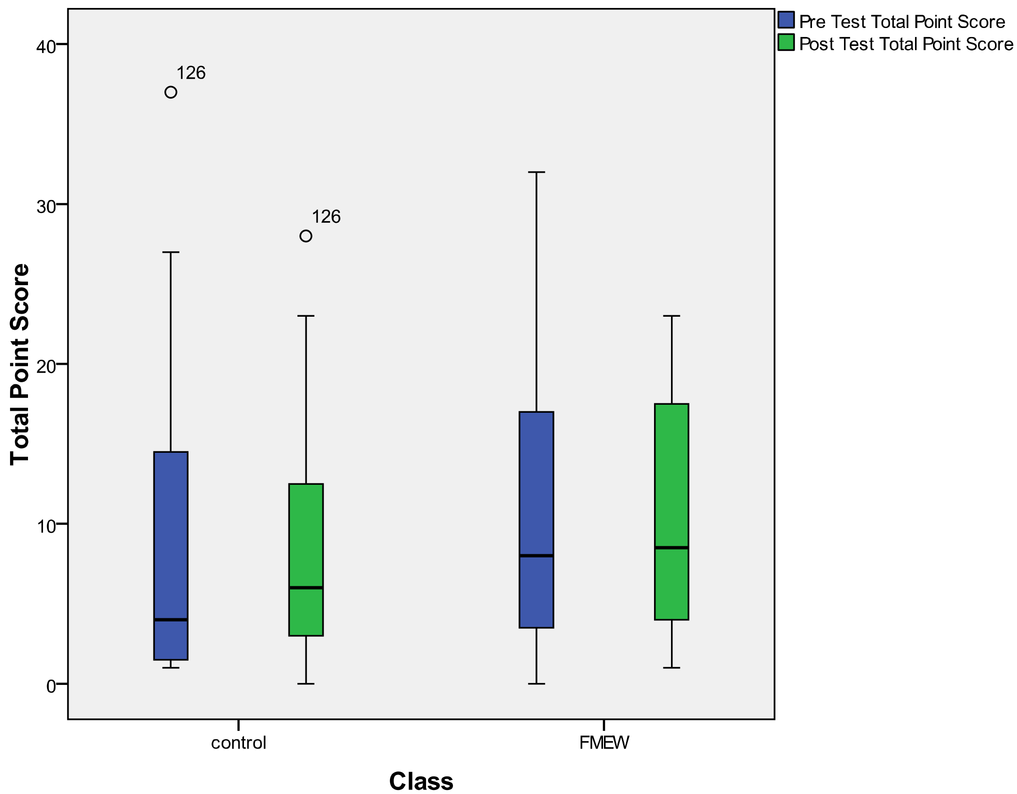


Figure 8. Improvement in Upper-Limb Coordination Total Point Score between Classes

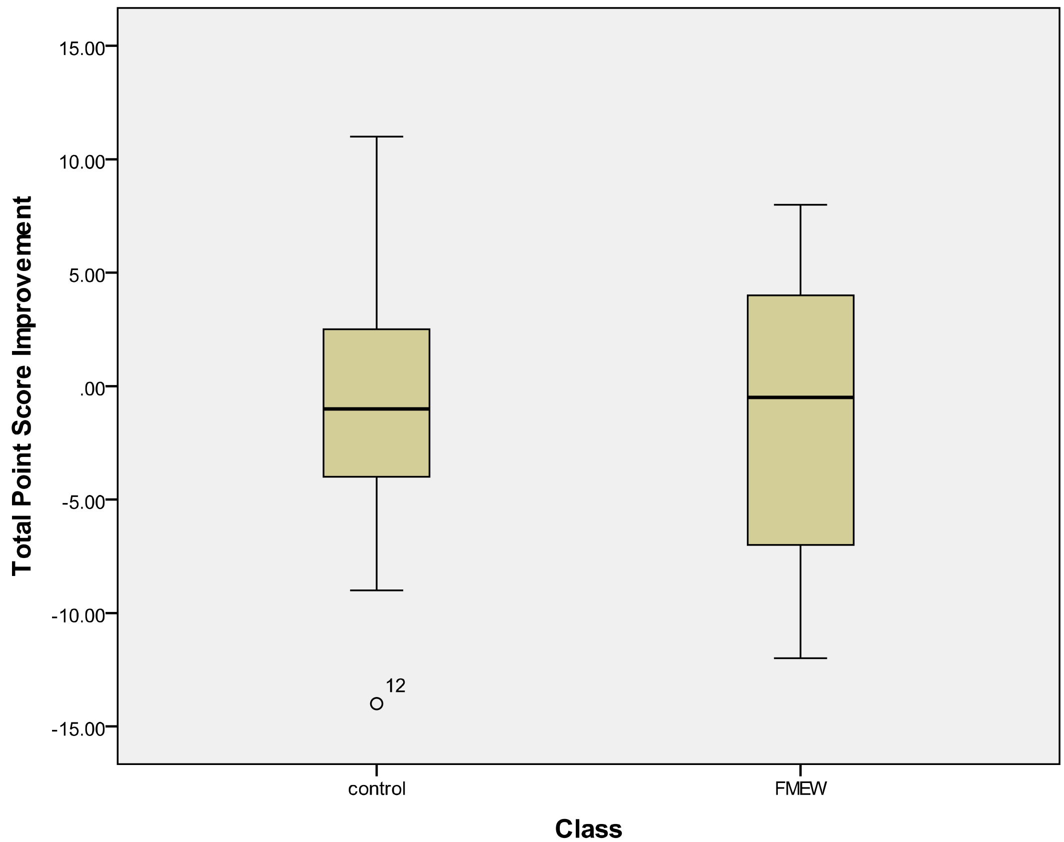


Table 1. Descriptive Statistics for BOT-2 Composite Standard Scores

	Composite	Pre-test	Post-test
Control	Fine Manual Control	34.42 ± 13.270	37.86 ± 11.135
	Manual Coordination	52.92 ± 12.124	47.00 ± 10.850
FMEW	Fine Manual Control	41.50 ± 9.445	38.50 ± 8.254
	Manual Coordination	49.06 ± 12.492	43.69 ± 10.719

The values displayed above are the mean ± standard deviation at pre-test and post-test for both composites of the BOT-2 for both the control and FMEW classes.

