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The Impact of Sensory-Based Movement Activities on Students in General Education

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Abstract

OBJECTIVE. Movement throughout the day in the school setting may help support skills such as time on task, and academics. This study examined the impact of sensory-based movement activities on academic learning. In addition, the teacher and student perceptions of the activities were analyzed.

METHOD. A mixed method design followed students in six classrooms during intervention (three classrooms) and control (three classrooms) (N = 135) with results based on participation in pre and posttest scores on STAR reading and math and DIBELS assessments. Students in the intervention group participated in six sensory-based movement activities, twice daily, once in the morning and once in the afternoon. Each activity was categorized as either energizing, activating, or restoring/regrouping.

RESULTS. Results indicated the intervention group trended toward higher positive changes in all results as compared to the control group, although the differences were not statistically significant. The students' perceptions of the movement activities' effect on work completion, ease of learning, and overall enjoyment were very positive. The teachers perceived the program to have positive results as well, but had concerns regarding behavior during the activities and the transition back to learning after movement breaks.

CONCLUSION. This study found that the use of sensory-based movement activities has the potential to influence academic outcomes and supported this program as a Tier 2 intervention. Teachers and students perceived the intervention to be effective and engaging. Occupational therapists can provide training and efficiently embed these types of activities into classrooms in collaboration with general education teachers.

The Impact of Sensory-Based Movement Activities on Students in General Education

Teaching so students will learn grade level skills in math, reading, and writing is the aim of every teacher in elementary school. For students to acquire these academic skills they need the underlying foundational abilities of appropriate attention, behavior, engagement, comprehension, and memory. Due to changes in modern educational policy and multiple curricular standards, our elementary school learning expectations continue to change. In the midst of this changing system, teachers are called upon to differentiate their instruction to support learning for each student (Center for Applied Special Technology, 2015). Additionally, there are increasing numbers of students identified with learning, behavioral, or attention deficits (National Association of Special Education Teachers, 2007) who are enrolled in general education classrooms and require appropriate application of differentiated instruction. Finally, many elementary schools now require 60 to 90 minute blocks for math and reading, during which students are required to sit and focus on learning. All the while, many schools are cutting physical education and recess time to create time for additional academic instruction (Lue, 2013). To provide additional support for students who are struggling, many school districts are using Response to Intervention (RtI), a multi-tiered approach, to structure early intervening services and provide more assistance to those students in need.

Occupational therapy (OT) in the schools typically serves as support for students eligible for specially designed instruction both individually and within their classrooms. Through the Individuals with Disabilities Education Improvement Act (IDEA 2004) and RtI, occupational therapists have the opportunity to offer their expertise early in the intervention process for all students. Occupational therapists are a valuable part of the educational team, having a wide scope of practice and bringing distinct value to interventions as they collaborate with teachers in

order to support student achievement. Their competence includes in-depth knowledge of neurology, child development, gross and fine motor anatomy, physiology, and theories such as sensory integration (SI). SI is one frame of reference used by occupational therapists to understand how the nervous system's processing of sensation influences effective and ineffective functional performance (Ayres, 1972). Activities that include proprioceptive, vestibular, deep pressure and visual input are used based on the theory that this type of input effects arousal levels. These types of input have been used clinically to increase alertness and to produce a calm state, supporting the student's ability to attend and learn (Spence, 2015). Research examining the effect of physical activities has found a positive correlation with academic behaviors, increased academic performance and on task behavior (Mahar et al., 2006; Mullender-Wijnsma et al., 2015; Rasberry et al., 2011). In addition to aerobic features, physical activity has sensory components that can be understood in the light of the sensory integration theory and used to promote adaptive student behaviors. The majority of the research has included physical activity that is primarily alerting in nature. However, few studies have been conducted using activities that were purposely selected for both their alerting and calming effects (Spence, 2015).

Through the addition of classroom sensory-based movement activities, that offer alerting and calming input, OT strategies have the potential to benefit not only identified students, but also the whole class. Mahar et al. (2006) found that while not every child needed physical activity breaks to remain on-task, offering the breaks helped many of the students, especially those who were more off task initially. While these physical activities and sensory-based strategies are easily embedded into general classrooms and have demonstrated effectiveness (Spence, 2015; Rasberry, 2011), the idea of adding additional expectations to the classroom can be met with resistance by teachers or administrators for many reasons. In a qualitative research

study by McMullen, Kulinna and Cothran (2014), teacher concerns included lack of time, threats to classroom control, ease of implementation, and student enjoyment.

Typical Classrooms in the United States

Each U.S. general education classroom is made up of a diverse population of students based on their background, learning abilities, and social skills. The academic diversity ranges from those identified as having special needs to those who are gifted. The number of students receiving special education in the 2012-2013 school year was approximately 13% of all students in public schools (National Center for Educational Statistics [NCES], 2015, para. 1). Within that number, 13% were students with autism spectrum disorders (ASD), which are being diagnosed at a rate of 1 in 68 children, with a much higher rate in boys than girls (Centers for Disease Control and Prevention, 2015a). Moreover, the rate of school-aged children diagnosed with attention-deficit hyperactivity disorder (ADHD) is approximately 11% (6.4 million) as of 2011, and each year this number is expected to grow (Centers for Disease Control and Prevention, 2015b). Sensory processing issues have been associated with both ASD (Watling, Deitz, & White, 2001) and with ADHD (Mangeot et al., 2001, p. 404). Sensory Processing Disorder (SPD) is also recognized as a valid disorder as well by the Interdisciplinary Council on Developmental and Learning Disorders (Greenspan & Weider, 2008). Students with any of these issues may struggle daily with academic performance in part due to problems with attention and on-task behavior.

Special Education Legislature and Policy

Individuals with Disabilities Education Improvement Act. For students who have a specific diagnosis and functional academics issues there is law and policy in place to guide their education. The Individuals with Disabilities Education Improvement Act (IDEA 2004) was most

recently reauthorized in 2004 with improved clarity and new stipulations. IDEA 2004 guarantees free and appropriate public education (FAPE) for children ages 3-21 and guides the evaluation and the individual education program (IEP) process. Students are required to be provided these services in the least restrictive environment which is often identified as inclusion, that process of including students with special needs into a general education classroom. It can be a challenge to integrate typically developing students with those with special needs, however, there are many positive benefits including increased social interactions, peer role models, and increased achievement (Kids Together Inc., 2010). Based on IDEA 2004 it is not only the right of the students to receive appropriate education, but also appropriate curricular accommodations and modifications. Occupational therapy is identified as a related service under Part B of this act, and is available to eligible students and as a preventative service for all students, to provide support for their education. Occupational therapy can be important in supporting classrooms in which students with special needs are integrated with typically developing students.

