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# Benefits of movement for academic achievement and classroom behaviors

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**Abstract**
The purpose of this review is to discuss the benefits of using movement throughout the daily routine of an early childhood classroom. The research focused on using movement to increase literacy and mathematics knowledge, teach self-regulation skills and increase attention. and have different seating options that would allow for consistent movement. Findings of this review show that movement does have academic and behavioral benefits in the early childhood classroom. Limitations are recognized for the research presented and recommendations are given for ways to incorporate movement into the classroom. To conclude this review of literature. educational policies and future research are included.

# BENEFITS OF MOVEMENT FOR ACADEMIC ACHIEVEMENT AND CLASSROOM BEHAVIORS

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# ABSTRACT

The purpose of this review is to discuss the benefits of using movement throughout the daily routine of an early childhood classroom. The research focused on using movement to increase literacy and mathematics knowledge, teach self-regulation skills and increase attention, and have different seating options that would allow for consistent movement. Findings of this review show that movement does have academic and behavioral benefits in the early childhood classroom. Limitations are recognized for the research presented and recommendations are given for ways to incorporate movement into the classroom. To conclude this review of literature, educational policies and future research are included.

# TABLE OF CONTENTS

# Chapter 1

## Introduction

The topic of my paper is using movement in the classroom to increase cognition and behavioral function. Movement strategies and seating devices can aid in increasing cognition and time-on-task. Also, incorporating physical activity can affect behavior and self-regulation skills. Kinesthetic learning has been shown to improve academic performance in both language arts and mathematics. Both of these areas are vital to student success and are assessed continually throughout the school years. Incorporating movement into these core subject areas, as well as throughout the day by using physical activity breaks and dynamic seating options, can help students to be more focused and increase their academic understanding of core curricular areas (Conyers & Wilson, 2014).

The topic of movement is not new but has become an increasing area of interest to many researchers to see ways in which children learn best and how to incorporate that into the school day. Dotson-Renta (2016) of *The Atlantic* published an article attesting to the need for children to be given the freedom to play, create, and move in order to learn about their bodies, to increase their self-regulation skills, and learn in a developmentally appropriate way. A small number of preschools and other early childhood classrooms are trying to get back to play-based and student-led learning. However with all the academic pressures at the federal, state, and district levels, this trend has not become the norm.

Allowing movement in the classroom is not just to give kids a break, but also helps them to develop physically. Drastic changes have occurred in the experiences, opportunities, and adults' educational expectations of young children in recent years, including not having enough play time at home, being required to sit and listen at younger ages, less recess time,

and the list continues. In Hanscom's article (as cited in Strauss, 2014) she discusses the importance of moving in the classroom in order to increase student's balance and motor skills so that they can sit for longer periods and remain active learners. Many researchers are looking into the early childhood years to determine what affects student attention and how to help students remain on-task in the classroom.

In this chapter I describe movement in relation to academics and behavior. Then, I explain why movement in early childhood is important and how the results of this study will contribute to preschool through second grade, specifically. Next, I explain specific terms used throughout the literature review, followed by the questions that guide this paper.

## Movement Throughout the School Day

Schools today have become much more academic with federal regulations calling for increased reading and math scores. These regulations trickle all the way down to early childhood because students are now expected at an even younger age to begin mastering academic skills (Guernsey, 2014). More children are attending preschool and at younger ages. All of these factors lead to less unstructured time for children to play, learn social and emotional skills, and be able to cope with the high academic demands.

Additionally, rising rates in childhood obesity are thought to be related to the lack of recess time and physical education. Pica (2010) notes that when students have recess or unstructured play time they have less stress, better physical fitness, more brain activity, better social skills, and increased focus and productivity. The academic demands and reduction in free time seem to have an effect on focus and physical fitness. The effects of movement and breaks are not limited to students. Adults need movement and breaks throughout their work day as well in order to be more productive and physically fit. Many companies give

employees breaks throughout the day, whether required by law or not (Guerin, 2016). Additionally, new seating options such as standing desks are thought to aid productivity (McDonough, 2016). Students should have the same opportunities to move and take a break from learning that adults do.