Table 2. Descriptive Statistics for BOT-2 Subtest Total Point Scores

	Subtest	Pre-test	Post-test
Control	Fine Motor Precision	4.47 ± 5.939	6.57 ± 5.571
	Fine Motor Integration	3.07 ± 6.464	8.79 ± 7.116
	Manual Dexterity	8.07 ± 4.131	9.40 ± 4.718
	Upper-Limb Coordination	9.73 ± 10.951	8.67 ± 8.624
FMEW	Fine Motor Precision	14.81 ± 6.863	14.44 ± 4.844
	Fine Motor Integration	10.75 ± 6.159	16.87 ± 5.35
	Manual Dexterity	11.56 ± 3.098	13.50 ± 2.805
	Upper-Limb Coordination	11.56 ± 10.558	10.44 ± 7.393

The values displayed above are the mean ± standard deviation at pre-test and post-test for all four subtests of the BOT-2 for both the control and FMEW classes.

Table 3. Comparison of Total Point Score Improvement between Groups for BOT-2 Subtests

	Total Point Score Improvement		
Subtest	**Control**	**FMEW**	**P-value**
Fine Motor Precision	1.79 ± 3.490	0.13 ± 4.941	0.306
Fine Motor Integration	5.50 ± 5.100	6.47 ± 5.939	0.641
Manual Dexterity	1.33 ± 2.968	1.87 ± 2.722	0.612
Upper-Limb Coordination	(-)1.07 ± 5.812	(-) 1.13 ± 6.66	0.977

The values displayed above represent the mean ± standard deviation for the 4 BOT-2 subtests for both the control and FMEW classes.

Table 4. Paired Samples T-test Comparison of Pre-Test and Post-Test Means for the BOT-2 Subtests

Class		Paired Differences					p-value
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		
					Lower	Upper	
Control	Fine Motor Precision	1.786	3.490	.933	-.229	3.801	.078
	Fine Motor Integration	5.500	5.095	1.362	2.558	8.442	.001
	Manual Dexterity	1.333	2.968	.766	-.310	2.977	.104
	Upper-Limb Coordination	-1.067	5.812	1.501	-4.285	2.152	.489
FMEW	Fine Motor Precision	-.375	5.188	1.297	-3.140	2.390	.776
	Fine Motor Integration	6.125	5.898	1.474	2.982	9.268	.001
	Manual Dexterity	1.938	2.645	.661	.528	3.347	.010
	Upper-Limb Coordination	-1.125	6.438	1.610	-4.556	2.306	.495

The values above show the mean, standard deviation, standard error mean, 95% confidence interval, and p-value for the 4 BOT-2 subtests used in the study. These values are a product of a paired sample t-test where each subtest displayed was calculated as an item of subtest post-test minus pre-test.

CHAPTER 5: DISCUSSION

Interpretation of Results

Children in a preschool setting spend approximately 37% of their day engaged in fine motor activities, with an increase in 46% once the child reaches the kindergarten level (Judkins et al, 2009). These percentages are even more astounding when considering the amount of this time the children were engaged in pencil to paper tasks; 10% at the preschool level and 42% at the kindergarten level (Judkins et al, 2009). These figures indicate support for the enhancement of fine motor skills beginning during preschool in order to help children develop the fine motor skills they require to be successful in the kindergarten classroom and beyond. The Fine Motor and Early Writing (FMEW) curriculum targeted the enhancement of fine motor skills through implementing the program with a classroom of children attending Head Start. The Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2) results in the areas of Fine Motor Precision, Fine Motor Integration, Manual Dexterity and Upper-Limb Coordination will help researchers better understand the implications of the FMEW curriculum on the preschool children of Head Start.

Fine Motor Precision

Both the experimental classroom and the control classroom had increases in total point score averages from pre-test to post-test. The control class had a greater increase in its average, but it is important to note that the control class also started out with a much lower average than the experimental class at pre-test. This shows us that the control class was starting off with a much lower baseline for Fine Motor Precision skills in comparison with their peers in the experimental classroom. The distribution of students into each classroom at Head Start is randomly chosen by the school officials and not the graduate research investigators in this study, which makes this difference in baseline scores a measure that was out of our control. A recurrent factor that could have influenced the large difference in baseline scores could be the average age difference between students in the experimental and control classrooms. The students in the experimental classroom were, on average, 8 months older than the control classroom. This means that developmentally, the students in the experimental classroom would have had the opportunity to develop skills that the students in the control classroom were not yet old enough to develop. However, when examining the data to discern if age was a statistically significant variable, there was no correlation to be found.