Response to Intervention Model (RtI). Occupational therapists and OT assistants working in public schools may provide intervention to students in general education under the umbrella of early intervening services as well as to students who are eligible under IDEA 2004 or Section 504 of the Rehabilitation Act of 1973 (Roley, Bissell, & Clark, 2009). School districts have approached this early service provision in a variety of ways, one of which is RtI. Not every student learns at the same rate, and some students struggle to learn to the level of the Common Core State Standard (CCSS) in the way most schools teach the information. The aim of RtI is to identify students who are not learning successfully within the typical general education classroom and provide them with assistance before they fail. It provides "an assessment and intervention process for systematically monitoring student progress and making decisions about

the need for instructional modifications or increasingly intensified services using progress monitoring data" (Johnson, Mellard, Fuchs, & McKnight, 2006, p. i.2). RtI continues to evolve, but is currently viewed as a multi-tiered system that provides support to all general education students at different rates including intervention and enrichment. The first tier includes core instruction taught by highly qualified teachers and is adequate for about 80% of students. The second tier is additional teaching that specifically addresses issues with learning or behavior in small groups, which is needed by an additional 15% of students. The third tier is more intense intervention for the remaining 5% of the student population who are performing significantly below grade level (Center on Response to Intervention, 2015). If students need Tier 2 or 3 intervention, they are provided specific instruction and monitored for progress. If they respond positively or need additional assistance, they may move up or down the tiered levels. Occupational therapists can provide early intervening services at each tier level and they can play a part in the universal design and instruction that will set up best learning practices (AOTA, 2012). In fact, related service providers, such as occupational therapists can utilize up to 15% of the amount the local educational agency receives under part B of the IDEA, to be available for "early intervening services" (IDEA, 2004). Early intervening services may include strategies such as providing training for teachers or whole class core instruction on strategies for hand strengthening, appropriate pencil grasp expectations, or sensory-based movement breaks.

Common Core State Standards (CCSS). In recent years, all public school teachers have had to adjust to teaching to the CCSS which were developed as "consistent goals and benchmarks to ensure students are progressing" at the rates set by the standards level (Common Core State Standards Initiative, 2015). They were also developed to ensure students receive the same teaching concepts no matter the school they attend or the state they live in. In response to

the increased rigor required by the CCSS, some districts have implemented block instruction time, on average 60-90 minutes, focusing on a specific subject such as math or English/Language Arts (ELA). Consequently, less time is allotted for physical education, music, art, recess, science, social studies or lunch (Center on Education Policy, 2008). While the longer blocks of instruction time are intended to help students learn, it can lead to an increase in difficulty for some children to stay alert and focused, leading to decreased learning.

Every Student Succeeds Act (ESSA). The Elementary and Secondary Education Act (ESEA, 1965) was originally passed for the purpose of closing the gap between schools who have fewer resources and those that have more resources. When revised as the No Child Left Behind Act (NCLB, 2007), annual testing was included as was the goal that 100% of children would meet academic standards. The goal for the newest version, Every Student Succeeds Act (ESSA, 2015), passed in December of 2015, has a similar goal, to close the achievement gap. Modifications in this version include measuring growth rather than proficiency and permitting states to use multiple measures of learning. There will still need to be evidence-based plans for student learning, especially those students who are falling behind benchmark expectations. This continues to support the need for additional options for evidence-based interventions for all students, but especially those individuals and groups of students who are struggling. In addition, it supports the involvement of Specialized Instructional Support Personnel (SISP) including OT as part of the comprehensive team to meet student needs.

Occupational Therapy in Public Schools

Occupational therapy is one profession on the team that serves students under IDEA 2004, ESSA, and RtI. Typically, occupational therapists serve students as a related service that is delivered to support students' educational program based on evaluation results and goals set in

the IEP or 504 plan. IDEA 2004, ESSA, and RtI have provided occupational therapists more opportunity to offer additional viewpoints and their professional expertise to benefit more children and teachers. By definition, occupational therapy services are collaborative in nature and used for the benefit of individuals, populations, and organizations (American Occupational Therapy Association [AOTA], 2014).

In the 2012 practice advisory on OT in relation to RtI, AOTA stated, "the fundamental background of occupational therapy practitioners is rooted in concepts related to promoting meaningful participation, optimum development, and engagement within natural contexts or least restrictive environments" (p. 1). In other words, the unique knowledge and skills of occupational therapists give them expertise that is directly applicable under RtI guidelines. A descriptive study in a school district in Texas examined how occupational therapists and physical therapists were involved in RtI. Reeder, Arnold, Jeffries, and McEwen (2011) documented a four-step process that included (a) administering a screening tool, (b) educating the supporting teachers and staff, (c) providing student resources and intervention strategies, and (d) referring students from RtI to special education and related services as needed. Positive outcomes included teachers using the suggested strategies effectively and seeking support from occupational therapists and physical therapists. Currently, the formal process of RtI is optional. However, all schools are required to provide some type of additional intervention and progress monitoring for struggling students.

Components that Affect Attention and Learning

To learn and gain knowledge one must have focused attention for the duration of the information being presented or else portions of the information may be missed. Many factors such as the brain's executive function and ability to tune in to salient information and tune out

information that is not important can affect attention and learning (Diamond, 2013). In addition, genetics, health, sensory processing, sleep and what one eats can also influence attention during learning (Dunn & Bennett, 2002). Furthermore, there are developmental variations within an age group that may affect attention (Center for Mental Health in Schools at UCLA, 2015). For example, a 4th grader may have difficulty maintaining attention to a topic, such as geometry, that is well above his developmental level. However, teachers expect that same 4th grader to maintain attention to an age appropriate educational topic for up to 30 minutes. As we continue to gain knowledge and evidence, additional factors that affect attention and learning will be discovered.

Neurology of attention and learning outcomes. Scientists are continually discovering what transpires in the brain and the effects it has on the body. It is well known that everything a person does takes neurons and neurotransmitters to carry messages to different parts of the brain and the nervous system (National Institute of Mental Health, n.d.). Movement activates neurons in the cerebellum, which is one of the motor centers of the brain. Dopamine is one of the neurochemicals used in neuron communication and has many functions, such as helping with movement and communicating thoughts and feelings (National Institute of Neurological Disorders and Stroke, 2015). Low levels of dopamine have been associated with conditions such as Parkinson's disease, Huntington's disease, attention deficit hyperactivity disorder (ADHD), depression, anxiety and obsessive-compulsive disorder (Rangel-Barajas, Coronel, & Floran, 2015). Given research that has demonstrated improvements in the physical presentation and symptoms of many of these conditions, physical activity has been hypothesized to increase levels of neurochemicals including dopamine and serotonin (Craft & Perna, 2004). Physical activity has also been shown to increase blood flow to the brain, which provides an increase in oxygen

level. Increased oxygen in the brain has the potential to have an impact on brain function (Perrey, 2013).

Neuroplasticity is the brain's ability to form new neural connections throughout the lifespan (Liou, 2010). The brain of a child has been shown to undergo development in the neuron connections after sensory experiences (Kolb & Gibb, 2011). The brain's ability to reorganize and adapt with therapeutic rehabilitation after injury, has been reported to result in increased function and a change in the brain based on functional magnetic resonance imaging as reported by Nudo (2006). This ability in the brain leads to many theories regarding how neuroplasticity can be maximized to promote desired outcomes. One such theory is sensory integration.

Sensory Integration and processing (SI). The SI theory was developed by A. Jean Ayres based on her knowledge of the neural processes and clinical observations of children with learning disorders (Ayres, 1972). In work by Dunn (2001) and Miller and Lane (2000), for the purpose of clarification of the theory they stated, "sensory processing" is used as an overarching term that refers to the process the nervous system uses to receive and organize sensory input and produce a response. "Sensory modulation occurs as the central nervous system regulates the neural messages about sensory stimuli" (Miller, Anzalone, Lane, Cermak, & Osten, 2007, p. 136). The generation of evidence to support the theory of SI is ongoing, and until recent years has been researched based on an individual's behavioral responses and changes in performance after a variety of sensory input.