## Importance of Movement

I chose the topic of movement because I have seen firsthand how the decline of movement in classrooms has academic and behavioral consequences. Students are being pushed to do more lecture style learning and the opportunity is decreasing for students to learn by interacting or working socially with others. I wanted to see if there were techniques and ideas that teachers could implement in order to help children learn in a developmentally appropriate way.

I took a personal interest in this topic this year when I realized that I had many challenging behaviors in my first grade classroom. I have one student who lacks self-regulation skills and goes to play therapy to learn how to cope and express herself in positive ways. I have another student who is constantly fidgeting and moving. She also lacks many social skills. Finally, my class as a whole requires lessons at a quick pace and needs constant reminders to pay attention and focus. Since this is a lot to manage with one class, I wondered what the research said about using movement in the classroom. Many of the articles presented in this literature review found information showing that when students are required to sit without movement they can be less focused and unengaged (Gaston, Moore, & Butler, 2016; Pfeiffer, Henry, Miller, &Witherell, 2008). Also, students are responsible for so much learning now that their movement time is limited; therefore it seems that there are more off-

task behaviors in class. Finally, students who consistently require reminders to focus are often a distraction for others within the classroom.

Many programs that use movement activities in the classroom (such as Energizers, Instant Recess, Take 10!, and Transformers) promise to increase children's attention. However, there is not sufficient empirical research on these programs to support their claims. Any of these, as well as others, are used for the purpose of putting more movement back into schools in order to help children focus their mind and body. Therefore, it is vital to learn more about ways to keep students focused so they stay on track in the classroom. It is also valuable for educators to know what research says about the importance of movement and how it can be incorporated more in the classroom setting. Knowing more about these aspects of movement will give teachers more resources to help keep students cognitively and behaviorally engaged.

## Purpose of Review Results

This study aims to support teachers with research on ways to help students stay on-task and make academic gain. Additionally, many teachers are seeking out new ways to arrange their rooms that will encourage movement and student choice. Currently, this is an area many teachers are starting to explore due to benefits seen in the classroom or in research studies. Not only can teachers benefit from this research, but so can parents. Parents can use this information to be aware of the best practices for learning and behavior expectations. Finally, school administration can benefit from the results of this review to understand more ways to increase student focus and keep students progressing with the academic content. In an educational system that is doing away with playtime, recess, and even physical education, this review is more relevant than ever.

## Terminology

*Dynamic seating* – This type of seating allows one to engage in movement while still sitting down. Different tools are used for this in the classroom (Pfeiffer, Henry, Miller, & Witherell, 2008).

*Embodied Cognition* – This term refers to using the whole body to learn, such as moving along a number line or making different shapes. (Link, Moeller, Huber, Fischer, & Nuerk, 2013).

*Proprioceptive senses* – These senses are related to balance. The joints and tendons have sensors that send messages to the brain about how to position the body. (Merritt, 2014).

*Self-regulation* – The ability to use working memory, inhibitory control, and self-monitoring in order to plan and execute an activity (Harvard Center on the Developing Child, & Blair, 2002).

*Vestibular system* – This system is responsible for balance and posture of the body (Burgoyne & Ketcham, 2015). Using physical activity and movement helps to increase this system.

## Research questions

The following questions were used to guide my research of this topic:

1. What are cognitive and behavioral benefits of using movement throughout the daily routine in preschool to third grade classrooms?
2. What are strategies and activities teachers can use to incorporate movement and increase behavior and academic performance?

# Chapter 2

## Literature Review

Using movement in the classroom is vital in helping early childhood students become more focused and engaged. This literature review will discuss the recent research around the topic of movement. Specifically, I will discuss the use of movement with instruction, the use of additional movement breaks, and the use of furniture that allows slight movement throughout the day. In order to guide my research, I sought studies which show the benefits to cognitive and behavioral development by using movement and physical activity in preschool through third grade. This chapter focuses on using movement to address instruction, particularly in literacy and mathematics, using physical activity breaks to increase focus and self-regulation skills, and dynamic seating to increase time-on-task.

