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Effects of a Collaborative RtI Based Integrated Kindergarten Motor and Academic Program

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This research, submitted by Wendi Trummert, has been approved and accepted in partial fulfillment of the requirements for the degree of
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Abstract

Objective: This study examined the effects of a collaborative program of fine motor activities, linked to state academic standards, in two general education kindergarten classrooms, on dexterity, handwriting skills, reading ability and math skills.

Method: A modified randomized design, with two experimental and two control classrooms, contained pre and post testing of motor and academic skills. Classrooms receiving intervention engaged in 25-30 minutes of activity over 18 weeks using a program designed through teacher-therapist collaboration. Teacher and students were surveyed for their perceptions.

Results: Both control and intervention groups made significant gains in all academic and motor areas evaluated. Compared with students in the control group, students in the intervention group improved significantly more in DIBELS Whole Words Read ($P = .027$) and DIBELS Letter Naming Scores ($P = .037$). Statistically significant results were achieved in the intervention group ($p = .017$) for students who scored below testing norms on the 9-hole peg with their non-dominant hand, yet not the control group ($p = .504$). Teacher and student surveys revealed a high level of both satisfaction and student learning as a result of participation in the intervention activities.

Conclusion: While both control and intervention groups made gains in academic and motor skills, the intervention group demonstrated greater gains in some academic and motor areas. Teacher and student satisfaction and engagement also demonstrated positive outcomes. This study provides support that a Response to Intervention, collaboratively developed program can improve children's academic and motoric skills in the general education setting.

One of the primary roles of children is participation in school. It is the business of the public education system to ensure that all children receive the necessary support and interventions to receive an appropriate education (Federal Role in Education, n.d.). This can be a challenging endeavor for educators when students enter the educational system at varying levels of ability. In fact, Kenning (2013) reported that two-thirds of children enter kindergarten unprepared for the demands placed on them. One of the demands expected of kindergarteners is strong fine motor skills. Marr, Cermak, Cohn, and Henderson (2003) found that kindergarteners spent 46% of their class time engaged in fine motor activities. Because so many kindergarteners are entering school without the fundamental skills needed for successful participation, the base curriculum necessitates inclusion of interventions that improve these foundational skills, including fine motor skills. Implementation of such interventions should not be the work of any one discipline (Barnes, & Turner, 2001; Cahill, & Lopez-Reyna, 2013; Swinth, Spencer & Jackson, 2007). Identifying collaborative approaches for occupational therapists to support students with a variety of fine motor needs at school within the general education curriculum is the focus of the current study.

Fine Motor Skills in Schools

Kindergarten Expectations. Children are expected at five years of age to participate in reading, writing, math, physical education, music, library, and recess (Swinth, Spencer & Jackson, 2007). Each of these subjects require them to use fine motor skills efficiently in order to be successful. Strong fine motor skills contribute to a child's successful participation in elementary school. Marr, Cermak, Cohn, and Henderson (2003) found that children in 10 kindergarten classrooms in a suburban-rural area of upstate New York spent 46% of their class time engaged in fine motor activities, and, furthermore, 42% of these fine motor activities were

paper and pencil tasks. The authors question if this may demonstrate that students are being required to complete a high amount of paper-and-pencil tasks, but not given the opportunity to also develop the foundational motor skills needed to support the paper-and-pencil tasks that would be obtained through manipulative activities. Partially fueled by the legislation for schools such as Every Student Succeeds (2015), coupled with Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010), and further supported by Individuals with Disabilities Education Improvement Act (IDEA 2004), this high level of expectations placed on children has been a trend for the past 25 years such that some have termed kindergarten the new first grade (Bassok, Latham & Rorem, 2015; Miller & Almond, 2009; Orenstein, 2009).

Practical Implications of Fine Motor Skills in Children. Fine motor skills are an indicator of neural connectivity and predict mastery of tasks requiring executive functioning integral to life situations (Roebers et al., 2013). Functional magnetic imaging (fMRI) tasks, show that the same area of the brain (inferior frontal gyrus [IFG]), is active during a variety of skills, such as handwriting (Gimenez et al., 2014). Gimenez et al. (2014) wrote that "the neuroanatomical properties and phonologically related neurofunctional properties of the IFG may be essential in the development of complex motor skills required in handwriting" (p. 10). Additionally, Roebers et al. (2013) found that fine-motor skills and intelligence were significantly interrelated (.58), and were a stronger predictor of academic achievement than I.Q. was to academic achievement (.27).

Fine motor skills also have a strong relationship with many areas of academics. Children with strong fine motor skills show greater gains in reading scores and, furthermore, fine motor skills predict gains in reading and in mathematics (Cameron, Brock, Murrah, Bell, Worzalla,

Grissmer, & Morrison, 2012; Ziegler and Stoeger, 2010). The same cerebellar parts of the brain involved in motor functioning have also been shown to be involved in cognitive processes necessary for word recognition during reading (Vlachose, Papathanasiou & Andreou, 2007). Moreover, literature suggests a relationship between motor deficits and reading difficulties, including dyslexia (Gladstone, Best & Davidson, 1989; Ramus, Pidgeon & Frith, 2003). A statistically significant relationship is seen between DIBELS reading scores and writing the alphabet letters quickly (Clark, 2010). Jones and Christensen (1999) found a correlation of .73 between handwriting and written expression, demonstrating that the orthographic-motor skills used in handwriting have a strong impact on a child's ability to produce a written manuscript. Visual-motor skills were found to be significant predictors of first grade writing skills, indirectly influence second grade mechanics of writing (Maki, Boeten, Vauras, & Poskiparta, 2001) and were highly correlated to performance in reading, writing and math (Pienaar, Barhorst and Twisk, 2013). Taken together, this evidence may suggest that if a child is not proficient in fine motor skills, the possibility of an adverse educational impact may be present. It further implies that adding manipulative tasks may not only increase fine motor development, but may support other academically related skills as well (Zeigler & Stoeger, 2010; Cameron et al., 2012; Jones & Christiansen, 1999; Clark, 2010; Pienaar, Barhorst & Twisk, 2013; Maki, Boeten, Bauras, & Poskiparta, 2001).

The method of practice is a critical element of motor skill development (Lee, Swanson & Hall, 1991). When children complete motor activities in novel, varied ways, rather than the same activity in rote repetition, they show the greatest improvements in learning and more permanent improvement of skills (Lee, Swanson & Hall, 1991). While rote repetition increases motor performance immediately, it does not hold as well over time or across varied situations

because the child is using motor and cognitive memory and bypassing the process taken to reach the end of the task (Lee, Swanson & Hall, 1991). Lee, Swanson and Hall (1991) suggest that this is because when motor activities are varied, the child must problem solve solutions each time. Thinking through process appears to aid the child's learning and transference of skills (Lee, Swanson & Hall, 1991).

Fine Motor Activities. With students engaged in writing tasks a large proportion of the school day, and the strong educational impact fine motor skills have on success at school, there is a necessity to develop practical fine motor activities within the general education classroom. These activities should provide both fine motor skill practice, and address other kindergarten expectations, such as academics, within the kindergarten program. Planning and creation of the fine motor activities requires a thorough review of relevant research. Due to the time constraints of the school day, activities that serve a dual purpose are highly desirable. The academic standards are a key element to activity development as they are the means by which all students are measured and they outline the functional expectations to be met. Aligning fine motor activities with these standards may help ensure that a strong return on time investment is obtained through participation in the activities. As a whole, the evidence for fine motor development indicates that specific types of fine motor activities are important in children's development and yield positive effects that lessen adverse educational impact. This evidence of child development can been seen in literature as far back as Cowden (1980), who found that activities designed with a series of movements, incorporated cognitive, visual-motor, and kinesthetic components, and used practical objects and tools daily, required the child to focus attention and most effectively develop body awareness and motor learning. The authors found

that using these activities daily, brought students with low visual-motor skills up to age equivalent levels (Cowden, 1980).

More recent studies have found evidence to suggest that when fine motor activities are specifically designed with practical life materials with collaboration of the classroom teacher, connected to academic skills, and consistently implemented into kindergarten classroom settings, children's fine motor skills are significantly improved (Ohl, Graze, Weber, Kenny, Salvatore, & Wagreich, 2013; Rezmer, Swinth, Mcnutty, and Smith, 2014; Rule and Stewart, 2002;). This research has found that despite most kindergarten students being engaged in fine motor activities at school, the results emphasize that the type and specific construction of activities is what leads to a significant effect on fine motor development (Ohl et al., 2013; Rezmer et al., 2014; Rule and Stewart, 2002). These examples demonstrate ways some therapists and educators have had success implementing motor development programs within general education classrooms.