Of importance to the SI theory is the understanding that an infant first learns about the world around him in relation to his own body using the senses of touch, vestibular, proprioceptive and visual input (Weiner-Vacher, Hamilton & Wiener, 2013). The vestibular

system helps the body perceive the movement and is important in balance and equilibrium. The vestibular system is closely tied to the visual system, which continues to provide information about one's body in relation to what is around them, especially as one moves. Vestibular input is sensed in the inner ear, specifically the semicircular canals and the otoliths and travels through the vestibular nerve to the vestibular nuclei on either side of the brainstem. The information then appears to work with the proprioceptive and visual systems to impact balance, equilibrium, readiness to move, and arousal level (Gray, 2016). Proprioception is the sense that provides the awareness of body position in space. Proprioceptive input is sensed in the muscles and joints, and along with the vestibular and tactile system appears to influence the righting reflex, timing and force of movement and body awareness (Blanche, Bodison, Chang, & Reinoso, 2012). Deep pressure input is sensed through the tactile system and appears to affect autonomic and parasympathetic activity producing calming effects (Reynolds, Land & Mullen, 2015). If the body is unable to or has difficulty perceiving and responding to vestibular or proprioceptive senses as well as the visual and touch senses, difficulty with learning can occur (Miller & Fuller, 2007).

Although there are specific diagnoses that have been associated with sensory processing differences (Clince, Connolly, & Nolan, 2016), there are also children who have these challenges that appear to be typically developing. To develop further understanding regarding typical and atypical sensory processing, Dunn (1997), completed a representative national study including over 1100 children, ages 3-10 years old. Up to 20% of the answers to questions on the Sensory Profile, a measure of sensory processing in relation to sensory input of daily activities, were common in the daily life of children without disabilities (Dunn, 1997). Ahn et al. (2004) found that in one region of the U.S. as many as 5.3% of kindergarteners were reported to have sensory

processing issues. This supports the idea that some challenges with sensory processing and adaptive responses occur even in the population without identified diagnosis. In 2007, Tomchek and Dunn reported that children ages 3 to 6 years old with ASD scored significantly differently in sensory processing on 92% of questions on the Short Sensory Profile. Disordered sensory processing in school aged children presents symptoms such as being overly sensitive to stimulation, having distractibility, being in constant motion, being slow to perform tasks, and having difficulty performing fine motor skills such as handwriting (SPD Foundation, 2015). In 2013, researchers discovered a difference in brain structure, pointing to a biological basis for sensory processing disorders (Owen et al., 2013). As we continue to research sensory processing, the prevalence of this disorder on its own or in conjunction with other disorders may be higher than we think.

To address sensory processing concerns occupational therapists may use sensory-based motor activities that include vestibular, proprioceptive or tactile input that are alerting and calming to affect the child's attention, behavioral response and readiness to learn. Occupational therapists may use sensory related strategies to

> promote increased physical activity for students to improve physical and mental health and cognitive and social performance; design sensory-enriched classrooms with a variety of seating options, as well as opportunity for tactile, movement, and proprioceptive experiences throughout the day.
>
> (Roley et al., 2009, p. 827)

This theory has been used in clinical practice to guide the assumption that input from primarily proprioceptive, vestibular, tactile and visual systems can affect arousal levels leading to calming or alerting effects on a person. In 2015, Reynolds, Lane and Mullen found that deep pressure decreased sympathetic arousal, decreased parasympathetic responses and improved performance using the outcome measures of heart rate, respiration, skin conductance analysis,

and a brainteaser game. In a recent capstone project, Spence (2015) analyzed the effects of sensory-based interventions, called S'cool Moves, in relation to on task behavior and work completion. After six weeks of 15-minute interventions one day a week, and 5-minute interventions the additional 4 days a week, it was reported that 100% of the students increased their average on-task behavior and 58% increased completed in-class work. Lin et al. (2012) embedded four types of sensory-based tools and activities including proprioceptive, vestibular, tactile and mixed input into a preschool setting. After two months of intervention 5 days a week, the teacher reported a perceived decrease in activity level for identified students. Changes in physical activity decreased compared to the control group, however did not reach statistical significance. This study supports the use of sensory-based tools and activities frequently used by the occupational therapist. Sensory-based strategies can easily be embedded into the classroom routine, carried out by the teacher, instructional aides, or parent volunteers, and produce positive outcomes (Roley et al., 2009).

Visual skills. While the visual system is primarily recognized as a source of sensory input, there are other aspects of vision that can affect attention and learning. It has been noted that up to one in five students has some type of visual impairment (Basch, 2010). To be successful in sustaining attention and learning through the visual system, especially while reading, a student needs to be able to maintain convergence of the eyes on the written material for the duration of the task. To rule out acuity issues a typical eye exam is first completed. Acuity problems alone may cause difficulty with reading and memory. If there are still issues learning, an assessment including eye teaming, depth perception, focusing, eye movements and visual-motor and or visual perceptual skills may be completed. It has been found that the inability to sustain convergence is present up to 3 times more often in students with the diagnosis

of ADHD (Granet, Gomi, Ventura, & Miller-Scholte, 2005). Another area that can impede reading is ocular motor and eye movements including tracking and saccades (Samuels, Rasinski, & Heibert, 2014). In addition, there is a link between fluency in reading and ocular motor skills (Quaid & Simpson, 2012).

Physical activity. The Committee on Physical Activity and Physical Education in the School Environment (2013) recommends increasing physical activity to improve academic performance. In addition, mainstream media sources have touted the need for movement to help with attention and learning (Strauss, 2014). One focus of research on physical activity in the classroom has been the ability of this type of activity to affect learning outcomes. Classroom-wide physical activities have been researched primarily by physical education, exercise and movement science, psychology, and education professionals with few studies being done by occupational therapists.

Mullender-Wijnsma et al. (2015) used a quasi-experimental design with pre-existing 2nd and 3rd grade groups, a sample of 228 students. In the intervention, Take 10!, 63 physically active, academic classroom lessons that could be completed in 10 minute increments, were implemented from 47 minutes to 65 minutes per week for one year. The control group in each grade level continued their typical classroom lessons. The 3rd grade students who participated in the intervention scored significantly higher than the control group on both reading and math scores as measured at the end of the school year. However, the 2nd grade students' results indicated there was no difference in reading scores and achieved a lower math scores compared to the control groups. This indicates there may be an age at which physical activity is a more effective intervention. Erwin, Fedewa, and Ahn (2012) found that a program in a 3rd grade classroom consisting of PE and classroom physical activities 20 minutes per day, resulted in

increased curriculum based measurements in math and reading but no significant difference in standardized test scores.

Other research has focused on the underlying components of learning such as attention, on-task behavior, response speed and executive functioning. Mahar et al. (2006) explored the effectiveness of physical activity breaks on attention to task. They reported that after 10 minutes of activity breaks once a day for 12 weeks, there was clear improvement in on-task behavior for 4th graders, especially for the students who were least on-task initially. There were smaller improvements for 3rd graders. Van der Niet (2015) found that after 30 minutes of physical activity 2 times a week, 8-12 year old boys and girls had a significant increase in self-control and working memory as compared to a control group. In a research study comparing the effects of engagement in physical activity over specific amounts of time (5, 10 and 20 minutes) as compared to a sedentary activity, students who engaged in 10 minutes of classroom based exercise demonstrated the highest time on task behavior (Howie, Beets & Pate, 2014). In addition, results appear to be most effective with students around the age of 10 years old (Kohl & Cook, 2013).

Adding non-academic activities believed to support student learning to the school day can be met with resistance by both teachers and administrators, who cite many concerns including a lack of time. In a qualitative research study by McMullen, Kulinna and Cothran (2014), some of the concerns included threats to classroom control as well as the importance of the ease of implementation and student enjoyment (Center on Education Policy 2011, Cox et al., 2011). Sallis et al. (1999) found even over a two-year period, extra time focused on physical education did not hinder academic achievement.