## Movement and Instruction

To begin, using movement in the classroom can have an impact on academic achievement. This section focuses on movement activities and strategies that are used during literacy and mathematics instruction. There is much research that incorporates using gestures, full-body movement, and signs in order to reach other modalities such as kinesthetic learning, which involves using the body to learn. The following studies provide information on different activities that can be used in order to make literacy and math concepts more accessible to all children.

### Movement and Language Arts

Block, Parris, and Whiteley (2008) examined the use of kinesthetic learning and comprehension strategies with students in kindergarten through fifth grade. There were 19 control groups and 19 intervention groups, which were randomly assigned. Students were

randomly assigned into either the intervention or control group based on their previous year's standardized reading tests scores so that students of all reading abilities were equally represented in each small group. In total there were 257 intervention students and 256 control students. Researchers wanted to use kinesthetic motions to help students make a mental picture for the abstract idea of comprehension. The use of the motions helps students internalize which comprehension processes are used by the brain in order to create meaning from the text. The use of hand motions activates the brain and gives a concrete way to know which comprehension process to use. Researchers created these specific motions and wanted to test if using them would increase comprehension. In this study teachers used Comprehension Process Motions (CPMs) with students. CPMs are ways of using hand motions to show what comprehension strategy a student is currently using. For this study, both the intervention groups and the control groups were taught the strategies of making predictions from the text, clarifying and following directions, inferring, drawing conclusions, and finding the main idea. The control groups used lessons from a basal curriculum. However, the intervention groups had a specific 12-day plan where teachers modeled the focus comprehension strategy along with the corresponding hand motions. The teachers would use think-alouds throughout the text with the CPM in order to explain the comprehension strategy. Over the 12 days, the lesson would move from teacher modeling to students initiating the CPM in order to explain their comprehension process while reading the text.

This study lasted for 60 school days, and during the last 10 days, the students in both the intervention and control groups took a standardized test on the comprehension processes called the Texas Primary Reading Inventory. The results of the study found that students in

the intervention groups significantly outperformed those in the control groups on all five comprehension processes they were taught during the study. They also found that the use of CPMs was more effective with younger students. Researchers believe the use of CPMs was more effective for students in kindergarten through second grade because their brains have not developed as much in the area of abstract thought. These findings suggest that by teaching CPMs, younger students, especially, are better able to decipher which comprehension strategy to use. This was a well-designed study with a large sample size, random assignment, and control groups. However, the fact that the researchers were also the creators of the the CPMs introduces the possibility of bias.

In a study of movement use and phonics instruction, Rule, Dockstader, and Stewart (2006) looked at using large body movement and tactile activities versus a basal curriculum for reinforcing phonics ideas. The participants were 34 first grade students that had qualified for Title I services; they were split into ability-matched sets based on the Idaho Reading Indicator and reading subtest of the Iowa Tests of Basic Skills. The first treatment group had 10 students and used very simple large body movements such as pantomime, using arm positions for long or short vowel sounds, and a stepping stone game. The second treatment group had 10 students and used different boxes with objects and environmental print to match sounds with pictures. Both of these groups met for 8 weeks before school for a total of 18 hours of instruction. The control group, which had 14 students, met during the day in a Title I reading class for the same amount of time; however, they used a traditional basal curriculum. It was found that the two intervention groups made significantly greater gains on the Phonological Awareness Test than the control group. This study shows that by incorporating simple movement tools, students can make greater growth than by just using a

text book approach. It was discovered after the intervention began that those in the control group had scored higher on the pretest than the treatment groups, but in the end, the treatment groups still made greater gains. Even though the sample size was small, the results are promising and warrant further study.