Educational Reform

Approximately 20% of the student population will demonstrate difficulties meeting the demands placed on them by the core curriculum alone (Burns, M. K., n.d.). Supporting these students is necessary in order to help them make adequate academic progress. The Individuals with Disabilities Education Improvement Act (IDEA 2004) is one piece of legislation that mandates that all children receive a "free and appropriate education" and provides funding and extra support to eligible students (Electronic Code of Federal Regulations, 2015). One tool for measuring if the child has received an "appropriate education" are the Common Core academic state standards, which are the grade-specific goals that many school districts use to ensure students have achieved grade level expectations (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). The inability to meet these state

standards can be an indicator that there is a negative effect on their ability to learn, termed an "adverse educational impact" (Child with a disability or student eligible for special education, 2007). Historically, once an adverse impact is identified, for those who warrant it, occupational therapy services in school settings are provided through direct intervention sessions either one-on-one or in small group settings (Cahill & Lopez-Reyna, 2013). Cahill and Lopez-Reyna (2013) further indicated that under this model, therapists feel as though they are asked to take children from the classroom, "fix" them, and return the children to class with improved skills. This may not be a realistic expectation, however, given that these students need significant practice to achieve a new skill. In addition, this specially designed instruction is only provided to students who are eligible for special education services skills as they are markedly below these expectations (7th percentile rank or lower compared to same age peers). Assisting students who are struggling to keep up with same age peers, or applying preventative models of service, are infrequent.

Preventative Services. IDEA 2004 opened the door for therapists to participate in preventative services. Meeting the needs of students who do not meet eligibility requirements for special education, but who fail to respond to the core curriculum and are, therefore, struggling, is of concern. Educator and author Mike Mattos made the comparison of education to the healthcare field indicating that, as a society, we do not wait until people are terminally ill to provide medical assistance (Knowledge Delivery Systems, 2011). Mattos suggested that the field of education would benefit from adopting the same model as healthcare by providing increased preventative interventions, as well as early and aggressive responses to educational difficulties (Knowledge Delivery Systems, 2011). Under IDEA 2004, schools are now permitted to use up to 15% of their allocated special education funding for preventative services for

students who are identified as struggling at school, but have not been identified as having a specific disability (IDEA - Building The Legacy of IDEA 2004, n.d.). Given Mattos afore mentioned illustration, occupational therapists cannot wait until students are "terminal" in skill acquisition before intervening, and then providing direct occupational therapy services through special education.

Response to Intervention. In an effort to support struggling learners and engage in preventative services in an increasing, three-tiered, systematic way, the Response to Intervention (RtI) model was created (Fletcher & Vaughn, 2009). Students who are not successful with the base curriculum (Tier 1), are provided with more interventions and instruction (Tier 2), and yet further intervention and instruction (Tier 3) should they not respond to the first two levels. One means for occupational therapists to provide preventative services in the school setting is participation in RtI to support students at all three tier levels of intervention. RtI is an avenue through which therapists can utilize an approach to intervention to indirectly support student success through collaboration with educational staff, activity analysis, curriculum modification, and implementation of accommodations. Contrary to the more prevalent service delivery style of occupational therapy, which is to work one-on-one with students who demonstrate significant need, the RtI model regards children and classrooms in a holistic manner. RtI determines the staff who is best trained to provide needed services, and implements the services in a systematic manner, which is inclusive of services to develop fine motor skills (Knowledge Delivery Systems, 2011). Occupational therapists are a highly trained member of the educational staff to assist in addressing fine motor development as it relates to students' educational needs. However, due to limitations placed by IDEA 2004, and due to time constraints of the school day, it is not always possible to provide preventative services through direct occupational therapy

services outside of the classroom to struggling students as they would miss primary classroom instruction in other skills areas. This further emphasizes the need for preventative occupational therapy services at all three tier levels.

Implementation of the RtI model is an increasing trend in education. In a recent survey, occupational therapists reported that 77.6% of their school districts had implemented RtI in some way (Cahill et al., 2014). Despite implementation at the district level, not all occupational therapists were engaged in this model themselves. In fact, 65.8% did not participate in the RtI model. One barrier to participation in RtI indicated by 29.7% was that there was no precedent set yet for how they should be involved (Cahill et al., 2014). Other barriers to RtI participation noted by occupational therapists were inadequate resources (66.3%), not having RtI understanding themselves (19.9%), belief RtI was not an occupational therapy practice domain (12.7%), and inadequate practice models (10.1%) (Cahill et al., 2014). For occupational therapists who have been engaged in RtI practices, however, there is growing evidence for the positive impact that occupational therapists have when working within the RtI model. Ohl, Graze, Weber, Kenny, Salvatore, & Wagreich (2013) found that implementation of an occupational therapy RtI program yielded statistically significant increases in fine motor and visual-motor skills compared to a control group. Reeder, Arnold, Jeffries & McEwen (2011) reported occupational and physical therapists, who work under the RtI model, increased the knowledge base of the teachers they worked with regarding their role as therapists within the school system. They furthermore saw an increase in teacher requests for services and interventions to aid students, as well as therapists providing teachers with needed supplies and equipment. Based on these studies, RtI may be an effective model for occupational therapists to provide preventative services.

Collaboration

One service as part of a team. A key element of successful collaboration in RTI is involving necessary team-members in the collaboration process (Clark, 2008). Shepherd and Hanft (2008) indicate the essential members of collaborative educational teams may include the following: the student and their family, general and special education teachers, administrators, related services personnel including occupational therapists, classified staff such as paraprofessionals, peers, volunteers and community partners. Occupational therapists are just one of many service professionals who may be a service provider under this collaborative model.

Benefits of collaboration. Collaboration within the education system has valuable implications. Hanft and Shepherd (2008) indicate that collaborative teaming creates a common purpose, shared responsibility for student outcomes, shared resources by learning from each other, and mutual decision-making. This is supported by Nochajski (2002) who found that 86.2% of participants, which included regular educators, special educators, occupational therapists, physical therapists, and speech-language pathologists, "viewed collaboration as being beneficial in facilitating students' progress and enabling them to meet their educational goals" (p. 107). Barnes (2000) wrote that increased collaboration between occupational therapists and teachers resulted in an increase in teachers' perceptions of occupational therapy contributions to student skill improvement.

Casillas (2010) found that when teachers had increased experience with, and knowledge of, occupational therapy, they maintained a better awareness of the role and scope of occupational therapy practice. In fact, Bayona, McDougall, Tuckker, Nichols, & Mandich (2006) found that teachers used 44% more child-individualized strategies post implementation of a consultative model with occupational therapy. Case-Smith, Weaver & Holland (2014) indicated that using

co-teaching allowed occupational therapists and teachers to work together to provide evidence-based practice to assist students at all ability levels. Furthermore, Cahill (2010) indicated that when occupational therapists were a part of the building problem solving team, 75% of the therapists' recommendations were expected to be implemented. Sayers (2008) synthesized 10 articles in a critical appraisal of occupational therapy collaboration in schools. The results indicated that collaborative methods of service delivery are as effective as direct pull-out, the 1:1 service delivery model, at achieving student goals (Sayers, 2008). Sayers (2008) further found in this review that teacher satisfaction and teacher ability to apply principles learned through the collaborative process, were significantly higher, than when the direct pull-out model was used.

Collaboration Challenges. There are challenges, however, that occupational therapists face when participating in a collaborative model. Hanft and Shepherd (2008) point out common challenges including team members having ineffective communication skills, personal attitudes, knowledge base and beliefs of individual team members and inadequacies within the system structure, such as available time and resources. Cahill, McGuire, Krumdick and Lee (2014) found that 46.7% of occupational therapists felt as though they possessed distinctive skills that were not used appropriately in RtI. One reason for this could be that more than half of participants indicated their colleagues usually did not have an understanding of the breadth of occupational therapy practice (Cahill et al., 2014). Other barriers include lack of administrative support, identified by 88.2% of occupational therapists and lack of consistent presence of therapists at the school, identified by 82% of educators (Nochajski, 2001)

Collaboration within RtI. Collaboration among occupational therapists, teachers and other education staff is a critical piece of operating in an RtI model. For general and special education students alike who spend the vast majority of time in their education classrooms, yet still present

with areas of deficit, it is important for occupational therapists to collaborate with the teachers with whom the children spend most of their time in order to support these students' to development at the most foundational level, which RtI terms Tier 1. Fine motor development is one area within their scope of practice (American Occupational Therapy Association, 2014) that occupational therapists can collaborate with educational staff under the RtI model. Furthermore, the research supports a collaborative approach to fine motor development through practical classroom activities (Barns, 2000; Bayona et al., 2006; Cahill et al., 2014; Case-Smith, 2014; Casillas, 2010; Nochajski, 2002; Sayers et al., 2008; Spencer, Turkett, Vaughan and Koenig, 2006).