Teachers and administrators are aware of many programs designed to increase movement in a student's daily routine, however, when looking for an evidence based program that can easily take place in the classroom, the programs found frequently require additional training. Programs such as the Alert Program (Williams & Shellenberger, 1996), Body Activated Learning (Schmalle, Andrade, Cardone-Bunker and Michel, 2015), and S'cool Moves (Wilson & Heiniger-White, 2000) are sensory based programs that require additional training to understand the background and implement with fidelity. Thus, many teachers use programs such as Brain Gym (Dennison & Dennison, 1989), Energizing Brain Breaks (Sladkey, 2013), GoNoodle (GoNoodle.com, 2016), and JAM (Just-a-minute) school program (Howell, 2014) because they are easy to learn and use and do not require specialized training. While these programs claim to be based in neuroscience, they are lacking in rigorous research and thus they are not considered evidence based. While many programs have their beginnings in theory all need to be carefully researched to provide evidence that the program does what it claims to do.

Research Hypotheses and Questions

With the increases in educational standards brought about by current legislation and policy, students are expected to sit for longer periods to learn. In addition, there has been an increase in both attention related and academic related disabilities in the classroom population in general. IDEA 2004, ESSA, and RtI support early intervening services through which occupational therapists can collaborate with teachers, as well as provide class wide intervention, especially from a sensory processing frame of reference. A variety of physical activities have demonstrated effectiveness in increasing on-task behavior, academic performance and overall physical activity levels in elementary school children. School-based occupational therapists may use the concepts of sensory processing to guide the implementation of alerting activities that

include proprioceptive, vestibular, tactile and visual input followed by calming strategies. In an extensive literature review, only one study was found in which a sensory-based movement program had been researched in a general education elementary school setting (Spence, 2015) and that was in a Montessori multi-age first through third grade program.

Given the current data regarding policy, educational environment, research and student learning, one hypothesis is that all students will benefit from sensory-based movement activities, as it would support their ability to remain alert, focused and ready to learn. Thus, sensory-based movement may be beneficial as a Tier 1 intervention for all students and including calming activities may help the students regulate the overall effects of the alerting activities causing fewer concerns from teachers about incorporating the activities in the classroom. Therefore, the purpose of this study is to examine the effects of whole class sensory-based alerting and calming movement activities on academic outcomes in 4th grade students, with and without the need for assistance in learning, in general education classes.

Method

Research Design

This study used a mixed method pretest-posttest control group design and descriptive techniques. The intervention was implemented as part of a typical daily classroom routine. This design allowed for analysis of both the intervention and the perception of the intervention without interrupting or changing the flow of the school day while providing Tier 1 RtI services to all students. Because it used preexisting school pre and posttests, and it embedded intervention into the daily routine, this study was a feasible and appropriate method to answer the research objective.

Participants

A convenience sample was used from the accessible population of general education 4th grade teachers and students. Student and teacher participants were recruited from two public schools, one middle to high socio-economic status and one low socio-economic status in the south Puget Sound region of Washington State. The inclusion criteria was 4th grade teachers and their students willing to participate in 5 minutes of specific sensory-based movement activities two times per day. All interested teachers signed a consent form and participated in a conversation of feasibility after which teachers were assigned, based on availability in their schedule, to the control group or intervention group. Consent forms were sent home to parents, providing information regarding the study and requesting permission for their child's participation. Additionally, students in both control and intervention classrooms were given the opportunity to sign an assent form that explained the right to refuse access to their testing data. Student's academic data was used only if the student signed the assent and the parent or guardian signed consent. Teachers, parents, and students were educated on their rights to give or refuse consent/assent, withdraw from the study at any time and were provided with information about how to contact the researcher with any questions they had. It was made clear that all students in the intervention classrooms would participate in movement activities as a part of the typical classroom routine. Three classrooms were included as control and did not have the option to receive intervention until after the study was completed. Of the total eligible students (n = 176) 76% (n = 135) provided parent consent and student assent.

Selection of Sensory-Based Intervention Program

Varieties of programs have been developed to address the sensory needs of students but have been used primarily on an individual or small group basis. When looking for a program to

implement in a whole classroom that meets the needs of the current academic climate, several factors were considered. These included 1) the use of sensory processing concepts, 2) the ability to be easily embedded into a general education classroom, and 3) the use of both alerting and calming activities. After reviewing several programs and gathering information from the teachers, the Body Activated Learning program (Schmalle, Andrade, Cardone-Bunker, & Michel, 2015) was used in the classroom with some modifications.

Instrumentation

STAR math and reading assessment. The STAR math and reading assessments were used as academic outcomes, measuring the effectiveness of the intervention by comparing the pretest and posttest data. The assessments are used in 4th grade as part of the regular classroom assessments for benchmark testing and progress monitoring of each child. These assessments are computer-based instruments and are reported to give accurate, reliable and valid data to help form decisions about instructional planning (Renaissance Learning, 2014). Fourth grade STAR reading primarily assesses reading comprehension. Fourth grade STAR math assesses skills in number sense and operations. For the STAR assessments, difficulty is automatically increased based on the time of year it is given. In addition, the computer based test continually adjusts the difficulty of each question based on the previous response (Renaissance Learning, 2015). The math and reading assessments took about 15-20 minutes for each topic, and were administered by the classroom teacher.

Dynamic Indicators of Basic Early Literacy Skills (DIBELS). The DIBELS reading assessment is used by elementary school teachers to monitor reading fluency, which is one indicator of literacy skills (Renaissance Learning, 2014). This assessment is administered to students who are struggling with reading skills at least 3 times a year and can be used more

frequently for monitoring progress. DIBELS is reported to be valid and reliable for the purpose of screening, progress monitoring and guiding instruction (Good et. al, 2004). The assessment takes about one minute per student and is administered by the general education teacher or trained assessor. This tool was used to compare the rate of improvement in the skills of struggling readers in the control and intervention groups.

Body Activated Learning. Body Activated Learning is a relatively new sensory-based program to be used on an individual basis or in the whole classroom to support student attention and engagement. Created by occupational therapists Schmalle, Andrade, Cardone-Bunker and Michel (2015), it provides sensory-based movement options that teachers can learn and apply following a 5 part process including 1) Assess, 2) Optimize (energize and restore), 3) Activate, 4) Regroup and 5) Get ready to learn. The entire process was set up to take approximately three to five minutes to complete and includes activities created to be used throughout the day.

The categories of energize, activate and restore/regroup were used. The activities in the energize category incorporate vestibular and proprioceptive input, speed and intensity, require minimal skill and are primarily alerting in nature. In the activate category the activities require motor planning, incorporate vestibular input, visual tracking and/or vision to lead the actions and are primarily alerting. In the restore/regroup category, the activities use rhythm, deep pressure, respiration, vision breaks and stretching and are primarily calming.

The current study utilized 27 sensory-based movement breaks based on the Body Activated Learning (BAL) handbook and the primary investigator's clinical experience. Some of the activities offered in the BAL handbook were not used because they were inappropriate for the age group or because the classroom space was limited. Each movement break session lasted approximately five minutes, and occurred twice a day.

Limited tools and equipment were required to implement the Body Activated Learning activities and these included cards with visual pictures and written information regarding each activity, video examples, a smart board based spinner and a timer. Classrooms were already set up with a document camera, smart board and computer connected to a projection unit to view videos.