Another variable of concern was the difference in gender. The experimental class had a significantly higher ratio of female to male, and vice versa for the control class. An independent sample t-test comparing the improvement between male and female also showed no significant differences in the means for the subtests. There were outliers in the control classroom as noted by identification numbers 129 and 126 in Figure 2. Identification number 129, the highest outlier in the control class, was 49 months old at pre-test which is equivalent with the mean for the class. Identification number 126 was 58 months at pre-test, making him 9 months older than the mean age for the class. These examples help to reconfirm that age was not a significant variable. A significant, negative correlation was found across all subtest between total score improvement and pre-test scores. This indicates that the students score at pre-test had a direct effect on the total point score improvement. This means that the students who had low pre-test scores had high total point score improvement and the students who had high pre-test scores had low total point score improvement. This implies that the students who were higher scoring at pre-test had less room for growth in performance. Since the experimental class, on average, had higher pre-test scores than the control class, this explains the low increase in total point score improvement that was seen throughout the data.

In looking at the difference between pre-test and post-test Fine Motor Precision scores in the experimental classroom, a decrease in range is noted at post-test. This suggests that these students' skill for fine motor precision became more uniform than it was at pre-test. Since the students were all learning the same concepts, with the method of teaching adapted for each specific student, it would make sense to see the students become more alike in their skill level. Although the average in total point score only increased a slight amount, it is extremely important to see that the program reached out to the lower scoring students in the classroom and in result brought up their average.

Fine Motor Integration

With Fine Motor Integration, the results showed an increase in the average total point score for both the experimental and control classrooms. A significant difference in pre-test average scores between the experimental and control classrooms, were again are attributed to the 8 month average age difference between the two classrooms. The average and minimum pre-test scores are approximately the same for the control classroom, showing that a majority of the control class begin their preschool year with little to no fine motor integration skills. A drastic increase in the range at post-test for the control class was noted, suggesting that their fine motor integration skills were starting to become more developed due to general maturation of skills. For the experimental classroom, there was a smaller increase in average compared to the control classroom. This is less of a concern, considering how much more developed their fine motor integration skills were at pre-test in comparison to the control class. An interpretation of this phenomenon may be that the experimental class had less room for improvement, as seen by the significant negative correlation between pre-test scores and total point score improvement. The students who did have room for improvement, particularly the lower quadrant of scores, drastically improved in the Fine Motor Integration subtest with implementation of the Fine Motor and Early Writing (FMEW) curriculum. The curriculum was especially reaching out to the lower scoring students who could have been at risk for decreased kindergarten readiness.

Manual Dexterity

For the subtest of Manual Dexterity, the control classroom did not have a significant change in mean total point scores from pre-test to post-test. This could be attributed to the fact that these particular skills may not have been specifically addressed by the standard Head Start curriculum. For the experimental classroom, there was an increase in average total point scores from pre-test to post-test, and also an increase in the minimum total point scores. It was exceptionally positive to see such an increase in the average total point scores for the experimental class because of the nature of what Manual Dexterity assesses. The FMEW curriculum included practice with manual dexterity skills with some of the center activities mimicking skills that were being tested by this section of the BOT-2. The BOT-2 Fine Motor Integration subtest included stringing beads and manipulating pennies and pegs (among other skills). During individual centers, the students had the opportunity to string beads and to manipulate pop beads. These two activities would have aided the development and precision of the skills addressed in the Manual Dexterity subtest. Development of these particular manual dexterity skills have influence over the development of other functional fine motor skills included in activities such as “holding and using utensils, buttoning buttons, sorting coins to make change, playing cards, putting together puzzles and building with blocks" (Bruininks & Bruininks, 2005, p.6).

Upper-Limb Coordination

For both the experimental and control classrooms, the total point scores averages were low at pre-test with a minimal increase at post-test. With this subtest, both classes seem to be less different in skill level opposed to the other three subtests. There was a slightly higher pre-test average in the experimental classroom, on which again can attribute to the 8-month average age difference between the two classes. The results from Upper-Limb Coordination were consistent with the original thought that there would not be much of a score increase at post-test for the experimental class due to the fact that the gross motor warm-up activities were not consistently completed and the ball skill activities were in independent centers with minimal instruction and low attendance. A couple of the independent learning centers of the FMEW curriculum introduced tossing bean bags to a target or to a peer. This would have been the only time the students had upper extremity gross motor activities of this type of exposure during curriculum implementation. What the children were exposed to in regard to upper-limb coordination throughout the remainder of their school week was unknown.

Application to the Classroom

Research on the development of handwriting in children has identified that between the ages of three and five, children's handwriting skills increase and become more stable (Puranik & Lonigan, 2009). The students in both the experimental and control classrooms fell in the middle of the three to five year old age range indicating that they were at the prime age for developing defined handwriting skills. Once children emerge from this age range and enter kindergarten, they are then expected to participate in pencil to paper tasks for approximately 42% of their school day (Marr et al, 2003). During these tasks, the students are using handwriting to explore, organize and refine content that they are learning in the classroom (Judkins et al, 2009). If students find themselves struggling with the mechanical aspects of handwriting, they may have difficultly completing all classroom assignments (Graham, Harris, & Fink, 2000). Their concentration would shift from the nature of the assignment at hand to how to correctly form letters and pre-writing shapes (Graham, Harris, & Fink, 2000). The implementation of the Fine Motor and Early Writing curriculum offered the students in the experimental classroom the chance to gain the foundational mechanical aspects of handwriting during a time in their development that has been shown to be conducive to refining handwriting skills.