Systems level services. Engagement in collaboration at the Tier 1 RtI level requires a change in occupational therapy service delivery. Historically, consistent consultation with teachers and students, preventative instruction to whole classrooms, or at the building level as part of the base curriculum, for many school districts has rarely been an element in occupational therapy services or supports, unless it is as a pre-referral for an occupational therapy evaluation due to a student performing poorly (AOTA, n.d.). Spencer et al. (2006) found that 62% of the time remedial or developmental methods were used and 37% of the time compensatory and educational methods were used by therapists in schools. Research suggests that the contrary is in the best interest of today's schools (Bayona, et al., 2006; Case-Smith, et al., 2014; Casillas, 2010; Ohl et al., 2013). Looking to the future of occupational therapy, Swinth, Y., Chandler, B., Hanft, B., Jackson, L., and Shephard, J. (2004) remind occupational therapists that adherence to the Occupational Therapy Code of Ethics (AOTA, 2010) requires delivery of services with fidelity, which encompasses closely following current evidence based practices. The current literature supports occupational therapist operation at the Tier 1 systems level within an RTI model as best

practice (Barnes, 2000; Casillas, 2010; Ohl, et al., 2013; Reeder, et al., 2011). Examples of systems level services may include providing training to school personnel around brain and physical development, collaboration with teachers to improve evaluation methods to identify skill deficits, collaboration to develop preventative programs such as bullying and obesity prevention, or collaboration for activity development to promote sensory, fine motor or social skill progression. Operating at the systems level allows both those who are eligible for special education to benefit as well as those at risk.

Occupational Therapy in the School Setting

The OT Practice Framework (AOTA, 2014) defines the occupational therapy domain category of Education as "activities needed for learning and participating in the educational environment" (p. S20). It further describes educational participation as "participating in academic (e.g., math, reading, writing), nonacademic (e.g., recess lunchroom, hallway), extracurricular (e.g., sports, band, cheerleading, dances), and vocational (prevocational and vocational) educational activities" (p. S33). In order to engage in the educational environment, the child must have the necessary level of client factors, which include body functions, such as fine motor skills. Occupational therapy "approaches to intervention" provide detailed ways that therapists may address client factors including "create/promote, establish/restore, maintain, modify and prevent." This official statement of the occupational therapy scope of practice, therefore, supports aiding students in a holistic manner, inclusive of fine motor skills, at all instructional levels.

The current culture of the educational system's use of occupational therapy services is not holistic in nature. By method of a questionnaire to 314 elementary teachers in 32 states, Hammerschmidt and Sudsawad (2004) found that a student's lack of progress in handwriting

skills with solely classroom help, was the reason for occupational therapy referral in 94.7% of cases. Moreover, they found that "illegible handwriting" was indicated as the problem most frequently seen (49.2%) in those students (Hammerschmidt & Sudsawad, 2004). While the current norm is to provide the majority of fine motor activities though paper and pencil tasks, and, when students struggle, occupational therapy services are used to fix their writing, the evidence points to the need for classrooms to increase fine motor skills through manipulative activities, which will, turn, have a positive effect on many academic skills. Although occupational therapists have not historically provided services at the general education level, evidence of recent years points to its necessity. Due to fine motor skills being significantly utilized in the course of the school day (McHale & Cermak, 1992), occupational therapists could play a key role in this skill development. Ensuring that the core kindergarten curriculum includes opportunities to improve developmental skill progression, including fine motor skills, is an important element of collaboration in systems level service delivery (Knowledge Delivery Systems, 2011).

Implications

The increasing demands placed on kindergarten students coupled with the prevalence of RtI use by some school districts, calls for more effective interventions with the dual purpose of serving students who receive direct services and other general education students under RtI. The current literature does not contain an example of occupational therapist engagement in RtI to implement fine motor activities in collaboration with an educational team, and which are in alignment with common core standards, to improve fine motor skills. The purpose of this study, therefore, is to determine if implementation of integrated fine motor activities that are linked to state standards, designed through teacher/therapist collaboration, into two pre-existing general

education kindergarten classrooms, will increase grip strength, dexterity, handwriting skills, reading ability or math skills of students in these two classrooms, compared to two classrooms with only pre-existing educational materials.

Method

Research Design

A modified randomized design was used in this study to investigate a naturalistic and generalizable environment, where the effectiveness of the intervention was determined. Due to the constraints of scheduling within the school day, randomization was not feasible, making quasi-experimental pre-existing groups with a control group design, using pretest-posttests, the logical option. Teacher and student perceptions of the intervention was also investigated.

Participants

The accessible population for this study was all 5-6 year olds entering kindergarten in a middle-class, suburban, public school district located in the Pacific Northwest. A convenience sample of one elementary school, where the author was assigned by the district as an employee, containing four kindergarten classrooms of approximately 20 students each, was chosen. This school's enrollment was 542 children, and the approximate school ethnic diversity may be seen in Table 1. Two classrooms were randomly assigned to be intervention groups and two classrooms by default were assigned as the control classrooms. All teachers were given the option to participate or not, but each elected to participate. All kindergarteners in the control and the intervention classrooms were invited to participate in the study by personal invitation at a parent teacher introductory meeting within the first three days of school. Written signed parent consent and verbal child assent were obtained for all participants. All students who spent at least 50% of their day in the general education classroom were eligible to be included in this study.

Instrumentation

Martin Vigorimeter. The Martin Vigorimeter is a pneumatic dynamometer with three sizes of rubber bulbs (circumferences of 19 cm, 16.5 cm and 13.5 cm), and a dial to indicate the pressure exerted. It measures spherical hold-hand grip strength and was chosen as it involves measurement of a more functional grasp pattern for children's activities, compared to the Jamar dynamometer (Link, Lukens, & Bush, 1995). The smallest bulb, with a diameter of 4 cm (13.5 cm circumference), will be used because Level (as cited in Link et al., 1995), found it to be the most effective with children. It was also recommended by the manufacturer for children (Link et al., 1995). Molenaar et al. (2008) indicated a strong reliability of .84 for the dominant hand and .86 for the nondominant hand using intraclass correlation coefficients (95% confidence level) for the Martin Vigorimeter. For the present study, the test procedures in Molenaar et al. (2008) were used.

Nine-hole Peg Test. The Nine-hole Peg was used as a test measure of dexterity for this study due to its' ease of use, coupled with high reliability and sensitivity to change (Mathiowetz, Weber, Kashman & Volland, 1985; Pool et al., 2005; Smith, Hong, & Presson, 2000). The Nine-hole has demonstrated high interrater reliability coefficients (r_{416} = .99 for the dominant hand and r_{416}s = .99 for the nondominant hand, ps < .0005) as well as moderately-high test-retest reliability (r_{503} = .81 for dominant hand and r_{503} = .79 for nondominant hand, ps < .0005). The Nine-hole Peg test measures manual dexterity by asking the participant to first place nine pegs into the holes of the pegboard, and then remove them as quickly as possible (Mathiowetz et al., 1985). For the present study, the test procedures outlined in Mathiowetz et al. (1985) were used.

Student writing samples. Children in all four classrooms were given the Handwriting Without Tears Screener of Handwriting Proficiency (SHP) as a whole classroom by this author

(SHP, n.d.). This screener was chosen for its ease of use for administrators with beginning writers and its ability to accurately measure growth over time. The SHP provided administration instructions and scoring criteria which were used for this study. Approximately 15 minutes was allotted to complete the SHP as suggested by the instructions. (SHP, n.d.).

Reading Scores. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) are measures for assessing children's early literacy skills from kindergarten through sixth grade. This assessment was chosen for this study as it is a standard measure given to the children in this study as part of their school standards and was used for comparisons with motor skill level. Scores in the areas of whole words read, nonsense word fluency, first sound fluency, letter naming fluency, and phoneme segmentation fluency were collected for this study.

WaKIDS. Washington Kindergarten Inventory of Developing Skills (WaKIDS) is an assessment for teachers to measure children's skills kindergarten and was chosen as a measurement for this study because it looks at 6 different areas of child development that will be of value to determine relationships for this study. The general education teacher or trained building staff collected this data within the first month of school. Teachers took an inventory via observation of each child's developing skills in six areas: Social-emotional, Physical, Cognitive, Language, Literacy, and Mathematics. Math skills, including counting by ones, counting by tens, shape recognition, and numbers 0-20 recognition in random order were investigated in this study.