Weekly survey. The teachers and students in the intervention group completed weekly surveys to provide their perceptions of the intervention. The surveys included a visual analogue scale (VAS) and open ended questions. The VAS measures a response or perception that may range from one end of a continuum to another end using a horizontal line approximately 100 mm long with the extreme values of the scale written on either end of the line (Wewer & Lowe, 1990). In a study by Shields et al. (2005), perceptions of children aged seven and above appeared to be accurate. The scales are most beneficial when analyzing change within an individual's responses. Survey questions assessed teacher and student perceptions of each activity including the ease of following the directions, their enjoyment of the activities, and how the activities affected their attention and work completion. One additional question for the teachers assessed their perception of disruptions at the end of the movement breaks (see Appendices A and B). Teachers and students were asked to draw a vertical line to indicate where they felt their answer to each question laid along the continuum of the VAS. Teachers also completed a weekly log of additional physical activity including the number of recess breaks, physical education, any additional movement provided throughout the day, and a space for any further comments. Due to automatic reformatting by the computer, the visual analogue scale used in this study was unintentionally set at 12.8 cm (128 mm) instead of the typical 10 cm (100 mm). The positive response to each question was set at 52% or 6.6 cm (66 mm).

Final survey. At the completion of the intervention period, a survey was given to teachers and students to assess overall perceptions of the sensory-based movement activities (see Appendices C and D). The first portion of the survey for both teachers and students gathered demographic information. Additionally, the teachers were asked for their years of experience, age and any specialty certifications. The remainder of the surveys contained questions similar to those in the weekly survey.

Procedural checklist. It is important that students be taught the same techniques with the same pacing throughout the program to ensure the outcomes can be attributed to the program and strategies. A fidelity measure was created and implemented to assure teachers used instructional strategies the way they were meant to be used (see Appendix E). On one occasion during the intervention period, each classroom was observed participating in the sensory-based activities. The teachers were rated on the set-up, following the plan, and correctness of leading the activities. Two of the three teachers had 93% and 95% on the fidelity measure. One of the teachers scored 75% on the fidelity measure. This teacher's overall score was lower due to her score on the correctness of teaching the activities. In addition, on the 3rd through 6th weeks there was a student "quiz" in which the primary investigator presented the name of the activity and the students were required to demonstrate the activity without a visual cue. The students in the classes whose teachers received higher fidelity ratings required less re-teaching and redirection to engage in the activities with correct form and position.

Procedures

Prior to the initiation of the study, approval was obtained from the University of Puget Sound, Puyallup School District and Dieringer School District Institutional Review Boards.

Pilot study. A brief pilot study of the interventions was completed with first year master's level students at the University of Puget Sound. After teaching the movement activities over 3 sessions, feedback was procured regarding clarity of teaching the sensory-based movement breaks, ease of performing the movement breaks, and any adaptations required for special needs. The pilot students also provided feedback regarding the survey questions and clarity of the instructions for the use of any materials. Based on the feedback, one energizing activity was removed due to clarity of expectation, and written directions for the weekly survey were added.

Teacher training. Prior to intervention, teachers in the intervention group took part in a two hour in-service on sensory processing and instructions regarding the movement options and procedures. This gave the opportunity to answer any questions and problem solve potential issues.

Implementation. The intervention time of 6 weeks was chosen as it followed the RtI intervention and data collection period of the school. Due to breaks in the school calendar, the intervention was carried out over a 7 week period.

Teachers had an available checklist of items needed and tasks to be accomplished prior to each school week. The first morning of the first week of intervention the researcher provided the students with basic information about proprioception, vestibular and vision senses as well as an introduction to how to fill out the survey including the visual analogue scale. In addition, the first three energizing, three activating and three restoring/regrouping activity options were taught to the students. The following five weeks, nine activities were taught or reviewed by the primary researcher in person during the second session of the first day of each week. Teachers were given a schedule to follow for implementing the movement breaks during the remaining sessions

of the week (see Appendix F). The second half of the week students were given the choice of all of the activity options they had learned thus far. A timer was set for one minute at the start of each activity during both energizing and activating exercises. During restore/regroup activities, a timer was set for 30 seconds each. Teachers completed a weekly log of additional physical activity including the number of recess breaks, physical education, any additional movement provided throughout the day as well as any further comments.

Communication. On Sunday, prior to each school week, an e-mail communication with reminders and new information was sent to the teachers. This included access to the video examples of the movement activities for the week and any additional notes and thoughts. It was anticipated that teachers would access the message and accompanying video examples prior to beginning teaching on Mondays. Teachers were given the opportunity to ask questions or make comments via e-mail or in person on the first day of the week. Prior to the last day of each week, the teachers were sent a reminder e-mail to have the students fill out the survey.

Data Collection.

Surveys. On the last day of the week the teachers were provided with weekly survey forms and a list of students who were not eligible to fill out the forms due to lack of consent or assent. Those students were given time to finish work, read or do an additional teacher assigned task. Teacher and student perceptions of the intervention were completed approximately forty minutes after the last session of each week. The survey required about 3 minutes to complete. If a student was absent, there was no survey data for that student for that week.

The week following the end of the study, students and teachers completed the final survey, reporting overall perceptions of the activities and effects on their attention and learning. Final surveys were provided on the following school day for those teachers and students who

were absent. The surveys were gathered by the teacher and returned in a manila envelope to the school office each week for pick up by the primary investigator.

Posttest data. The STAR reading and math assessments were given to both the control and intervention students by their teachers as part of the typical school data collection. Teachers provided information regarding the student needs for academic assistance and students who had been identified as struggling in reading also received the DIBELS reading assessment after the intervention period. While the intervention lasted only 7 weeks, the time between the pre and posttests included 12 weeks due to breaks in the school schedule.

Data Analysis

Demographic characteristics including gender and academic grouping of students in the study were analyzed for frequency. Data were grouped/blocked by different variables including no support needed, and IEP/504/Learning Assistance Program (LAP). Descriptive data including central tendency and variability for pre and post testing were obtained. Quantitative data from the academic assessments (STAR reading and math and DIBELS assessment) were analyzed for the differences from pretest to posttest for the control and intervention classrooms using a two sample t-test to determine the effectiveness of the sensory-based activity intervention on academic scores. In order to examine the differences between the control and intervention sub-groups ANOVA was used to compare mean differences. Differences were considered statistically significant if they met the conventional level of $p < .05$.

To assess the perceptions of students and teachers the visual analog scale ratings and question responses were averaged per classroom. The students' and teachers' perceptions were described by the percentage of students with positive or negative responses to each question. IBM SPSS Statistics 23 (IBM, 2015) software was used to analyze the data.

The primary researcher and two 1st year entry level masters' students recorded the data over the course of the study. Interrater reliability was measured on two separate occasions with five randomly chosen surveys. Agreement was within 0-1 millimeters accuracy for 100% of the samples.

Results

Demographic Information

Subjects. Of the 135 participants that met the inclusion criteria, due to absences, only 124 students had usable data for the purpose of studying the effects of sensory-based movement activities on academic scores. The intervention and control groups were similar in number and demographics (see Table 1). A Chi-square test of independence was completed to examine the difference between males and females. The results indicated no significant difference between the genders. There were small numbers of students who received IEP/504 support, as is typical for a general education classroom, and 26% of all participants received some type of learning support including IEP/504 and LAP. The school was in a middle to high socio-economic area with 11.8% of students in the school receiving free and reduced lunch services.

Research was completed in an additional school, which included two classrooms, one intervention and one control. However, due to significant confounding variables, including the intervention teacher's medical absence for a month and an additional teacher added for relief of class size, the information from this school was not included in the study data.