Technology use in the classroom is increasing across all subject areas. In some cases, technology seems to be replacing traditional teaching methods. The importance of pencil-to-paper handwriting practice has decreased in the eyes of some classroom teachers who are using technology to teach this specific domain (Hart, Fitzpatrick & Cortesa, 2009). The shift to using computer technology to teach handwriting skills is concerning for the development of literacy and writing skills (Beringer at al, 2009). The pencil-to-paper handwriting practice taught in the FMEW curriculum will activate the neural pathway for facilitating letter memory and recognition in a way that it cannot be activated through learning handwriting skills via computer technology (Longcamp et al, 2008). The FMEW curriculum was designed to offer practice and repetition with pencil-to-paper handwriting skills. The repetition of forming upper case letters with a consistent writing tool helps students develop the skill to a point where it becomes automatic with increased accuracy (Pape & Ryba, 2004). Implementing handwriting instruction and practice in short increments on a regular basis has been more effective than teaching less often for extended period of time (Graham et al, 2008).

Teacher training is especially important when considering handwriting instruction in the classroom. Some teachers who feel they are not adequately trained to instruct their students on handwriting skill development will seek out occupational therapists to teach the explicit handwriting skills to their students (Vander, Fitzpatrick & Cortesa, 2009). Other teachers will limit the amount of explicit handwriting instruction they offer (Asher, 2006). Teachers are starting to become more comfortable using structured handwriting readiness programs to guide their handwriting instruction for students with three out of five teachers choosing to take this approach (Graham et al, 2007). The FMEW curriculum was designed by occupational therapists who are highly knowledgeable about instruction of handwriting skills, and has been designed to be implemented by teachers in the classroom. With the FMEW curriculum as a guide, the classroom teachers would be able to follow the designed curriculum. Completing the various workbook activities and using the provided and classroom required materials allow teachers to be trained to implement the program with their students. This type of implementation opens up the occupational therapist to serve as a consultant for curriculum administration, opposed to the primary instructor for explicit handwriting skills.

The Fine Motor and Early Writing Pre-K curriculum has been designed as a way for teachers to facilitate development of fine motor and handwriting skills of preschool students. The curriculum is organized in a easy to use binder that outlines what skills are to be addressed for each session, how to execute facilitation of those skills, and materials required. There are two sessions for each week, with four centers for each session. The sessions build upon each other so that the teacher can start the curriculum from the beginning and easily go through the curriculum session by session. With the exception of the workbooks, most of the materials needed to facilitate the multisensory guided practice are items typically found in the classroom. Since the program is designed to have two teacher led centers along with two independent learning centers, the curriculum could be easily implemented by the classroom teacher and a teacher assistant. Additionally, through the FMEW curriculum, each student receives their own workbooks in which they will progress through during the entire course of the curriculum. This allows the teacher the opportunity to look back and reflect upon the progress each student is making and offer additional practice on skills with which the student may be struggling. Overall, the program gives teachers, who may not feel adequately prepared to teach handwriting to their students, an opportunity to teach handwriting skills easily and effectively.

Clinical Application for Therapists

Handwriting referrals to occupational therapy are increasing in the school systems. Many of these referrals are the result of witnessed handwriting skill deficits in the classroom, resulting in the occupational therapist instructing the student on handwriting skills in individual sessions (Asher, 2006). The implementation of a structured handwriting readiness program in the classroom, such as the Fine Motor and Early Writing curriculum, could help to decrease the amount of handwriting referrals to occupational therapy. Although the Fine Motor and Early Writing curriculum was implemented by an occupational therapist and occupational therapy graduate students in this study, it was designed with intent to be implemented in the classroom by trained, classroom teachers. The long-term vision is that classroom teachers would be trained on the proper way to implement and teach the FMEW curriculum in the preschool class, and the classroom teachers could then implement the program throughout the entire school year. The research showed that the Fine Motor and Early Writing curriculum enhanced fine motor skills of the lower scoring students in the experimental classroom, which in result could increase these students potential for success at the kindergarten level. Fine motor skills are essential to develop handwriting skills. The fact that this program addresses the underlying fine motor skills needed for handwriting, in conjunction with teaching handwriting skills, is unique and was received positively in the classroom by both the students and the classroom teachers. If such a program was implemented at the whole class level, the number of referrals to occupational therapy could decrease. This would allow the occupational therapists to focus more time and attention towards students with distinct fine motor skill deficits affecting their ability to participate in the school setting.

Limitations

There were some limitations that had to be accounted for throughout the research process. One limitation was the limited amount of time available weekly for the small group sessions with the students. Ideally, graduate research investigators would have potentially been in the classroom offering the Fine Motor and Early Writing (FMEW) curriculum each class day, but due to time restraints during this pilot study, that was not feasible. However, the curriculum was designed for twice a week implementation. However, due to the pre- and post-testing time frames on the study, an entire year was not implemented which may account for the minimal statistically significant results. There were also some weeks where graduate student investigators were not able to be in the Head Start classroom for both session days out of the week. This was due to fieldtrips the experimental class was taking, closings due to inclement weather, and other scheduling conflicts. Due to the limited amount of time with the students, the entire FMEW curriculum was not completed for this pilot study. When implementing the curriculum, decreased attendance for the independent learning centers was observed. Although the students were encouraged by graduate research investigators and their classroom teachers to attend the center, it was not required. There were several occasions where one of the independent learning center areas would be inadvertently taken over by a classroom teacher who required the table for non-FMEW curriculum related classroom related activities. This made the center less accessible for the students, which would decrease student participation for that individual learning center.