Student Survey. After the intervention period, students were provided with a 7 question survey designed specifically for this study, with questions regarding their experience of the intervention (Appendix A). Six questions were analog displaying both words and pictures of animated faces that represented the word on a four point scale, and one question that was a fill in

the blank question. The survey was read to the children as a group, and they were asked to circle the picture of the response that best fit how they felt regarding the activities.

Teacher survey. After the intervention period, each teacher was provided with a written survey composed by the author specifically for this study, with questions regarding their experience of the intervention Eleven questions were Likert style on a four point scale, and two were fill in the blank (Appendix B).

Procedures

Prior to beginning the study, university Institutional Review Board approval as well as school district Institutional Review Board approval were obtained. Four teachers were randomly assigned to either control or experimental group status initially. The author collaborated with the teachers regarding typical classroom daily procedures and schedules to align the study methods with the natural flow of the classroom, as well as regarding development of the activities to ensure alignment to the Common Core standards as part of the building RtI process.

Development of activities. For this RtI intervention, the fine motor activities were designed by the occupational therapist in collaboration with the general education teacher. Each required at least one or more skills such as intrinsic hand musculature, finger isolation, pincer grasp, hand strength, translation, hand rotation, opposition, visual-perceptual skills, visual-motor skills and/or bilateral coordination. Each activity was stored in a shoe box and the teachers referred to them to the children as “game boxes” or “activity boxes.” It was one criterion of the activity development that each poses elements of both fine motor dexterity and/or strength, as well as an academic component as defined by the Common Core standards. An activity example used clothes pins with one number written on the end and a stack of cards that each had an addition problem. The children had to indicate the correct answer to the math problem by placing the

corresponding clothes pin on the matching card, thereby working on hand strength, coordination, and math skills simultaneously. Each activity had an element of variation, allowing for each task to be modified to be slightly easier or slightly more challenging depending upon the skill level of the child. One example was to make the clothes pins in a task larger or smaller. Both size options were present in the box and children were instructed to participate in the activity at the level they were comfortable. A six-year-old child who did not participate in the study piloted each of the designed activities prior to implementation in the classroom. Activities were modified based on the pilot experience and/or teacher feedback. Necessary modifications included tweezers being too difficult for child's hands to manipulate or materials not being durable enough for child use and easily broken.

Consent, pretesting and training. Prior to beginning the study, consent was obtained from all four teachers for participation in the study as well as from the parents of each student whose child participated. At this time, the purpose of the study was verbally explained to students as a group, and verbal assent was obtained. Pre-testing was then conducted. Masters level occupational therapy students, who were blind to the study design and hypothesis, were trained by the author with 14 years of experience as an occupational therapist, for administration and scoring of the pre-tests. The occupational therapy students and the author administered the Nine-hole Peg and the Vigorimeter to each other to establish inter-rater reliability prior to administration to the kindergarten children. The children in all four classrooms were then given the pretests Martin Vigorimeter and Nine-hole Peg, by the trained occupational therapy students. The children were tested in an area of the school that was familiar to them to complete this strength and coordination tests, and returned to class upon completion. Children in all four classrooms were given the Handwriting Without Tears SHP as a whole classroom by the author

(SHP, n.d.). Administration and scoring of all other pretests was conducted by trained masters level occupational therapy students who were blind to the design and hypotheses. When pretests had been completed, the author took one week to present the activities to each classroom and explain the process, as a week of training for the children. Approximately 5-7 activities were introduced to the children each day of this training week. This allowed the children an opportunity to observe and learn about each activity and ask questions. After this training phase, the intervention phase began the following week.

Intervention process. Historically, the classrooms have engaged in "centers" which were sections of the classroom that each focus on a different, specific educational activity, and each child rotates among these activities. The centers are academic in focus and ask the child to complete a task, such as a math game or word family activities. This use of centers was mimicked for this study and the boxes with activities will be rotated systematically between students at tables, providing a variety of tasks each day, for a total of a 30 minute fine motor center block. Students were provided with the first activity box which was randomly selected for them. After the first activity, each subsequent activity was provided to the child by the student sitting at the child's left, as the children were directed to pass their activity to the student on their right on the sound of the bell. The fine motor centers were rotated upon the sound of a bell every 7-9 minutes, for ~28 minutes, but no less than 25 minutes, at which time it will be announced as "clean up time" for the last 2 minutes. Children completed 3-4 activities in a 28 minute period each day. The children had a total of 60 different activities to engage in throughout the entire 20 week intervention, thereby completing each activity approximately once every two weeks. The teacher and one other adult, either the author or a trained volunteer, were available in the room to

assist children throughout the center time as needed, including to encourage or assist children who needed the activity to be graded to be easier or more difficult.

Collaboration and conditions for activity use. The author met at least once a month throughout the intervention for 5-15 minutes with the two intervention group teachers to discuss the progress of the intervention activities. One activity was identified by the author/teachers team as being ineffective as it was too easy and, therefore, it was be pulled from the set of activities and replaced with a new activity.

Timeline. The intervention phase took place for 18 weeks and 3 days. If the school calendar had only 2 or 3 days of school in a given week during this phase, it was counted as a half week, and a second half week took place at a later time, to make a full week. At the end of the intervention phase, the children in both the intervention group and the control group completed post-testing. At this time, children in the intervention group then engaged in an analog paper and pencil survey to provide their perspective on the activities. The intervention group teachers were also given a paper and pencil survey to obtain their experience of the intervention.

Data Analysis

The author of this study worked in collaboration with trained masters level occupational therapy students to complete the scoring and data analysis process. Vigorimeter grip values were averaged from three consecutive trials. The mean of the three trials was used for analysis, rounded to one decimal place. Descriptive statistics including measures of central tendency and variability were obtained for all variables. The coefficient of variation (CV) was calculated to assess the variability of measurements for each child. The handwriting scores were represented as a legibility percentage. Linear correlations were run to evaluate the relationships among

strength, dexterity, and handwriting legibility. Comparison of intervention and control groups were completed using two sets of a 2 (Time: fall and spring) · 2 (Group: control and intervention) mixed design, repeated measures ANOVA's on academics, strength, dexterity and handwriting scores were conducted.

Data were also analyzed separating children who fell below average based on age specific test norms to determine if the intervention had an effect specifically on students who started at lower ability level in the area of dexterity. All data were analyzed using IBM SPSS Version 23.

Results

This study began with 78 students, however, three students moved out of the district, therefore, due to attrition, 75 students participated in the full duration of the study. Table 2 provides additional demographic information. There was not a significant difference in age between the two groups $t(72)= 1.99$, $p = 0.33$. The 18.5 week (93 session) intervention program was implemented by the two intervention classrooms with high fidelity, as indicated by accurate implementation for all sessions. The program was carried out for 25-30 minutes each session. The classroom teacher and one volunteer, either the occupational therapist or a community volunteer, assisted during the program intervention time. In order to decrease interruptions in the classroom, an informal check-in process was utilized to ensure fidelity. This process revealed that the teachers carried out the program with 100% fidelity per the occupational therapist's recommended procedures on each school, with one day skipped due to a classroom field trip.

Comparison of intervention program and standard instruction effects

All students in both the control and intervention groups made statistically significant improvements in both academic and motoric areas evaluated at the $p < .01$ level, with the exception of student in the control group who did not make statistically significant gains in 9-

hole peg scores for the non-dominant hand at the $p < .05$ level. An ANOVA for repeated measures was conducted for all factors of reading, writing, math and motor skills. Compared with students in the standard instruction control group, students in the intervention group improved significantly more in DIBELS Whole Words Read, $F(1, 72) = 5.122$, $P = .027$, and DIBELS Letter Naming Scores, $F(1, 72) = 4.504$, $P = .037$. No other variables analyzed yielded statistically significant results between control and intervention groups. Due to an error in equipment functioning, Vigorimeter scores were determined to be invalid and were not used as part of the analysis. Analysis were next run removing students from the data who scored in the average range at the time of pretest on the non-dominant hand 9-hole peg test. Analysis of 95% confidence intervals of means revealed that there were significant differences between groups for the non-dominant hand, but not the dominant hand (see Table 3 for 9-hole Peg paired samples t-test results). For students who scored below average for their age on the 9-hole peg with their non-dominant hand, statistically significant results were achieved in the intervention group, but not in the control group. For students who scored below average for their age on the 9-hole peg with their dominant hand, statistically significant results were not achieved in the intervention group or in the control group. An ANOVA for repeated measures between the control and intervention group did not reveal statistical differences, $F(1, 42) = .075$, $P = .786$.