Teachers. While all intervention and control group teachers had a teaching certificate, there was a variation among factors such as additional schooling, training, and years of experience. The largest difference between the three control classroom teachers was years of experience, ranging from 4 years to 13 years in the classroom. The two most experienced

teachers also had master's level education and were national board certified. The difference in years of experience between the three intervention classroom teachers was even more vast, ranging from 2 years to 24 years of teaching. Two of these three teachers also had master's level education and one had a special education certificate.

Quantitative Data

STAR Reading assessment. Independent t-tests were run to assess similarities between both intervention and control group scores for reading at the pretest, and no significant difference was noted, $t(135) = -.14$, $p > .05$. There was wide variability in reading scores well as standard deviations for all students. The pretest scores ranged 103 to 1,102 with a mean score of 606. Posttest scores ranged from 86 to 1183 with a mean score of 662. Based on paired t-tests, both control and intervention groups made significant improvements in their reading scores over the intervention time (See Table 2). While both groups made progress, the intervention group made slightly more gains in STAR reading scores (9% vs. 8%). However, the independent t-test revealed no significant differences in the posttest data between the intervention or control groups $t(127) = .31$, $p > .05$.

STAR Math assessment. At pretesting there was no significant difference between the intervention and control groups for math scores based on an independent t-test, $t(131) = -1.31$, $p > .05$. The STAR math standard scores had less variability as a whole, with the pretest scores ranging from 507 to 863 with the mean score of 706 and post-test scores ranging from 486 to 892 with a mean score of 743. Based on paired t-tests both control and intervention groups made significant improvements in their math scores over the intervention time (See Table 2). Again, while both groups made progress, the intervention group made slightly more positive gains.

However, the independent t-test revealed no significant differences in the posttest data between the intervention or control groups, $t(126) = .136$, $p > .05$.

DIBELS assessment. A paired t-test comparing DIBELS data for those students in the intervention and control group who received additional learning assistance (LAP/504/IEP) showed positive change, with the intervention group making more positive growth than the control (8% vs. 6%), In addition, only the intervention group demonstrated statistically significant change over the intervention time (see Table 3).

Qualitative Data

Student surveys. The student surveys were completed in class and handed back directly afterwards with a 94% return rate. One set of classroom data was unacceptable the first week due to inappropriate rating on the visual analogue scale. One classroom forgot to complete the survey on the fifth week due to a class party. Based on the surveys that were returned, the average student perception of the sensory-based movement activities was positive, (see Table 4) with responses ranging from 0 to 12.8 cm, which are the extreme options. When the data were analyzed per individual intervention classroom, there were only two negative scores based on the mean response, and it was during the first week in relation to the questions, "Did I like the movement break activity choices this week?", and "Did I focus on my teacher and/or work after the movement activities?" Overall, the responses to the interventions were positive and the students enjoyed the sensory-based movement activities.

Teacher surveys. Based on teachers' reports, the students requested to participate in a few of the activities at different times during the day. For example, one student requested to do the activity called "visual shifts" prior to a test. In addition, it was observed that students used

the activities throughout the day on their own. Many students appeared to have specific activities of choice which they enjoyed more than others.

The teachers reported overall positive perceptions of the sensory-based movements (see Table 4). The transition for the teachers to regularly use the movement activities in the first week was difficult, and it was reported "it took a few days to get used to the routine" and the students were "silly" during and after the activities were completed. Over the weeks, however, the students and teachers became more accustomed to participating in the sensory-based movement breaks. Nevertheless, according to the teachers, the students continued to need redirection at times. In the first and fifth weeks, the teachers reported more disruption than normal, however, it must be noted that the first week the entire process was novel to the students, and the fifth week was both the week of Valentine's Day and the week before mid-winter break. The teachers also expressed concerns regarding the week 3 and week 6 activity options. The activity choices were the same those two weeks, and the teachers reported that they especially did not like "jumping" and "desk pounds". Finally, the response to the final question of the survey, "How important is it to continue to use sensory-based movement breaks?" was 100% positive from both teachers and students. However, the teachers reported they might not use the activities breaks in the same format, but would use the activities throughout the day.

Discussion

Academic Outcomes

The results of this study provide initial information regarding the effects of sensory-based movement activities on academic outcomes for fourth grade students. Outcomes indicated that students in both the intervention and control classrooms demonstrated a significant increase in STAR reading and math scores. Therefore, the hypothesis that all students would benefit

academically from the intervention was not supported by this study. However, these results do support the findings of both Sallis (1999) and Erwin, Fedewa & Ahn (2015) that additional time devoted to physical activity does not interfere with academic outcomes.

It has been shown that specific sensory input can lead to changes in brain chemistry and development of new neural pathways (Liou, 2010) when input is repeated over a period of time. This study used a 6-week intervention phase which is the typical duration of an intervention block in the public elementary school setting, but is a short period in which to influence neurological change. In addition, students who need additional learning assistance, such as those with an IEP, 504 plan, or receiving LAP services, may require even more frequent intervention over a longer period in order to make changes (Vaughn, Denton, & Fletcher, 2010). There was slightly more positive change noted in the intervention group versus the control group with all academic tests. Since 23% of the intervention participants received some type of learning assistance it is possible that a longer period of intervention could have demonstrated more positive effects in the area of academics.

Students who were both below benchmark in reading and received learning support in the intervention group demonstrated significant improvement in DIBELS scores that was not demonstrated in the control group. This suggests that these intervention activities may have an effect on reading speed and fluency for students with challenges in this area. The primary sensory components of these activities include proprioceptive and vestibular input as well as visual tracking and/or vision to lead the actions and respiration. The positive effect on reading fluency after these activities is supported by the association found between ocular motor function and reading speed (Quaid & Simpson, 2012). In the elementary school setting, one focus is on reading speed and fluency for struggling students, because it has been linked to better reading

comprehension (Neddenriep, Fritz & Carrier, 2010), and better reading comprehension should lead to the increased ability to learn new information from literature, notes and computer based activities. While previous studies have linked sensory-based movement to improved classroom behaviors such as attention (Spence, 2015, Lin et al., 2012), this is the first study to explore the effects of sensory-based movement on academic skills. Based on CCSS at the 4th grade level, students are expected to read to learn new information. The outcome of students demonstrating significant improvement in DIBELS scores provides support for the use of this program as part of an RtI program (Tier 2) to support students within the general education classroom who demonstrate reading speed and fluency skills that are below average.

While both the intervention and control groups demonstrated significant progress in reading and math, when individual classroom results were analyzed it was noted that there were two classrooms that did not demonstrate statistically significant progress. While this was not a focus of the study, it was an interesting finding. The intervention classroom that did not demonstrate significant progress in both reading and math was taught by the teacher with the fewest years of experience, as well as the lowest score on the fidelity measure. The control classroom that did not demonstrate significant progress in reading was taught by a teacher with nine years of experience and a master's degree in technology. This leads to a question regarding the potential influence of teacher experience and training on the ability to use a variety of strategies in order to differentiate instruction. Teacher experience and training in the intervention group ranged from 2 years to 24 years of experience with 2 of the 3 teachers having a master's degree and one having a certification in special education. Would this classroom have made more positive gains if the teacher had been more experienced? The control group experience and training ranged from 3 years to 13 years with two of the three teachers having a

master's degree and national board certification. Would this classroom have made more positive gains if the teacher had more or different training? When examining evidence, Rice (National Center for Analysis of Longitudinal Data in Education Research, Urban institute 2010) reported that teacher experience affects academic outcomes, especially in the first 1-2 years of teaching. This may indicate the need for increased mentoring, support, and modeling of differentiated instruction for new teachers during the first year or two of teaching. In addition, due to the increased complexity of the student population in general education classes, additional attention to placement, with the consideration of types of services and programs needed, would be merited (Giangreco, 2001). The occupational therapist can be a part of the team that discusses student placement, program planning and provide additional support to all students and teachers within the school based on the RtI model.