Callcott, Hammond, and Hill (2014) add to this research by using two programs, *Moving on with Literacy*, and *Let's Decode*, to see if using movement can help with phonetic retention. In the program *Moving on with Literacy,* different action songs are used to improve the body's coordination and to aid in developing emergent literacy. The *Let's Decode* program utilizes explicit teaching of phonetic principles with oral response and listening. Researchers used a quasi-experimental design with 400 five-year-old children in eight different schools. There were four pretests given to students, including an assessment of phonological awareness (the Test of Phonological Awareness [TOPA]), spelling (Developmental Spelling Test [DST] and the spelling subtest of the Wide Range Achievement Test-Revised [WRAT-R]), and a movement assessment (Movement ABC [M-ABC: Test of Phonological Awareness, Developmental Spelling Test, spelling subtest of Wide Range Achievement Test-Revised, and Movement ABC. Two schools used both *Let's Decode* and *Moving on with Literacy*, two used only *Let's Decode*, two used only *Moving on with Literacy*, and two did not use any of the interventions. Schools were randomly assigned to their condition except for two schools where the teachers were already trained on *Let's Decode*. The conditions were put together to determine if movement and explicit instruction would provide the best results instead of just movement or just explicit instruction. The authors found that when students had both of these programs, they scored better on academic and movement tests, although the scores were not statistically significant on any test but the

DST. They also found that the two *Let's Decode* groups scored better than the movement and control groups on the TOPA and the DST. The *Moving on with Literacy* groups typically had similar results compared to the control groups. The researchers found small gains when using movement along with explicit instruction; therefore, it cannot be concluded that movement was the reason for growth. The authors explain these results by suggesting that movement can be a helpful tool. They believe that the results from the assessments indicate that movement instruction needs to be brought back into the instruction of early childhood classrooms so that explicit instruction and movement can work together when teaching phonics and phonological awareness. Researchers need to continue to test the finding that using movement and literacy programs together can produce greater academic achievement in order to confirm consistent results and rule out coincidence. Also, one of the researchers created the *Moving on with Literacy* assessment so there was the possibility of some bias when doing this study.

Ericsson (2008) looked into the effect of movement on motor skills and academics. This study included 251 students in years 1 through 3 and continued until students that started in year one made it to year three. Ericsson studied the effect of increasing physical education (PE) from two lessons to three lessons per week with two intervention groups. The control group continued to have PE only twice a week. These groups were not randomized. The assessments used to determine results were a parent and teacher observation form, a reading development test, the national tests of mathematics used in Sweden , and a motor skill observation using the motor skills as foundation for learning observation program. The results of the study found that those students in the intervention groups had better results on the national tests including reading, writing, and math. It was also found that students with

the largest deficits in motor skills increased the most academically if they were in the intervention group. These findings indicate that students with increased physical activity time appear to do better academically; however, since this study was not randomized, it cannot be generalized to a larger population.

Erwin, Fedewa, and Ahn (2012) found increased academic achievement when using movement breaks. They had 29 third-grade students participate in their quasi-experimental design. There was one treatment group and one control group which were based on the homeroom class the student was assigned to. Researchers measured reading fluency and math aptitude using a variety of assessments, including curriculum-based reading fluency and curriculum-based mathematical fluency measurements, recorded reading and math grades, and the Test of Primary Reading Outcomes. They also used Standardized Testing and Reporting Reading tests with the Accelerated Reader program, the Discovery Education Assessment to assess reading and math, and students wore pedometers for five school days to measure their physical activity. To establish baseline data, researchers gave the Curriculum Based Measurements (CBMs), one minute timed reading and math passages, to all students. The CBMs were given every two weeks to identify progress over time. The teacher used break cards from the program *Promoting Physical Activity and Health in the Classroom* to provide a 20 minute structured physical activity break related to math or literacy content per day. A record was kept of which breaks were being used, and the teacher was trained beforehand on the use and importance of physical activity breaks.

Researchers found that using the physical activity breaks had a significant, positive effect on the CBM scores for reading and math. The results on standardized test scores and teachers grades did not show significant improvements, but the improvements of CBM

scores were significant. Since the intervention was only 20 weeks, researchers believe that the CBMs are more reliable when showing improvements over a short amount of time. The findings of this study suggest that incorporating physical activity breaks connected to curricular areas such as reading and mathematics can lead to academic gains. This study did not use random assignment, nor did they specify which break cards, literacy or math, were used most often so it is difficult to generalize the results.