Qualitative Measures

Student Survey. Each of the 40 kindergarten students in the intervention group completed a survey at the end of the intervention period. The average scores on a four point Likert scale, where four is highly positive, per question, are provided in Table 4. Students were read the questions one at a time and asked to circle one of the four emotions faces that best fit their response to the question. Students were allowed to ask clarifying questions during the

process. Students made specific comments regarding the activities bringing a high level of pleasure, but also of skill accomplishment. The students looked forward to doing the activities each day and would choose the activities instead of paper and pencil tasks. Overall, students reported a high level of both satisfaction and learning by completing the activities. While completing the activities, students made comments such as, “look teacher I made my first word ever,” “I love this putty” and “I learned how to skip count” with the manipulative materials. One student opened an activity box and upon seeing the contents, proclaimed aloud, "It is my dream come true!" When asked to provide verbal feedback about the activities after completing the survey, students stated, “they were fun because you get to play games,” “they make your finger muscles strong ‘cause they have tweezers and beads,” “they were fun and tricky too,” “they help you get smarter ‘cause I learned sight words.” One student described one of the activities he did not like and indicated that it was “too hard for his fingers.”

Teacher Survey. The two intervention group teachers each completed an eleven question Likert style survey with two additional open-ended questions, for a total of 13 questions, designed by the author (Table 5). The teachers indicated that the new intervention activities were highly fun for the students, that they had certain activities that were their favorites for the students to complete, and taught the students’ academic skills as well as improved fine motor skills. Both teachers indicated that their knowledge of how classroom activities can be modified to include both academic and motor components grew as a result of this study and they believed that they could use the knowledge they gained through the process activity development and OT/teacher collaboration to benefit future classrooms they teach. The teachers indicated that the students made increased progress toward goals because of the team approach of the study.

Overall, the teachers reported a high level of both satisfaction and student learning by implementing the activities into their classrooms.

The studies revealed that collaboration was a highly valued factor of the intervention. The teachers both indicated that the most helpful part of participation in the study was "getting to collaborate with the OT." They appreciated that watching the children engage in the activities gave them a "new perspective on the motor and academic abilities of the children" that the paper and pencil types of tasks did not reveal to them. This was helpful in that the teacher could take that information and provide each child with further "support or intervention in that area" that the child demonstrated difficulty. The teachers further stated that "the activities were a nice switch after an hour and a half of reading when the kids needed some play time, so they could learn, but was not paper and pencil task." Outside of the survey, during a collaborative session, one teacher stated, "Looking at this activity you made, I was thinking of this other classroom math activity that I could do something similar with just by adding a fine motor part to it, like with tweezers." The teachers indicated that one downfall of participating in the activities every school day for the intervention period was that they "sometimes wanted to use that 30 minutes to do a formal writing workshop but ran out of time on some days."

Occupational therapist observations. As the first author of this study participated in implementation of the intervention one to two times each week, observations provide insight into the value of the intervention for occupational therapist practitioners. The first author was able to be in the classroom, collaborating with the teachers during the intervention implementation which allowed for shared opportunities for problems solving and intervention modification for individual student needs or programming needs. The first author believes that this assisted in the effectiveness of appropriate preventative interventions for students in needs, as well as

appropriate referrals for a special education evaluation to determine the need for direct occupational therapy services.

Discussion

The results of this study provide insights on methods that influence improvements in motor and academic skills. Implementation of a Response to Intervention (RtI) program into two general education classrooms for 25-30 minutes each school day over 18 weeks with high fidelity, yielded positive qualitative and quantitative results. Due to all students in both the control and intervention groups making statistically significant improvements in both academic and motoric areas evaluated provides evidence that both the standard classroom instruction of the control group, as well as the intervention program for this study, are able to support children's motoric and academic skill development. Results indicated that the students in the intervention group made significantly more gains than those in the control group on DIBELS Whole Words Read (WWR) as well as DIBELS Letter Naming Fluency (LNF), provide support that the intervention was more effective than the standard instruction in helping students improve their reading skills. Because the intervention group contained some students who received special education services at some level, the intervention demonstrated it's ability to offer preventative services for general education students, and further support for special education students within their regular programing time. In addition, the results may indicate that children in the intervention group improved just as significantly as those in the standard instruction control group, for the other areas that were analyzed in math, dominant hand coordination and handwriting skills for this group of children. This appears to indicate that the new intervention was equally as effective, and certainly not contraindicated, in comparison. These results are consistent with the previous research

findings that use of hands-on manipulatives, activities and interventions significantly improve academic skills and learning of children (Boggan, Harper, & Whitmire, 2010; Grouws, & Cebulla, 2000; Hartman, Miller, & Nelson, 2000; Leinenbach & Raymond, 1996).

For students who scored below average for their age on the 9-hole peg with their non-dominant hand, statistically significant results were achieved in the intervention group, but not in the control group. These results are interesting and beg the question as to how this is the case. Change was not observed in students whose motor coordination on the 9-hole peg was within average ranges, which is to be expected. However, this intervention appears to be effective in assisting students who were, in fact, below average in motor coordination skills for their non-dominant hand. One consideration might be that, for those children in the control group, they carried out typical classroom activities that allowed them to primarily use their dominant hand to complete activities. Conversely, the activities implemented in the intervention group primarily required bilateral hand use. The inclusion of bilateral coordination tasks in activity development was an important criteria of the activity development for this study. Bilateral coordination has been shown in literature to be interrelated with cognitive development (Diamond, 2000). Furthermore, interhemispheric integration deficits have been found in children with reading difficulties (Gladstone, et al., 1989). Moreover, not only has bimanual activity has been shown in literature to have an impact on reading performance (Uhrich & Swalm, 2007), but students with reading impairments have been shown to demonstrate decreased accuracy in bimanual tasks (Moore, Brown, Markee, Theberge & Zvi, 1995). The findings may provide support for use of this program as a Tier 2 Response to Intervention (RtI) program to support students within the general education classroom who demonstrate below average fine motor coordination or bilateral integration skills.

In addition to examining the effects of the intervention on fine motor and academic skills, the perceptions of both students and teachers was captured in this study through surveys. The students' report of high level of satisfaction and learning by completing the activities supports pedagogical theory of the importance of high engagement on positively impactful outcomes. The intervention group teachers confirmed the positive sentiments of the students, indicating that the intervention activities were fun for the students. These results are useful in that higher levels of student engagement are shown in literature to improve academic achievement and outcomes of students in reading, math and science (Kirby, & DiPaola, 2011; Reyes, Brackett, Rivers, White, & Salovey, 2012; Singh, Granville, & Dika, 2002). Furthermore, research shows that if students are engaged, they have a sense of increased connection with both the teacher and the material being taught, are more involved in the educational process and achieve stronger grades in comparison to students who are disengaged (Reyes, et al., 2012). Kuh (2009) states, "engagement helps to develop habits of the mind and heart that enlarge their capacity for continuous learning and personal development." The strength of positive student attitudes and engagement in this study supports the statistically significant growth found in the intervention group's reading scores.

The teachers in the intervention group of this study indicated strong positive outcomes in multiple regards. The teachers were pleased that the intervention lead to improved academic skills as well as improved fine coordination in the non-dominant hand, which was an expected study outcome. Moreover, they embraced aspects of the intervention that they did not foresee. These included positive collaboration opportunities with the occupational therapist, which assisted them in making plans for students' educational growth. These findings are consistent with previous findings in the literature (Bayona, et al., 2006; Nochajski, 2002; Sayers, 2008).

Other comments made during the collaborative process with the teachers throughout the year, that were confirmed in the follow up survey, included that the collaboration process with the occupational therapist helped them "to learn more child-individualized strategies." The teacher who made a comment referencing the other activity in her classroom was able to learn the underlying program development concepts and transfer her knowledge into adapting an activity currently in her classroom such that in incorporated both academic and motor components. This was reiterated in the follow-up survey by both of the teachers indicating that their knowledge of how to modify classroom activities, and that they could use their new knowledge to benefit future classrooms they teach. This was yet another finding that was consistent with previous findings in the literature (Sayers, 2008). In this way, the occupational therapists' role as collaborators providing support to a general education classroom appears to have been enhanced by the teacher acquiring new learning about fine motor and dual purpose activities that she can transfer to future activities in her classroom. Furthermore, both teachers acknowledged that the intervention activities allowed them to gain a better understanding of what academic and motor skills the child was struggling with in order to further target that skill in their classroom plan. This is confirmed in the literature that states that using co-teaching allows occupational therapists and teachers to work in partnership to provide evidence-based practice to improve outcomes for students at all ability levels (Case-Smith, Weaver & Holland, 2014; Sayers, 2008).