Teacher and Student Perceptions

The second research question examined the teacher and student perceptions of sensory-based movement activities. Findings from the surveys indicated that both teachers and students perceived that the intervention had positive effects on both focus and work completion. The program provided activities including vestibular, proprioceptive, and deep pressure input that have been used in the clinical and school settings by occupational therapists, based on the assumption that these activities effect arousal levels which in turn affect attention and thus the ability to learn. Different types of movement have different effects on arousal levels. Energizing activities are designed to increase alertness while restoring/regrouping activities are designed to calm a student's body. The restore/regroup activities which occurred at the end of each movement session received the highest rating of popularity by all participants. No other programs currently found have calming activities included specifically at the end of the activity

session. This positive perception may indicate the need for more restoring/regrouping activities than energizing activities with this classroom.

Teachers indicated a desire to continue using the activities after the study was completed. Considering that if teachers did not perceive a benefit, they most likely would not want to continue to provide this type of activity in the classroom. Based on teacher and student perceptions, it appears that calming activities may be a requirement of successfully integrated programs in the general education classroom. However, the teachers reported concerns regarding the transition back to academic tasks following the sensory-based intervention. This is consistent with research by McMullen, Kulinna and Cothran (2014) which reported teacher concerns regarding threats to classroom control. The teacher's perception was that after the first week of "getting used to the new routine," the student's "silly behavior" decreased. Teachers reported that typical whole class behavioral approaches and redirection were successful in helping the students' transition back to work. For optimal success, it may be beneficial to include this information and specific redirection strategies in the initial teacher training.

Additional Considerations

There may be additional benefits to be gained from this program including increased physical activity and movement throughout the day, that may have an impact on overall student health and wellness. The childhood obesity rate has increased to over 16% of all children in the U.S. (CDC, 2015c) and has become a major social and health care issue. Childhood obesity can lead to a low self-esteem and depression, as well as an increased incidence in bullying. In addition, there is a relationship between obesity and ADHD, anxiety, and behavior problems that can affect learning and school-related activities (American Academy of Pediatrics, 2014). Due

to the apparent enjoyment of the program, these physical activities may lead to increased engagement and improvement in the educational climate and enjoyment of school by students.

Implications for Occupational Therapy

School and academics are a major occupation of school aged children. In addition, the concepts and theories of sensory processing are primarily based on the research of occupational therapists. The link between sensory-based movement and academics is one that school based occupational therapists have the opportunity to encourage and make a part of the universal design or RtI approaches used by the state or school district they are employed in.

This program shows promise in the area of academics, especially reading fluency, and the related component of attention to task. It could additionally be considered a Tier 2 intervention for all students with below benchmark reading skills. This program is cost effective, needs minimal training, and requires low levels of support for teachers to implement successfully. Recommendations for physical activity breaks by the National Academies Committee on Physical Activity and Physical Education in the School Environment additionally support the inclusion of this type of program in general education classrooms. A systematically integrated sensory-based movement activity program could be another piece of the puzzle in addressing academic behaviors and academic outcomes.

Occupational therapists that consider using this program or approach would benefit from understanding the theory the program is based on to be able to explain it to teachers, parents, and administrators. As usual, education may need to be provided to the teachers or administration to support understanding of the OT scope of practice and distinct value that OT can add to the school environment. This program that is easily learned and incorporated into the schedule

every day at school and may be beneficial for all students but especially those who are struggling in reading fluency.

Limitations

This study has several limitations that should be assessed when considering the application of this information. Although the intention was to randomize the assignment of control and intervention groups, in reality, the teachers and classrooms that were chosen to participate in the intervention were scheduled by availability. It is possible that the selected teachers may have inadvertently affected the outcome due to increased interest or desire to succeed, because the primary researcher was the principal's wife. In addition, the original plan was to have students from two schools with different demographics. However, due to a teacher's extended absence and additional confounding variables, only one school's data could be used. Therefore, the participants in this study came from a middle to high socioeconomic area, and their baseline scores started in the 80th percentile, indicating the overall mean was higher than typical to start with, leaving less room for positive change. Finally, no true generalization of the results can be made due to the multiple limitations and relatively small convenience sample. In order for conclusive generalizations to be made, another study with a larger participant base and wider demographics among the participants is needed.

Future Research

Although there were positive changes for all students, this study did not demonstrate a significant difference between the intervention and control groups. Therefore, for future research, it would be important for the length of the intervention to be longer to potentially effect a more global change. Based on the teacher and student enjoyment of the restore/regroup activities (calming), it would be interesting to further study the impact of the program if the time

engaged in these activities was increased. To assess further impact of this program on health and wellness, future researchers may want to keep track of the overall physical activity difference between classrooms. This could be addressed by having students wear a pedometer to measure activity level for the duration of the intervention period.

Summary

The goal for all teachers is to teach their students well and help their students learn to the best of their ability. In order for students to learn, they need to take breaks throughout the day to help them remain alert and attentive. As a means to address the need to remain focused and increase learning potential, sensory-based movements based on Body Activated Learning were provided for students in three 4th grade classrooms. The results trended toward more positive changes in math and reading abilities of the intervention class than the control classrooms, although the trend was not statistically significant. The programs greatest effect was on students who received supplementary learning support. Additionally, both students and teachers reported a high level of satisfaction and perceived results of the intervention. These results suggest that this program could be a successful Tier 2 RtI approach supported by the occupational therapist. Additional research with a longer trial period could provide stronger evidence for the impact of sensory-based movement activities in general education classrooms.

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Appendix A

Teacher's Weekly Perceptions

Name: _____
Date: _____

Please make one vertical line at the point that represents your answer. At the very left of the line is the most negative answer, at the very right the most positive answer.

Were the movement breaks activities easy to follow?

_____

They were not easy to follow — They were easy to follow

Did I like the movement break activity choices this week?

_____

I did not like the movement breaks — I liked the movement breaks.

At the end of the movement breaks was there more disruption than normal?

_____

There were more disruptions — There were less disruptions

What type of disruptions were evident:

_____

_____

Did the students focus on my directions after the transition?

_____

Students did not focus on my directions — They were focused the whole time and followed my directions.

Did the students complete their work?

_____

They did not complete any work. — They were focused the whole time and completed all of their work.

My favorite activities were:

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

I didn't like:

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Appendix B

Student's Weekly Perceptions

Student number: _____
Teacher's name: _____
Date: _____

Please make one vertical line at the point that represents your answer. At the very left of the line is the most negative answer, at the very right the most positive answer.

Did I think the movement break activities were easy to follow?

_____

They were not easy to follow — They were easy to follow

Did I like the movement break activity choices this week?

_____

I did not like the movement activities — I liked the movement activities

Did I focus on my teacher and/or work after the movement activities?

_____

I talked with my neighbor and/or I played with items in or on my desk. — I was focused the whole time. I did not talk or play and I followed directions on my work

Did I get my work done after the movement activities?

_____

I didn't finish anything — I finished all of it

My favorite activities were:	I didn't like:
☐ _____	☐ _____
☐ _____	☐ _____
☐ _____	☐ _____
☐ _____	☐ _____

Appendix C

Teacher's End of Study Perceptions

Name: _____
Date: _____
Age: _____
Gender: M F
Years of experience as a teacher: _____
Any specialty certifications: _____
How many 4th grade students are in your class? _____

In general did I think the movement break activities easy to follow?