**Movement and Mathematics**

Another area where movement has made a difference is in mathematics ability. The four studies that I review in this section examine different ways movement can be used to promote learning of mathematical concepts. Shoval (2011) discussed using mindful and sustained movement, along with verbal and socio-kinesthetic interaction, when learning about angles in math. Mindful movement refers to children using their bodies in ways that specifically relate to the learning. For example, if students are learning about circles, they make their body into a circle, much like acting out a scenario. Movement techniques were used with 158 second and third grade students in the experimental groups who were learning about angles by using movement in cooperative groups with task cards. The researchers did not indicate what was on the task cards other than the cards had instructions on them for the lesson the group was to do. The control groups included 103 total students and were taught from a traditional curriculum that included direct instruction from a teacher and were then followed by completion of individual worksheets. This was a quasi-experimental design in which groups were based on the classroom children were assigned to. A portion of an achievement test from the Board of Education Pedagogical Center that focused on the use of angles was used as a pretest and posttest. Both the experimental and control groups met with

their teacher two times a week for four weeks. The students in the experimental groups, using movement, were able to improve their understanding of angles at significantly higher rates than those in the control groups. However, the control group did not work cooperatively or use movement; thus, it cannot be known for certain if cooperative learning was a factor in the significant gains. Specifically, it can only be stated that there were positive effects between the learning activities and academic achievement. Researchers found that physical contact with the environment, using movement and visual modeling, and sustained movement learning all were positively correlated with academic achievement for the experimental groups. These were recorded using observations of each child with a coding system to show when a specific movement was used. This finding shows that incorporating kinesthetic learning into the math curriculum could help students have greater achievement when learning about angles. However, the researchers did not observe students in the control groups using the same movement activities or cooperative learning as the experimental groups so they cannot make a definitive statement about the impact of the traditional curriculum on their learning. Future studies need further explanation about the specific learning activities used with the experimental groups, as well as random assignment.

The next two studies focused on using whole body movement (embodied cognition) when working with numbers on the number line or adding numbers together. In order to aid students with spatial awareness, physically and mentally in relation to the number line, Link, Moeller, Huber, Fischer, & Nuerk (2013) conducted an experiment with two groups to see if walking the number line would help when adding numbers together as compared to using a tablet with a number line. They had 33 first-grade students who were randomly assigned to either group. Before either group started, the students completed a paper-pencil test of the

number line making an estimate where any given number would be. Then, the experimental group was taken one-on-one with the researchers to walk along a number line to estimate where a number was. The control group used a tablet with a number line to estimate where the number was. When the results were being evaluated by using a computerized addition task that asked students specific addition problems and symbolic and non-symbolic number comparison tasks where students had to compare numbers or arrays of dots, they found that students in the embodied cognition group had significantly improved their knowledge of the number line compared with those in the control group. Even more importantly, this transferred over to addition problems. Those in the experimental group had better performance when adding single-digit numbers with a single digit sum, and single-digit numbers that made a two-digit sum. Neither group improved significantly when adding a two-digit number and a one-digit number. The findings that walking the number line can increase estimation and addition knowledge positively relates to using movement within the math curriculum.

In addition to the work of Link et. al (2008), Ruiter, Loyens, and Paas (2015) also studied the use of embodied cognition when working with two-digit number building. This study had 118 first grade students from two Dutch elementary schools who also worked with a number line. The students were randomly assigned to one of four groups. There were two control groups. One group had a paper with a ruler drawn on it, and after the students verbally said the smaller numbers that made up a larger number, they were to mark the position of the larger number on the paper. The other control group sat in front of a ruler on the floor and after verbally saying the smaller numbers that made up a larger one, they would then walk to that position on the ruler. Both experimental movement groups were asked to

take steps of different sizes on a number line that only had lines indicating ones, fives, and tens, but otherwise had no numbers. The lines were important in order to indicate that jumping ten places would be a larger step and moving one place would be a smaller step; this process was used to develop spatial awareness. However, the second movement group did this in front of a mirror in order to see if observing themselves doing the activity would have any effect on their achievement. The experimental and control groups all were given instruction and ten number exercises to complete based on the instruction of their grouping. Once the instruction and practice was completed, each child used Lego blocks of three sizes to build numbers. The large blocks represented tens, medium blocks represented fives, and the small blocks represented ones. The goal was to figure out that larger numbers are made of small parts (e.g., tens, fives, and ones) and use as few blocks as possible to build the numbers.