The study also found that the intervention group teachers believed that the intervention activities allowed the children to engage in a different kind of activity than was typical in their classroom following a lengthy reading or paper and pencil time block which increased their engagement and fostered continued learning. In light of the collection of these teacher perceptions, this appears to provide support for use of this program as a Tier 1 RtI intervention.

Both teachers indicated during collaborative sessions that they strategically placed some activities with certain students in order to target a skill that student was missing. This appears to be an indication that teachers believe that a program such as this can be used as a Tier 2 RtI intervention to assist students with specific skill development.

Another significant finding of this study was that the teachers indicated that the collaboration process with the occupational therapist helped them to learn more about the full scope of occupational therapy practice. This is noteworthy in that, if teachers have a better understand of occupational therapy scope of practice, they will be able to more effectively access the support and expertise of the profession. This, in turn, may have the effect of furthering the collaborative process the teachers have with the occupational therapist that the teachers indicated helped them to learn more child-individualized strategies and increase progress of student educational goals. This is supported in the literature by Hanft and Shepherd (2008) who indicate that collaborative teaming creates a common purpose, shared responsibility for student outcomes, shared resources by learning from each other, and mutual decision-making.

Implications for Occupational Therapy

In this study, an RtI intervention program appears to show effectiveness at Tier 1 or Tier 2 level in improving reading skills and fine coordination skills of the non-dominant hand in general education kindergarteners who demonstrate below average fine coordination skills. The intervention program also may be effective in achieving high satisfaction and perceived learning of both students and teachers. Occupational therapists may consider the following implications:

- Collaborative development of Tier 1 and Tier 2 interventions and programs between teachers and occupational therapists show potential to have strong impact on both general education

and special education student outcomes (Bayona et al., 2006; Nochajski, 2002; Case-Smith, et al., 2014; Sayers, 2008).

- Implementation of a collaborative program may allow both the teacher and the occupational therapist to identify individual student needs and adjust the intervention to meet the diverse needs of children in classrooms (Barns, 2000; Bayona et al., 2006; Cahill et al., 2014; Case-Smith, 2014; Casillas, 2010; Nochajski, 2002; Sayers et al., 2008; Spencer et al., 2006).
- The collaborative process between teachers and occupational therapists may allow occupational therapists to understand the unique needs of the classroom in project development, and also may provide the teachers with tools and strategies to implement in their classrooms in the future (Bayona et al., 2006; Nochajski, 2002; Case-Smith, et al., 2014; Sayers, 2008).
- Occupational therapists could have a role as part of the building RtI team to conduct activity analysis, program development and offer expertise regarding intervention strategies (Barns, 2000; Bayona et al., 2006; Cahill et al., 2014; Case-Smith, 2014; Casillas, 2010; Nochajski, 2002; Sayers et al., 2008; Spencer et al., 2006).

Limitations

This study presents with decreased external validity due the small sample size. Implementation at only one school, makes it necessary to use caution in making generalizations to other schools due to the lack of a heterogeneous sample of students. In addition, neither interrater reliability nor test-retest reliability were statistically established for the motor tests. Limitations also presented in an apparent defect of the Vigorimeter functioning, causing the hand strength data to be unusable.

Future research

Future research may include investigating the efficacy of a program such as the one provided in this study under different time intensity, such as three days per school week instead of five. Given the teachers of this study indicating that they at times wished to have flexibility with the number of days per week the intervention took place in order to address other learning needs, this knowledge would assist teachers and therapists to know if the intervention would remain effective in those areas identified in this study with lesser time intensity provided. Future research is needed to investigate the effects of bimanual dexterity activities on reading skills. Due to the improper functioning of the Vigorimeter, further study investigating the impact, if any, of hand strength on academic performance skills may help to inform educational staff. Finally, replication of the current study methods with a larger, more diverse population, and at multiple schools, would increase the generalizability of the findings.

Conclusions

The RtI intervention program implemented in this study offered a variety of activities to students that incorporated both academic and fine motor component in each. The program was found to be effective in improving kindergarteners reading skills and fine coordination skills of the non-dominant hand. Implementation of a collaborative program allows both the teacher and the occupational therapist to identify individual student needs and adjust the intervention to meet the diverse needs of children in classrooms. Teachers appreciated that this program provided them with tools and strategies to implement in their classrooms in the future. The students who participated in this program reported high levels of pleasure and achievement in completing the activities, which supports pedagogical theory of interventions that promote student success. This research may offer support for occupational therapists role as part of the building RtI team to

complete tasks analysis, program development and offer new skill sets to teachers regarding intervention strategies. Finally, intervention programs such as this may support occupational therapists to offer support in Tier 1 and Tier 2 interventions that support student success, target preventative methods and facilitate appropriate referrals for special education.

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References

American Occupational Therapy Association. (2010). Occupational therapy code of ethics and ethics standards (2010). American Journal of Occupational Therapy, 64(6), S17-S26.

American Occupational Therapy Association. (2014). Occupational therapy practice framework: Domain and process (3rd ed.). *American Journal of Occupational Therapy,* 68, S1-S48. doi:10.5014/ajot.2014.682006

American Occupational Therapy Association. (n.d.). *AOTA Practice Advisory on Occupational Therapy in Response to Intervention.* Retrieved November 15, 2015 from http://www.aota.org/practice/children-youth/school-based/rti.aspx

Backman, C., & Daniels, L. E. (1996). A description of grip and pinch strength in children aged 6 to 11 years using the Martin Vigorimeter. *Canadian Journal of Occupational Therapy, 63,* 234-244.

Barnes, K. J., & Turner, K. D. (2001). Team collaborative practices between teachers and occupational therapists. *American Journal of Occupational Therapy, 55,* 83-89.

Bassok, D., Latham, S. & Rorem, A. (2015). Is kindergarten the new first grade? EdPolicyWorks Working Paper Series No. 20. Retrieved from: http://curry.virginia.edu/uploads/resourceLibrary/20_Bassok_Is_Kindergarten_The_New_First_Grade.pdf

Bayona, C. L., McDougall, J., Tucker, M. A., Michols, M., & Mandich, A. (2006). School-based occupational therapy for children with fine motor difficulties: Evaluating functional outcomes and fidelity of services. *Physical & Occupational Therapy in Pediatrics, 26*(3), 89-110.

Benson, J. (2013). School-based occupational therapy practice: Perceptions and realities of current practice and the role of occupation. *Journal of Occupational Therapy, Schools, & Early Intervention, 6,* 165-178.

Boggan, M., Harper, S., & Whitmire, A. (2010). Using manipulatives to teach elementary mathematics. *Journal of Instructional Pedagogies, 3*, 1-6.

Burns, M. K. (n.d.). Using technology to enhance RtI implementation. *RtI Action Network.* Retrieved from http://www.rtinetwork.org

Cahill, S. M. (2010). Contributions made by occupational therapists in RtI: A pilot study. *Journal of Occupation Therapy, Schools, & Early Intervention, 3*, 3-10, doi:10.1080/19411241003683771

Cahill, S. M., & Lopez-Reyna, N. (2013). Expanding school-based problem-solving teams to include occupational therapists. *Journal of Occupational Therapy, Schools, & Early Intervention, 6,* 314-325.

Cahill, S. M., McGuire, B., Krumdick, N. D., & Lee, M. M. (2014). National survey of occupational therapy practitioners' involvement in Response to Intervention. *American Journal of Occupational Therapy, 68,* e234-e240. http://dx.doi.org/10.5014/ajot.2014.010116

Cameron, C. E., Brock, L. L., Murrah, W. M., Bell, L. H., Worzalla, S. L., Grissmer, D., & Morrison, F. J. (2012). Fine motor skills and executive function both contribute to kindergarten achievement. *Child Development*, *83,* 1229-1244.

Case-Smith, J., Weaver, L., & Holland, T. (2014). Effects of a classroom-embedded occupational therapist-teacher handwriting program for first-grade students. *American Journal of Occupational Therapy, 68,* 690-698. http://dx.doi.org/10.5014/ajot.2014.011585

Casillas, D. (2010). Teachers' perceptions of school-based occupational therapy consultation: Part II. *Early Intervention & School Special Interest Section Quarterly*, *17(*2), 1-4.