Another limitation was the lack of randomization for both groups in the study. Having a non-randomized sample not only prevented the study from being a true experimental-based experiment, but it decreased the accuracy of the data collected. The feasiblity of randomizing the curriculum implemented by student would be practically impossible in a school setting. In order to account for this lack of randomization, graduate research investigators performed a comparison of base line scores after pre-testing so that they could make the proper adjustment in the post-testing if necessary. The classrooms in the study were also chosen based on teacher interest which contributes to the lack of randomization.

The possibility that the data outcome could be influenced by the normal developmental maturation of the children, aside from the intervention, could also be a limitation of this study. It is possible to see an increase in the handwriting and fine motor skills of the students in the control classroom due to maturation. In an effort to minimize this limitation, the two classrooms selected for the study were both 4-year-old classrooms with comparable in class size. Having the classrooms as similar as possible, within reasonable means, would help distinguish if the students who received intervention improved their fine motor skill abilities or if it was more attributed to cognitive maturation. However, despite the attempt to have similar groups, the experimental group was an older group than control group by a mean of 8 months.

Another limiting factor for this study was the manner in which the students were pre-tested and post-tested. Due to time constraints, availability of the students, and student cooperation, the order that each subtest was administered was not consistent. Some students were assessed by the four subtests in order of subtest 1, subtest 2, subtest 3 and subtest 7. Other students were assessed in differing orders of these four subtests. Also, periods of pre-testing and post-testing occurred over a course of 2-3 weeks at a time. This meant that some students may have not completed all four subtests of the BOT-2 in the same day.

Conclusion

In order to address the fine motor skill and handwriting deficits seen in students of low socioeconomic status, graduate research investigators implemented a structured handwriting readiness program in a pre-school classroom at the Pitt County Head Start. The program was designed to be implemented twice a week, with a focus on development of fine motor skills and early writing. The research findings did not show that the FMEW curriculum produced significant increases in fine motor skills for all students. However, it did demonstrate that the students who were lowest performing in fine motor skills at pre-test did improve significantly at post-test. Therefore, the FMEW curriculum was effective for the students who were the most delayed in their fine motor skills. By post-test, the range of scores in the experimental classroom decreased showing that the class became more uniform in their fine motor and early writing skills. The results offer positive support for the implementation of the Fine Motor and Early Writing curriculum to the whole classroom due to its ability to improve the fine motor skills of the lower performing preschool students.

The research study's findings also indicated a greater increase in total point scores for the Fine Motor Integration and Manual Dexterity subtests of the BOT-2. The Fine Motor Integration subtests assessed the students' ability to replicate complex geometric shapes. The FMEW curriculum offered practice with these skills through pencil to paper copying and construction with multisensory medium. The Manual Dexterity subtest assessed the students' ability to perform precise fine motor skills under a time constraint. The FMEW also offered practice with these types of skills through the use of pop beads and other small manipulatives and the use of tweezers and putting together puzzles. The data supports the use of the FMEW to enhance skills in fine motor integration at a whole classroom level.

Overall, the combination of these two positive results supports implementation of the Fine Motor and Early Writing curriculum at the preschool level. The study's findings demonstrated that the FMEW curriculum benefited the classroom as a whole, as well as enhanced the fine motor skills of the students who had a more pronounced deficit in fine motor skills.

Future Research

This research study opened up opportunities for further research regarding the development of fine motor and handwriting skills for the preschool-aged population. Students from the experimental and control classes were given the chance to be a part of a continuation of this research study. These students were further assessed by the BOT-2 assessment approximately a year following the initial pre-testing to determine growth in fine motor skills over the summer months. These same students will be post-tested again towards the end of the school year to determine how their fine motor skills have further developed after a year of kindergarten. Future research should include further exploration of the impact of the Fine Motor and Early Writing Pre-K curriculum with a larger sample size and teacher implementation.

REFERENCES

American Occupational Therapy Association. (2008). Occupational therapy practice framework: Domain and process (2nd ed.). *American Journal of Occupational Therapy*, 62, 625-683.

Asher, A.V. (1996). Handwriting instruction in elementary schools. *American Journal of Occupational Therapy*, 60(4), 461-471.

Bowman, J.O., & Wallace, B.A. (1990). The effects of socioeconomic status on hand size and strength, vestibular function, visuomotor integration, and praxis in preschool children. *American Journal of Occupational Therapy*, 44(7), 610-621.

Bruininks, R.H., & Bruininks, B.D. 2005. *Bruininks-Oseretsky Test of Motor Proficiency*, Second Edition. Circle Pine, MN: AGS Publishing.

Case-Smith, J. (2002). Effectiveness of school-based occupational therapy intervention on handwriting. *American Journal of Occupational Therapy*, 56(1), 17-25.

Case-Smith, J. (1996). Fine motor outcomes in preschool children who receive occupational therapy services. *American Journal of Occupational Therapy*, 50(1), 52-61.

Cermak, S. (1991). Somatodyspraxia. In A. Fisher, E. Murray, & A. Bundy (Eds). *Sensory integration: Theory and practice* (pp.138-170). Philadelphia: F.A. Davis.

Cornhill, H., & Case-Smith, J. (1996). Factors that relate to good and poor handwriting. *American Journal of Occupational Therapy*, 50(9) 732-739.

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.

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(12), 793-794.

Exner, C. (1990). The zone of proximal development in in-hand manipulation skills of nondysfunctional 3- and 4- year old children. *American Journal of Occupational Therapy*, 4(10), 884-891.

Graham, S., Harris, K., & Fink, B. (2000). Is handwriting causally related to learning to write? Treatment of handwriting problems in beginning writers. *Journal of Educational Psychology*, 92(4), 620-633.