The results showed that students in the experimental groups did significantly better than those in the control groups on the final test where they used the Lego blocks to build numbers or write the number that the instructor built (Ruiter, Loyens, & Paas, 2015). Researchers believe that taking different sized steps allowed for the students to embody the understanding that numbers are made of smaller units. This research adds to the literature on movement with mathematics and suggests that adding the activity of moving along a number line can help students to internalize where numbers are located and how they are composed. In addition this study shows "a new way of integrating full-body movements in the conventional mathematical curriculum of young school-aged children" (Ruiter, Loyens, & Paas, 2015, p. 468).

Cook, Mitchell and Goldin-Meadow (2007) present findings on the use of gesturing to aid in academic understanding when it relates to mathematical problems. They randomly assigned 84 third and fourth graders to one of three conditions. First, there was a speech condition group where students simply repeated after the instructor. Next, there was a gesture condition group where the instructor would use her right hand to gesture under the right side of the equation and then use her left hand to gesture under the left side of the equation with students mimicking the gestures. Finally, there was a speech and gesture condition group where the instructor would talk about the equation while using gesturing and the students repeated. Students were learning the concept of equalizing an equation by having both sides of the equal sign be the same amount. Each condition group had six problems that were taught before the assessment. During the assessment, in which they solved six problems, they were instructed to use only the behavior that was taught during the instruction, based on which condition they were assigned. On the posttest, all students made gains; however, when they were re-assessed four weeks later, those in the gesture, and gesture plus speech groups were able to retain the information at significantly higher rates. These findings suggest that using movements such as gestures may help students learn and retain information. Although instruction was not continued over a significant amount of time, the results still show gains made by students.

Two studies previously mentioned in the movement and literacy section also found increases in mathematic understanding. Ericsson (2008) studied an increase of PE time on the effects of literacy and mathematics skills. Increases in mathematic understanding were found with the intervention group on the national Swedish tests of mathematics. Also, Erwin, Fedewa, and Ahn (2012) studied the effect of 20 minute physical activity breaks on

academics using curriculum-based reading fluency and mathematical measurements, reading and math grades, Test of Primary Reading Outcomes, Standardized Testing and Reporting Reading tests, which goes with the Accelerated Reader program, and the Discovery Education Assessment. It was found that the CBM fluency test for math was significantly higher after students were given the 20 minute breaks.

## Movement Breaks

The following reviews of research examine the use of physical activity to increase focus in class and self-regulation skills. Movement provides children the opportunity to have a release from the academic pressures of each day. Movement also affects their physical well being. Much research exists on the effects of physical activity on weight, but only a few studies have looked at the effects of physical activity on behavior and self-regulation (SR). The next studies presented examined the use of physical activity in the classroom in order to develop skills related to self-regulation and increase focus.

### Physical Activity Breaks

Wiebelhaus and Hanson (2016) focused on time-on-task in a kindergarten classroom. The purpose of their study was to see if physical activity breaks would increase students' on-task behavior and if the students' perceptions of being able to focus would improve. There were three kindergarten students that participated in the study over the course of eight weeks. Researchers collected data with student interviews, field notes, video recordings, and frequency charts. All three students participated in the stations. Each station had materials and activities to work on gross and fine motor skills. This allowed the students to have a chance to move around using different materials, while still having the goal of improving gross and fine motor skills. The three children showed an increase in on-task behaviors

during whole group instruction once the stations were implemented. The increase in on-task behavior was noticed as soon as the stations were implemented. Even though this was only a seven week intervention, researchers found that incorporating movement can increase time on-task during instruction. While this study was only done with three participants, it shows promising results that would encourage further investigation.