Child with a disability or student eligible for special education. Washington Administrative Code (WAC) §§392-172A-01040 (2007). Retrieved from http://app.leg.wa.gov/WAC/default.aspx?cite=392-172A-01035

Clark, G. F. (2008). Getting into a collaborative school routine. In Shepherd, J. & Hanft, B. (Ed.), *Collaborating for student success (pp. 105-137).* Bethesda, MD: American Occupational Therapy Association, Inc.

Clark, G. J. (2010). The relationship between handwriting, reading, fine motor and visual-motor skills in kindergarteners (Graduate Theses and Dissertation). Iowa State University. (Paper 11399) Retrieved from: http://lib.dr.iastate.edu/etd/11399/

Cowden, J. (1980). A controlled single subject research design utilizing a sensory motor intervention system. Retrieved from ERIC database (ED235637). http://eric.ed.gov/?id=ED235637

Diamond, A. (2000). Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child development, 71*(1), 44-56.

Daly, C. J., Kelley, G. T., & Krauss, A. (2003). Relationship between visual-motor integration and handwriting skills of children in kindergarten: A modified replication study. *American Journal of Occupational Therapy, 57,* 459-462.

Electronic Code of Federal Regulations (ECFR). (n.d.). Retrieved from http://www.ecfr.gov/cgibin/retrieveECFR?gp=&SID=17de37259ea61d0ab97d9285590e4ac2&mc=true&n=pt34.2.300&r=PART&ty=HTML

Every Student Succeeds Act of 2015, Pub. L. No. 114-95

Federal Role in Education. (n.d.). Retrieved November 14, 2015, from http://www2.ed.gov/about/overview/fed/role.html

Fletcher, J. M., & Vaughn, S. (2009). Response to Intervention: Preventing and remediating academic difficulties. *Child Development Perspectives, 3, 30-37.*

Gimenez, P., Bugescu, N., Black, J. M., Hancock, R., Pugh, K., Nagamine, M. ... & Hoeft, F. (2014). Neuroimaging correlates of handwriting quality as children learn to read and write. *Frontiers in Human Neuroscience, 8,* 1-15.

Gladstone, M., Best, C. T., & Davidson, R. J. (1989). Anomalous bimanual coordination among dyslexic boys. *Developmental Psychology, 25*(2), 236.

Grouws, D. A., & Cebulla, K. J. (2000). Improving Student Achievement in Mathematics. Educational Practices Series - 4. Retrieved April15, 2016 from http://www.ibe.unesco.org/en/resources?search_api_views_fulltext=grouws

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

Hanft, B. & Shepherd, J. (2008). Teamwork vs. the lone ranger. In Shepherd, J. & Hanft, B. (Ed.), *Collaborating for student success (pp. 73-104).* Bethesda, MD: American Occupational Therapy Association, Inc.

Hartman, B. A., Miller, B. K., & Nelson, D. L. (2000). The effects of hands-on occupation versus demonstration on children's recall memory. *American Journal of Occupational Therapy, 54*(5), 477-483.

Hoy, M. M. P., Egan, M. Y., & Feder, K. P. (2011). A systematic review of interventions to improve handwriting. *Canadian Journal of Occupational Therapy, 78,* 13-25. doi: 10.2182/cjot.2011.78.1.3

Hutton, E. (2009). Occupational therapy in mainstream primary schools: An evaluation of a pilot project. *British Journal of Occupational Therapy, 72*, 308-313.

IDEA - Building The Legacy of IDEA 2004. (n.d.). Retrieved November 8, 2015 from http://idea.ed.gov/explore/view/p/,root,dynamic,TopicalBrief,8,

Jones, D., & Christensen, C. A. (1999). Relationship between automaticity in handwriting and students' ability to generate written text. *Journal of Educational Psychology, 91*, 44-49.

Kenning, C. (2013, March 5). Two-thirds of JCPS kindergarteners unprepared for academic demands. *Courier-Journal.* Retrieved from http://www.courierjournal.com/article/20130305/TABLETVERSION/303050096

Kirby, M. M., & DiPaola, M. F. (2011). Academic optimism and community engagement in urban schools. *Journal of Educational Administration, 49*(5), 542-562.

Knowledge Delivery Systems. (2011, Nov 9). Pyramid response to intervention: How to respond when kids don't learn. [Video file]. Retrieved from www.youtube.com/watch?v=ApzX15USq2w&feature=youtu.be

Kuh, G. D. (2009). The national survey of student engagement: Conceptual and empirical foundations. *New Directions for Institutional Research*, *141*, 5-20. DOI: 10.1002/ir.283

Lee, T. D., Swanson, L. R., & Hall, A. L. (1991). What is repeated in a repetition? Effects of practice conditions on motor skill acquisition. *Physical therapy, 71*(2), 150-156.

Leinenbach, M., & Raymond, A. M. (1996). A Two-Year Collaborative Action Research Study on the Effects of a "Hands-On" Approach to Learning Algebra. ERIC Clearinghouse.

Link, L., Lukens, S., & Bush, M. A. (1995). Spherical grip strength in children 3 to 6 years of age. *American Journal of Occupational Therapy, 49*, 318-326.

Maki, H.S., Voeten, M. J. M., Vauras, M. M. S., & Poskiparta, E. H. (2001). Predicting writing skill development with word recognition and preschool readiness skills. *Reading and Writing: An Interdisciplinary Journal, 14*, 643-672.

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.

Mathiowetz, V., Weber, K., Kashman, N., & Volland, G. (1985). Adult norms for the Nine-hole Peg Test of finger dexterity. *Occupational Therapy Journal of Research, 5*, 24-38.

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*, 898-903.

Miller, E., & Almon, J. (2009). *Crisis in the Kindergarten: Why children need to play in school.* College Park, MD: Alliance for Childhood. Retrieved from: http://www.allianceforchildhood.org

Molenaar, H. M., Zuidam, J. M., Selles, R. W., Stam, H. J., & Hovius, S. E. (2008). Age-specific reliability of two grip-strength dynamometers when used by children. *Journal of Bone & Joint Surgery, 90*, 1053-1059.

Moore, L. H., Brown, W. S., Markee, T. E., Theberge, D. C., & Zvi, J. C. (1995). Bimanual coordination in dyslexic adults. *Neuropsychologia, 33*(6), 781-793.

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). Common Core State Standards. *National Governors Association Center for Best Practices, Council of Chief State School Officers*, Washington D.C.: Author.

Nelson, D. L. (2006). Group comparison studies: Quantitative research designs. In G. Kielhofner (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (pp. 65-90). Philadelphia, PA: F. A. Davis.

Nochajski, S. N. (2002). Collaboration between team members in inclusive educational settings. *Occupational Therapy in Health Care, 15,* 101-112.

Obiakor, F. E., Harris, M., Mutua, K., Rotatori, A., & Algozzine, B. (2012). Making inclusion work in general education classrooms. *Education and Treatment of Children, 35,* 477-490.

Ohl, A. M., Graze, H., Weber, K., Kenny, S., Salvatore, C., & Wagreich, S. (2013). Effectiveness of a 10-week tier-1 Response to Intervention program in improving fine motor and visual-motor skills in general education. *American Journal of Occupational Therapy, 67,* 507-514. http://dx.doi.org/10.5014/ajot.2013.008110

Orenstein, P. (2009, May 3). Kindergarten cram. *New York Times.* Retrieved from: http://www.nytimes.com/2009/05/03/magazine/03wwln-lede-t.html?_r=0

Pienaar, A. E., Barhorst, R., & Twisk, J. W. R. (2014). Relationships between academic performance, SES school type and perceptual-motor skills in first grade South African learners: NW-CHILD study. *Child: Care, Health and Development, 40,* 370-378.

Poole, J. L., Burtner, P. A., Torres, T. A., McMullen, C. K., Markham, A., Marcum, M. L., ... & Qualls, C. (2005). Measuring dexterity in children using the Nine-hole Peg Test. *Journal of Hand Therapy, 18,* 348-351.

Ramus, F., Pidgeon, E., & Frith, U. (2003). The relationship between motor control and phonology in dyslexic children. *Journal of Child Psychology and Psychiatry, 44*(5), 712-722.

Reeder, D. L., Arnold, S. H., Jeffries, L. M., & McEwen, I. R. (2011). The role of occupational therapists and physical therapists in elementary school system early intervening services and

Response to Intervention: A case report. *Physical & Occupational Therapy in Pediatrics, 31,* 44-57.

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of educational psychology*, *104*(3), 700.