Graham, S., Harris, K., Mason, L. Fink-Chorzempa, B., Moran, S., & Saddler, B. (2008). How Do primary grade teachers teach handwriting? A national survey. *Reading and Writing,* 21 (1-2), 49-69.

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

Hart, H.V., Fitzpatrick, P., & Cortesa, C. (2019) In-depth analysis of handwriting curriculum and instruction in four kindergarten classrooms. *Reading and Writing*, 23: 673-699.

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

Levine, M.D. (1987). *Developmental variation and learning disorders*. Cambridge, MA: Educators Publishing Service.

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

McHale, K., & Cermak, S.A. (1992). Fine motor activities in elementary school: Preliminary findings and provisional implications for children with fine motor problems. *American Journal of Occupational Therapy*, 46(10), 898-903.

Olsen, J. (2008). *Handwriting without tears pre-k teacher's guide*. Cabin John, MD: HandwritingWithout Tears, Jan Z. Olsen, OTR.

Olsen, J. (2010). Handwriting without tears. Retrieved April 20, 2010, from Handwriting without tears, website: http://www.hwtears.com/

Owens, L.L. (2004). The effects of the handwriting without tears program on the handwriting of students in inclusion classrooms. Master's thesis. Virginia Commonwealth University, Richmond, Virginia.

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

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 (2), 152-160.

Pathways for Learning (2010). *Products: Discover Writing Success*. [Brochure]. Toni Schulken.

Puranik, C.S., & Lonigan, C.J. (2009) From scribbles to scrabble: preschool children's developing knowledge of written language. *Springer Science+Business Media*, 26 November 2009

Schulken, T.M. (2008). *Pathways for learning.* Retrieved February 25, 2010, from Pathways for Learning website: http:pathwaysforlearning.com/About_Us.html

Tolchinsky, L. (2003) The cradle of culture and what children know about writing and numbers before being taught. Mahwah, NJ: Lawrence Erlbaum Associates.

Troia, G., & Graham, S. (2003) Effective writing instruction across the grades: What every educational consultant should know. *Journal of Educational & Psychological Consultation*, 14(1), 75-89.

West, J., Denton, K., & Germino-Hausken, E. (2000) *America's kindergartens*. Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Zwicker, J.G., & Hadwin, A.F. (2007). Cognitive versus multisensory approaches to handwriting intervention: A randomized controlled trial. *OTJR: Occupation, Participation and Health*, 29(1), 40-48.

APPENDIX A: Letter of Support from the Director of Head Start

July 12, 2010

RE: Head Start Director's Letter of Consent

To Whom It May Concern,

I support the collaborative project being conducted by Dr. Denise Donica and occupational therapy graduate students from East Carolina University in two 4-year-old classrooms at Pitt County Head Start Program. The project will compare 2 classrooms of 4-year-old students' pre-writing skills needed for kindergarten to another 4-year-old (developmentally similar) classroom.

I understand that the administration of 2 developmental assessments will occur. These assessments focus on fine motor and pre-writing skills: Bruininks-Oseretsky Test of Motor Proficiency, (BOT-2) – Fine Manual Control and Manual Coordination and an informal handwriting assessment. These assessments will be conducted on the children in all three classrooms whose parents give consent. They will be conducted twice: once in September/October 2010, and once in approximately March 2011.

I understand that that one 4-year-old classroom will be an experimental group (Ms. O'Kelly's class) using the Handwriting Without Tears Pre-K Handwriting Readiness program that has been used in that classroom for the last couple of years. Another 4-year-old classroom will be an experimental group (tentatively Ms. Urton's class) using the Pathways for Learning handwriting readiness program. Both of these programs have been developed by occupational therapists and are developmentally appropriate to meet the needs of preschool-aged children. One 4-year-old class of similar developmental levels will be the control group (Ms. Chapman's class). Ms. O'Kelly's class will receive the Pre-K Handwriting Without Tears Programming 2 times per week during center time for 5 months. The Pre-K Handwriting program will prepare students' beginning abilities to write when they enter kindergarten by developing body awareness, good habits, coloring, drawing, and handwriting skills. The other class will participate in the Pathways for Learning program 2 times per week during center time for 5 months. This program focuses on coordinating the two hands to work together, coloring, cutting, grasp, fine motor skills, capital letter formation, and cutting skills. I understand that if any questions come up with regard to this project I may contact the principal investigator, Dr. Denise Donica at 252-744-6197 (work) or 252-414-4460 (cell).

I certify that I have read all of the above, asked questions and received satisfactory answers concerning areas I did not understand. As the director of the Pitt County Head Start Program in Greenville, NC, I give my consent for the collaborative research project *Pre-K Handwriting Readiness Programs* between East Carolina University and the Pitt County Head Start Program in Greenville, NC.