A study done by Carlson et al. (2015) used short physical activity breaks to determine if they could increase student behaviors of paying attention, cooperating, being positive and producing high quality work. They also wanted to know if it would decrease student behaviors of defiance, lack of effort, excessive movement, inattention, and difficult transitions. Seven school districts, grades one through six, participated in their study. Each district made a plan that was unique to their district but that supported teachers so they could have 10 minutes of a structured, physical activity break per day. Teachers could choose whether or not to participate in giving students a 10 minute break. The intervention lasted through an entire school year and 1322 students participated in the study. To assess children's physical activity, they wore Actigraph GR3X+ accelerometers, which recorded the students' moderate to vigorous physical activity (MVPA). Teachers that participated completed a survey on classroom characteristics and a survey from the Classroom Behavior and Assets Scale to assess student behavior. The results showed that students' MVPA increased during the day for those students who had been provided breaks and that teachers provided more physical activity breaks, with 46 percent providing at least one break per day. Analysis of the behavioral survey showed that the behaviors listed above (defiance, lack of effort, excessive movement, inattention, and difficult transitions) decreased after the intervention in the classrooms that gave a 10 minutes break. This was compared with the

survey teachers filled out at the beginning of the year on student behavior. The lack of a control group required researchers to do a process analysis to know the likely effects of the intervention, which could result in some errors. Although a limitation of the study was a lack of a specific control group in which to compare these findings, the authors still suggest that implementing simple 10 minute activity breaks could improve student behavior during the school day and decrease behaviors such as lack of effort or inattention. Additionally, only using a survey from the teachers who provided breaks for results could have resulted in biased information, as well as teachers could have over-reported their actual implementation in order to be in compliance with the district initiative.

**Physical Activity and Self-Regulation Skills**

One way to improve self-regulation skills, especially in children from low-income areas, could be from use of the *Tools of the Mind* curriculum (Bodrova & Leong, 1996). It is a curriculum that includes a focus on the development of self-regulation skills in order to decrease behavior problems and impulsivity, as well as to increase focus and academic skills. This curriculum emphasizes the development of self-regulation through giving the students "tools" to work through their emotions and to learn to problem solve. The *Tools* curriculum uses play; specifically, teachers include play as a deliberate part of the curriculum and children create play plans during their free play time. Also, another defining characteristic of the *Tools* curriculum is using movement to develop self-regulation skills. Barnett et al. (2008) did a randomized trial of the curriculum in a low-income urban district. They had 274 three- and four-year-old students participate in the study, which had 11 control classrooms and 7 treatment classrooms. The control classrooms used a curriculum designed by the district that put a heavy emphasis on literacy, but did not put a heavy emphasis on self-

regulation strategies. All students were assessed in the fall and spring with six assessments. The Social Skills Rating System, completed by the teacher, measured self-regulation.

Use of the *Tools* curriculum decreased behavior problems substantially, as recorded by the teacher. The *Tools* curriculum also improved classroom quality, as measured by the Early Childhood Environmental Rating Scale-Revised, Supports for Early Literacy Assessment, and the Preschool Classroom Implementation. The subsections that were significantly higher were language and reasoning, activities, interactions, quality of the literacy environment, and more frequent use of scaffolding techniques. The *Tools* curriculum also improved students' social development, based on the teacher input on the Social Skills Rating System; specifically, results showed substantially fewer behavior problems in the treatment groups. A major limitation of the study is that researchers only used one measurement of self-regulation. Also, the study was only done with low-income families.

Becker, McClelland, Loprinzi, and Trost (2014) researched the relationships among self-regulation, active play, and academics. They had 51 preschool students participate in their study to see if more active play would contribute to better self-regulation skills, which they hypothesized would aid in academic achievement. They measured children's levels of activity with an ActiGraph GT1M accelerometer, their self-regulation with the Head, Toes, Knees, Shoulder task (HTKS), and their math/literacy with the Woodcock Johnson III Tests of Achievement. What they found, after a year-long study, was that active play was related to the HTKS task, but did not predict academic scores. The authors used path analysis to determine both direct effects and indirect effects of active play on SR and academic achievement (both emergent literacy and mathematics). They found a significant direct effect of active play on SR, a significant direct effect of SR on academic achievement, a non-

significant direct effect of active play on achievement, and a significant indirect effect of active play on achievement. They concluded that the relationship between active play and achievement is mediated by SR. These findings show that the use of movement through play does work to improve self-regulation skills, which in turn can help students to improve academically.