_____

They were not easy to follow — They were easy to follow

In general did I liked the movement break activity choices?

_____

I did not like the movement breaks — I liked the movement breaks.

In general at the end of the movement breaks did I think there more disruption than normal?

_____

There were more disruptions — There were less disruptions

What type of disruptions were most evident:

_____
_____

In general did I think the students focus on my directions after the movement activities?

_____

Students did not focus on my directions — They were focused the whole time and followed my directions.

In general did the students complete their work directly after the movement breaks?

_____

They did not complete any work. — They were focused the whole time and completed all of their work.

In general what did the sensory breaks do for my classroom?

_____
_____ See other side….

How important is it to continue to use sensory-based movement breaks?

_____

It is not at all important It is very important

My favorite activities were:

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

I didn't like:

- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Appendix D

Student's End of Study Perceptions

Student number: _____
Teacher Name: _____
Date: _____
Age: _____
Gender: M F

In general did I think the movement break activities easy to follow?

_____

They were not easy to follow — They were easy to follow

In general did I like the movement break activity choices during the past 6 weeks?

_____

I did not like the movement activities — I liked the movement activities

In general did I focus on my teacher and/or work after the movement break activities?

_____

I talked with my neighbor or I played with items in or on my desk. — I was focused the whole time. I did not talk or play and I followed directions on my work

In general did I get my work done after the movement break activities?

_____

I didn't finish anything — I finished all of it

How important is it to continue to use sensory based movement breaks?

_____

It is not at all important — It is very important

My favorite activities were:

☐ _____
☐ _____
☐ _____
☐ _____

I didn't like:

☐ _____
☐ _____
☐ _____
☐ _____

Appendix E

Treatment Fidelity: **Body Activated Learning**

Teacher Name: _____

Date _____

Materials: Teacher has…	Yes	No	N/A	Comment
1. Research Manual readily available				
2. Times and activities for movement breaks listed				
3. Schedule checklist				
4. Weekly notes form				
5. Timers, spinner, etc. ready				

Procedures	Yes	No	N/A	Comment
1. Teacher announces that it's time to do movement activities				
2. Students move items to the top or inside their desk				
3. Teacher announces activity name or lets a student choose each time				
4. Teacher or student sets the timer each time				
5. Teacher participates in the activities				
6. The class completes the 6 activities within 5-6 minutes				
7. Teacher makes notes on schedule				
8. Teacher makes notes on weekly notes form				
9. Last day/last session of the week the teacher passes out the survey about 40 minutes after last session				
10. E-mails or calls with any immediate feedback				

General:

Appendix F Intervention schedule for sensory-based activities Week 3 Date: _____

Session	Energizing (1 minute)	Activating (1 minute)	Restoring/Regrouping (30 sec.)
Monday morning	1.Elbows to knees 2. jumping	1. desk pound 2. piano fingers	1. Stretch it out 2. Palm press
Monday afternoon all 3 of each for review with researcher	1. jumping 2. sprinkler 3. elbows to knees	1.piano fingers 2. visual shifts 3. desk pounds	1. palm press 2. eye cupping 3. stretch it out
Tuesday morning	1. Sprinkler 2. jumping	1. visual shifts 2. piano fingers	1. stretch it out 2. eye cupping
Tuesday afternoon	1. elbows to knees 2. sprinkler	1. desk pounds 2. visual shifts	1. Stretch it out 2. eye cupping
Wednesday morning	1. jumping 2. elbows to knees	1. piano fingers 2. desk pounds	1.Palm press 2.stretch it out
Wednesday afternoon	1. jumping 2. sprinkler	1. piano fingers 2. visual shifts	1. palm press 2. eye cupping
Session	Energizing	Activating	Regrouping/Restoring
Thursday morning Circle 2 completed	Ladder Climb chair push ups Rocking chair Body wake up Front Chop jumping Rope pull down Sprinkler Elbows to knees	body taps desk pound piano fingers visual shifts partner handshake star throw windmills push ups cross chops	see saw the wave jelly drop Stretch it out Palm press shoulder rolls Eye cupping head massage letting go
Thursday afternoon Circle 2 completed	Ladder Climb chair push ups Rocking chair Body wake up Front Chop jumping Rope pull down Sprinkler Elbows to knees	body taps desk pound piano fingers visual shifts partner handshake star throw windmills push ups cross chops	see saw the wave jelly drop Stretch it out Palm press shoulder rolls Eye cupping head massage letting go
Friday morning Circle 2 completed	Ladder Climb chair push ups Rocking chair Body wake up Front Chop jumping Rope pull down Sprinkler Elbows to knees	body taps desk pound piano fingers visual shifts partner handshake star throw windmills push ups cross chops	see saw the wave jelly drop Stretch it out Palm press shoulder rolls Eye cupping head massage letting go
Friday afternoon Circle 2 completed	Ladder Climb chair push ups Rocking chair Body wake up Front Chop jumping Rope pull down Sprinkler Elbows to knees	body taps desk pound piano fingers visual shifts partner handshake star throw windmills push ups cross chops	see saw the wave jelly drop Stretch it out Palm press shoulder rolls Eye cupping head massage letting go

Table 1. Participants' Demographics

Variable	Intervention Group (*n* = 62)	Control Group (*n* = 73)
Gender		
Female	42 (68%)	39 (53%)
Male	20 (32%)	34 (47%)
Student Groupings		
No Support	44 (70%)	56 (77%)
IEP/504	4 (6%)	3 (4%)
LAP	14 (23%)	14 (19%)

Table 2. Pretest and posttest comparison for intervention and control groups

Outcome	Group	*n*	Pretest M(SD)	Posttest M(SD)	Difference	Dep. *t*	Significance (p)
STAR Reading	Intervention	56	613(166)	667(165)	9%	3.5	.001*[b]
	Control	73	609(145)	658(177)	8%	3.2	.002*
STAR math	Intervention	57	701(74)	744(79)	6%	6.6	<.001*
	Control	67	712(61)	743(67)	4%	6.1	<.001*

Note. [a] Dependent t test was performed pre to post test on each group.
[b] A * indicates statistically significant p values

Table 3. Pretest and posttest comparison for students who receive assistance (LAP/504/IEP[a])

Outcome	Group	*n*	Pretest M(SD)	Posttest M(SD)	Difference	Dep.[b] *t*	Significance (p)
STAR Reading	Intervention	13	490(79)	534(99)	9%	1.6	.13
	Control	16	483(82)	530(93)	10%	3.6	.003*[c]
STAR math	Intervention	17	644(77)	685(90)	6%	3.6	.002*
	Control	14	664(40)	718(66)	8%	4.7	<.001*
DIBELS	Intervention	13	97(24)	105(25)	8%	2.4	.04*
	Control	14	106(18)	113(20)	7%	2.1	.06

Note. [a] LAP = learning assistance program, 504 = 504 plan, IEP = individualized education program.
[b] Dependent t test was performed pre to post test on each group.
[c] A * indicates statistically significant p values

Table 4. Average perception of sensory-based movement activities by teachers and students

	Activities easy to follow	Liked the activities	Focused on teacher or work after	Got work done after activities	Teacher only: There were fewer disruptions after activities	Important to continue with activities
Teachers	82%	66%	64%	65%	56%	59%
Students	84%	73%	80%	79%		76%

Note. A positive perception was set at 52%

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