Reginald Speight

Head Start Director's Name (print)

Signature of Head Start Director

7/13/10

Date

APPENDIX B: Fine Motor and Early Writing material list

Fine Motor & Early Writing
Pre-K Curriculum

Materials List

The individual students' kits include:

- *Shape Builders™ Learn to Draw*
- *Capital Letter Stories™*
- *Snip It!™*
- *Number Stories™*
- *ColorBound™*
- *Learn to Letter writing tablet*
- *Connect with Color™*

The teacher kit includes:

- Curriculum Binder
- *Shape Builders™ Stencil Kit*
- *Capital Letter Stories™ Flashcards* (5)
- *Train Chain™* (1)
- *Capital Letter Write on/Wipe off tablet* (5)
- *Grotto Grips™* (48)
- 8 pack of colored pencils (3)
- #2 pencils (24)
- 1 lb of popbeads (the larger the bead, the lower the resistance)

Additional classroom materials (not included) needed throughout the year:

Play dough
Construction paper
Popsicle sticks
Finger paint
Paintbrushes
Stringing beads
Markers
Drinking straws
Beanbags
Small ball (tennis ball, etc.)
Broken crayons
Cotton balls
Pillows, mat or bean bag chair
Tongs
Toy cars
Colored chalk — broken into small pieces
Scissors (we recommend Fiskars or Koopy brand)
Dry erase markers
Interlocking puzzles (4-15 pieces)
Paint
Glue sticks
Lacing cards
Individual hole punchers
Cones
Tape
Building toys (ex. blocks, interlocking blocks)
Clothespins
Plastic cups
Pipe cleaners
Masking tape/ painters tape
White tissue paper

Head Start
Pilot Program

APPENDIXC: University & Medical Center IRB Revision Form

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: August 30, 2010

RE: Expedited Category Research Study

TITLE: "Effectiveness of Handwriting Readiness Programs on Children in Eastern North Carolina Head Start"

UMCIRB #10-0447

This research study has undergone review and approval using expedited review on 8.27.10. This research study is eligible for review under an expedited category number 7. The Chairperson (or designee) deemed this **unfunded** 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 **8.27.10** to **8.26.11**. The approval includes the following items:

- Internal Processing Form (dated 8.24.10)
- Parental Permission Form (received 8.25.10)
- BOT 2: Examinee Booklet
- BOT 2: Bruininks-Oseretsky Test
- Beery VMI
- Shore Handwriting Screening
- COI Disclosure Form (dated 8.27.10)
- Letter of Support (dated 7.13.10)

The Chairperson (or designee) does not have a potential for 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.

APPENDIX D: Parental Consent Form

Dear Parent/Guardian,

We are presently working on our Masters of **Occupational Therapy** at East Carolina University (ECU). As part of these degree requirements, we are planning an educational research project to take place at Pitt County Head Start that will help us learn more about handwriting readiness skills of preschool-aged children. This study will look at the use of some handwriting readiness programs developed by occupational therapists to determine with what skills children improve when participating in structured activities from these programs. The fundamental goal of this research study is to determine the effectiveness of these handwriting readiness programs. As a benefit, the participants may develop some skills at a faster rate than those not participating.

As part of this research project, your child will participate in pre-testing (October) and post-testing (Martch) activities that will be conducted during the school day but outside the classroom. Those students in the experimental groups will participate in structured handwriting readiness activities **2 days per week** over **a 6 month period.** As this study is for educational research purposes only, the results of each writing activity **<u>will not</u>** affect your child's grade. No risks or discomforts are foreseen from participating in this study. Your child is placed in one of the three classrooms involved in this study.

We are requesting permission from you to use your child's data (i.e. **the test results**) in the research study. Please understand that your permission is entirely voluntary. If you have any questions or concerns, please feel free to contact Dr. Denise Donica at ECU at **252-744-6199** 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 detach and return the form below by _____. Thank you for your interest in this exciting educational research study.

Sincerely,

Brittni Mattocks, OTS; Amy Goins, OTS; & Leslie Wagner, 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 use my child's data in the educational research project on writing instruction. I voluntarily consent to Dr. Donica using any of the data gathered about my student in the study. I fully understand that the data will not affect my child's grade, will be kept completely confidential, and will be used only for the purposes of her research study. In addition, I DO consent to the researchers taking photographs of my child for use in data collection and presentation of the research.**

☐ **YES, I grant my permission for Dr. Donica to use my child's data in the educational research project regarding writing instruction. I voluntarily consent to Dr. Donica using any of the data gathered about my student in the study. I fully understand that the data will not affect my child's grade, will be kept completely confidential, and will be used only for the purposes of her research study. However, I do NOT consent to the researchers taking photographs of my child for use in data collection and presentation of the research project.**

☐ **NO, I do NOT grant my permission for Dr. Donica to use my child's data in the educational research project regarding writing instruction.**

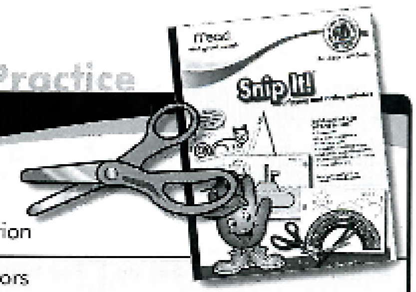
Signature of Parent/Guardian:____Date:____________

APPENDIX E: Fine Motor and Early Writing curriculum example

Fine Motor & Early Writing

Pre-K Curriculum

Center 1 Teacher-Led Practice



Week 5

Subject	Cutting skills, bilateral coordination
Materials needed/ Set up	*Snip It!*™ individual books, scissors
Objectives	To develop and improve cutting skills and bilateral coordination.
Direct Instruction	Have the students open to the rainbow picture in the book and also pick several colors from the back of the book. Cut the strips out of the book and give them to the student. The student will then be instructed to snip the strips into small pieces.
Guided/ Independent Practice	While the students are cutting, encourage proper scissor technique. They should be holding the scissors with their dominant hand, using a "thumbs up" approach with both thumbs pointing up, adjusting the paper with their non-dominant hand, pointing the scissors forward, with their elbows in at their sides. After cutting the strips into small pieces, they will peel the paper off the rainbow and stick the pieces onto the rainbow.