Roebers, C. M., Rothlisberger, M., Neuenschwander, R., Cimeli, P., Michel, E., & Jagar, K. (2013). The relation between cognitive and motor performance and their relevance for children's transition to school: A latent variable approach. *Human Movement Science, 33,* 284-297. http://dx.doi.org/10.1016/j.humov.2013.08.011

Rule, A. C., & Stewart, R. A. (2002). Effects of practical life materials on kindergartners' fine motor skills. *Early Childhood Education Journal, 30,* 9-13.

Sayers, B. R. (2008). Collaboration in school settings: A critical appraisal of the topic. *Journal of Occupational Therapy, Schools, & Early Intervention, 1,* 170-179.

Screener of Handwriting Proficiency. (n.d.). Retrieved from Handwriting Without Tears. http://screener.hwtears.com

Shepherd, J. & Hanft, B. (2008). Team faces and spaces. In Shepherd, J. & Hanft, B. (Ed.), Collaborating for student success (pp. 35-72). Bethesda, MD: American Occupational Therapy Association, Inc.

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagement. *The Journal of Educational Research*, *95*(6), 323-332.

Smith, Y. A., & Hong, E. (2000). Normative and validation studies of the Nine-hole Peg Test with children. *Perceptual and Motor Skills, 90,* 823-843.

Spencer, K. C., Turkett, A., Vaughan, R., & Koenig, S. (2006). School-based practice patterns: A survey of occupational therapists in Colorado. *American Journal of Occupational Therapy, 60*, 81-91.

Swinth, Y., Chandler, B., Hanft, B., Jackson, L., & Shephard, J. (2004). Occupational therapy in school-based settings. *Journal of Special Education Leadership, 17*, 16-25.

Swinth, Y. L., Spencer, K. C., & Jackson, L. L. (2007). *Occupational therapy: Effective school-based practices within a policy context* (COPSSE Document No. OP-3E). Gainesville, FL: University of Florida, Center on Personnel Studies in Special Education.

Uhrich, T. A., & Swalm, R. L. (2007). A pilot study of a possible effect from a motor task on reading performance. *Perceptual and Motor Skills, 104*(3), 1035-1041.

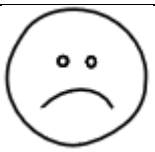
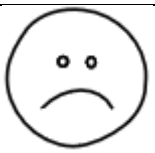
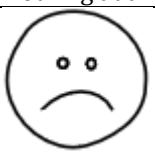
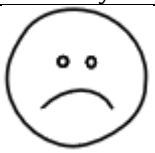
Vlachos, F., Papathanasiou, I., & Andreou, G. (2007). Cerebellum and reading. *Folia Phoniatrica et Logopaedica, 59*(4), 177-183.

Washington State Report Card. (n.d.). Office of Superintendent of Public Instruction [Data file]. Retrieved from http://reportcard.ospi.k12.wa.us/Summary.aspx?schoolId=2044&OrgTypeId=1&reportLevel=School &orgLinkId=1

Ziegler, A., & Stoeger, H. (2010). How fine motor skills influence the assessment of high abilities and underachievement in math. *Journal for the Education of the Gifted, 34*, 195-219.

Appendix A – Student Survey

Each child is given a survey and the researcher will read the directions and questions to students:
We did a lot of fun activities in kindergarten this year. Some of the activities were new activities to this classroom. Let's talk about what you thought of the new activities. We will talk about each question together one at a time. You will color the face that matches your answer to the question. Only color one face for each question.

1. Most of the new activities were:	 Very fun	 A little fun	 Not very fun	 Not fun at all
2. The new activities taught me:	 A lot	 A little	 Not very much	 Nothing at all
3. I looked forward to doing these activities every day:	 Definitely yes	 Yes	 No	 Definitely not
4. I would choose these activities to learn something new instead of a worksheet: (see worksheet your teacher is holding)	 Definitely yes	 Yes	 No	 Definitely not
5. Should kindergarteners get to do these activities next year?	 Definitely yes	 Yes	 No	 Definitely not
6. There were some activities that were my favorite:	 Definitely yes	 Yes	 No	 Definitely not

7. My favorite activity was: _____

_____

_____

_____

Appendix B – Teacher Survey

Please provide your thoughts regarding this study by answering the following questions.

Questions:	Excellent, strongly agree	Good, agree	Ok, neither agree or disagree	Poor, Strongly disagree	Comments:
1. Most of the new activities were fun for the students	4	3	2	1	
2. Most of the new activities taught the students BOTH an academic skill and improved fine motor skills	4	3	2	1	
3. I looked forward to my students doing these activities every day	4	3	2	1	
4. I would choose these types activities for my students to learn something new instead of a worksheet	4	3	2	1	
5. I would do these activities with my kindergarteners next year	4	3	2	1	
6. There were some activities that were my favorite for the students to complete	4	3	2	1	
7. My knowledge of how classroom activities can be modified to include both academic and motor components grew as a result of this study	4	3	2	1	
8. The collaboration process with the OT helped me to learn more child-individualized strategies	4	3	2	1	
9. The collaboration process with the OT helped me to learn more about the full scope of OT practice.	4	3	2	1	
10. The students made increased progress toward goals because of the team approach of the study	4	3	2	1	
11. I can use the knowledge I gained through the process activity development and OT/teacher collaboration to benefit future classrooms I teach	4	3	2	1	

12. The most effective activities for my students were: _____

The most helpful part of this study was: _____

Table 1. Diversity Statistics 2013/14 school year

Diversity Statistics	**School District of Study**
Hispanic/Latino	16.7%
American Indian/Alaskan Native	.4%
Asian	1.7%
Black/African American	2.4%
Native Hawaiian/Other Pacific Islander	.6%
White	66.9%
Two or more races	11.4%
Free/reduced-Price Meals	35.8%
In Special Education	9.2%

(Washington State Report Card, n.d.)

Table 2. Study Demographic Characteristics (*N* = 75)

	Intervention (*n* = 40)	Control (*n* = 35)
Gender, *n* (%)		
Male	22 (55.0)	21 (60.0)
Female	18 (45.0)	14 (40.0)
On an IEP, *n* (%)		
OT, PT and/or SLP	3 (0.08)	0 (0.0)
Social & Adaptive	0 (0.0)	2 (0.06)
Age, yr, M (SD)	5.62 (0.35)	5.5 (0.35)

Note. *M* = mean; *SD* = standard deviation.

Table 3. Fine Motor Paired Samples t-test Scores (*N* = 75)

	Intervention (*n* = 40)		Control (*n* = 35)	
	M (*SD*)	*t* (*p*)	*M* (*SD*)	*t* (*p*)
9-Hole Peg, *M* (SD)				
Dominant Hand	5.442 (11.058)	2.360 (.028*)	4.719 (5.129)	2.385 (.000**)
Non-dominant Hand	3.498 (6.468)	2.594 (.017*)	.879 (5.911)	2.594 (.504)

Note. *M* = mean; *SD* = standard deviation; *t* = t-score;

* $p < .05$. ** $p < .01$ (one-tailed).

Table 4. Findings of Student Survey Summary per Question

Question	Average Response (max = 4)
1. Most activities were:	Fun - 3.73 (93.1%)
2. The activities taught me:	A lot - 3.45 (85.0%)
3. I looked forward to doing these activities daily:	Yes - 3.65 (91.3%)
4. I would choose these activities to learn something new instead of a paper worksheet:	Yes - 3.55 (88.8%)
5. Kindergarteners get to do these activities next year:	Yes - 3.90 (97.5%)
6. Some activities that were my favorite:	Yes - 3.68 (92.5%)
	Total - 3.69 (92.4%)

Table 5. Findings of Teacher Survey Summary per Question

Question	Score (%)
1. Most of the new activities were fun for the students	3.5 (87.5%)
2. Most of the new activities taught the students BOTH an academic skill and improved fine motor skills	4 (100%)
3. I looked forward to my students doing these activities every day	3.5 (87.5%)
4. I would choose these types activities for my students to learn something new instead of a worksheet	4 (100%)
5. I would do these activities with my kindergarteners next year	4 (100%)
6. There were some activities that were my favorite for the students to complete	4 (100%)
7. My knowledge of how classroom activities can be modified to include both academic and motor components grew as a result of this study	4 (100%)
8. The collaboration process with the OT helped me to learn more child-individualized strategies	4 (100%)
9. The collaboration process with the OT helped me to learn more about the full scope of OT practice.	4 (100%)
10. The students made increased progress toward goals because of the team approach of the study	4 (100%)
11. I can use the knowledge I gained through the activity development process and OT/teacher collaboration to benefit future classrooms I teach	4 (100%)
	Total - 3.91 (97.8%)

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Signature of DrOT Student