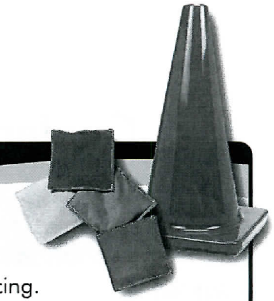
Center 2 Teacher-Led Practice

Week 5

Subject	Letter Formation: Letters E, H
Materials needed/ Set up	*Capital Letter Stories*™ from students' kits, pencils with *Grotto Grips*®.
Objectives	To teach proper capital letter formation of E, H, pencil control and grasp, paper stabilization, and visual motor integration.
Direct Instruction	The teacher will read the "stick kid" story that goes along with the letters, verbally instruct the students on proper letter formation and if needed, provide a demonstration.
Guided/ Independent Practice	The students will practice the formation of E, H and complete the 2nd and 3rd rows of each letter. Their work should be checked over to insure proper formation, alignment, & sizing.

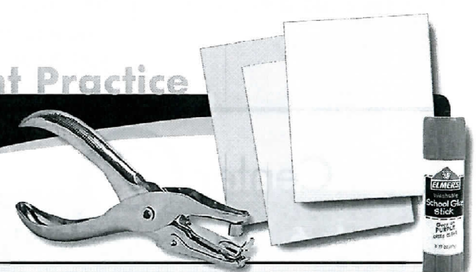
Week 5 Day Ten

Center 3 Independent Practice



Week 5	
Subject	Visual perception, oculomotor skills, and sequencing.
Materials needed/ Set up	Straws (one per student), cotton balls, bean bags/cones. Before beginning, spread out the beanbags or cones in lines (one line per student). Allow 3-4 feet in between each cone.
Objectives	To improve visual perception, oculomotor skills, left/right sequencing and overall body strength.
Direct Instruction	Instruct the students to move the cotton balls around the cones in a left/right sequence by blowing through the straw.
Guided/ Independent Practice	The students will independently blow the cotton balls around the cones.

Center 4 Independent Practice



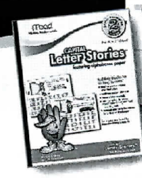
Week 5	
Subject	Hand strengthening
Materials needed/ Set up	Small, individual hole punchers, construction paper, glue sticks
Objectives	To improve hand strength.
Direct Instruction	Instruct the students to use the hole punchers to make multicolored "confetti." They can then glue down the confetti to another piece of paper to make a multicolor design.
Guided/ Independent Practice	Allow the students to punch holes in the construction paper then glue down to another piece of paper.

Center 1 Teacher-Led Practice

Letters

T I J

Week 7



Subject	Letter Formation: Letters T & I Multisensory formation of J
Materials needed/ Set up	Construction paper (2 pieces for each student), paint, and paintbrushes, *Capital Letter Stories*™ from students' kits, pencils with *Grotto Grips*®.
Objectives	To teach proper capital letter formation of T, I & J, pencil control and grasp, paper stabilization, and visual motor integration.
Direct Instruction	The teacher will read the "firefighter" story that goes along with the letters, verbally instruct the students on proper letter formation and if needed, provide a demonstration.
Guided/ Independent Practice	Demonstrate the J and allow the children to imitate the formation of the letter using the paint and the paintbrushes. The students will practice the formation of T, I & J and complete the 1st row of J and the 2nd and 3rd rows of T & I. Their work should be checked over to insure proper formation, alignment, & sizing.

Center 2 Teacher-Led Practice

pre-printing Shape

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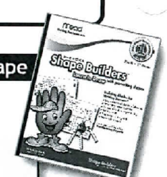
Week 7



Subject	Pre-printing shape (\ ), sequencing, direction following
Materials needed/ Set up	Construction paper with "\" drawn, glue, tissue paper, students' *Shape Builders*™ *Learn to Draw* book, pencils with *Grotto Grips*®.
Objectives	To teach and reinforce pre-printing shapes, sequencing and direction following.
Direct Instruction	The teacher will demonstrate how to form the "\". Then instruct the children to roll small pieces of tissue paper into balls with one hand. They will then glue the tissue paper balls onto the "\". Instruct the students to open the book to the second page. They will complete the row of \. After this, they will complete the balloon and ice cream pictures. Instruct them they will be completing the pictures in order. They will first trace the picture located in the left box, and then draw it on their own in the right box.
Guided/ Independent Practice	Allow the students to complete the row of \ and then complete the balloon and ice cream pictures in the *Shape Builders*™ *Learn to Draw* book. Make sure they are following the steps in the correct order and holding their pencils correctly.

Week 7 Day Thirteen

Center 3 Independent Practice

Week 7

Subject	Design copy
Materials needed/ Set up	Popsicle sticks
Objectives	To increase design copy skills.
Direct Instruction	Instruct the students to take turns making a design using 3-5 popsicle sticks. The other students in the group will then copy the design.
Guided/ Independent Practice	Allow each child to have a turn to be the design maker. The other students will copy the design.

Center 4 Independent Practice

Week 7

Subject	Fine motor control, gradation of force, pinch strength
Materials needed/ Set up	Small beads, small tongs, small cup or container
Objectives	This activity will improve fine motor control and increase pinch strength. It will also work on the gradation of force, as they cannot apply too much force or the bead will pop out of the tongs.
Direct Instruction	Instruct the students to use the tongs to place the beads into the cup.
Guided/ Independent Practice	The students will place the beads into the cup/small container using only the tongs. Encourage them to place as many as they can and see who can get the most into their cup.