Another study from Tominey and McClelland (2011) looked at improving behavioral self-regulation through the use of circle time games in preschool in order to help students improve academically. Researchers used six different games where children had to use attention and working memory to be successful. One game was *Red Light, Purple Light* where students stop and go based on the color shown. They also played the *Freeze Game* where students danced to music until it stopped; they also had to adjust their speed according to the tempo of the music. They did *Color-Matching Freeze* where they danced until the music stopped and in addition, had to find a specific color. Also they played it was *Sleeping, Sleeping, All the Children Are Sleeping* where children pretended to sleep until the teacher told them to wake up and act like a specific animal; later there were more complicated tasks. Finally, they played musical instruments when the teacher conducted them and they followed drum cues while sitting, standing, and moving around the room. The games that were chosen for this study had a focus on self-regulation and proved to be highly engaging due to the use of movement and music, as well as letting students lead the games when appropriate (Tominey & McClelland, 2011).

There were 65 students from low-income families that participated in the year-long study. The Head, Toes, Knees, Shoulders test was used to assess children's self-regulation, while the Woodcock-Johnson III Tests of Achievement was used to assess letter-word

identification, vocabulary, and mathematics. Students were pretested in the fall with a posttest in the spring. Children in the intervention groups had two 30-minute sessions per week where they focused on six different circle time activities. Researchers found that students who entered the intervention with low self-regulatory skills made significant gains in behavioral self-regulation, as well as in letter-word identification. Overall, this study showed positive results of improving self-regulation skills and letter-word identification by the use of movement and games.

Razza, Bergen-Cico, and Raymond (2013) did a study on the use of mindful yoga with 34 preschool students, aged 3 to 5, to improve self-regulatory skills, specifically effortful control (EC) and executive function (EF). They had a pretest-posttest design and used a modified version of the program *YogaKids*. Students in the intervention classroom had 25 weeks of yoga with approximately 40 hours of instruction, which included breathing, sun salutations, and yoga posture linked to literacy activities (Razza et al., 2013). Parents were given a behavior questionnaire rating their child's self-regulation and students were assessed with two tasks for EC (toy wrap task, and toy wait task), two tasks for EF (pencil-tapping task, and Head, Toes, Knees, Shoulders task), and one task for attention (Attention Sustained task from Leiter International Performance Scale-Revised). The researchers found that children in the intervention had significant improvements of inhibitory control, which falls under EF (pencil-tapping task and the attention task). They also were able to maintain focus, while students in the control group had a decline of focus overtime. Therefore, researchers concluded that students improved EC, EF, and attention because mindful yoga taught students to control their impulses, which increases self-regulation based upon their findings.

They suggest that teachers can improve self-regulation and attention by incorporating yoga within their daily routine.

Finally, a study by Davis et al., (2011) looked at the benefit of exercise on the executive function and achievement of overweight children. They included 171 children ages 7 through 11 in a randomized trial of three groups. The first group did 20 minutes a day of aerobic activity, the second group did 40 minutes a day of aerobic activity, and the third group did no aerobic activity. The aerobic exercise was done outside of the school day, and the goal for the first two groups was to keep their heart rate above 150 beats per minute. This trial took place five days a week for 13 weeks. Researchers used three tests for all students: a standardized psychological battery to assess cognition and achievement (the specific names of the assessment were not given), the Cognitive Assessment System to measure mental ability relating to planning, attention, simultaneous, and successive, and the Woodcock-Johnson III Tests of Achievement. Additionally, there were 20 participants that also participated in an fMRI brain scan to see if there were physical changes in the brain due to the intervention.

The results from the study found that there was a significant benefit of exercise on executive function, particularly in planning skills. They also found that math achievement was higher after the intervention, even though there was no teaching of mathematics during the exercise intervention. Additionally, researchers found that there were physical changes of the brain in students from the intervention group. This study demonstrated that with exercise of either 20 or 40 minutes a day, students could improve executive function as well as mathematical skills.

## Movement and Classroom Seating

In this last section, I discuss two different seating options that have been researched for the effectiveness of increasing time-on-task. The first two studies pertain to using disc cushions for students. The last two studies researched the use of stability balls in the classroom.

**Use of Disc Cushions**

Disc cushions are small circular objects with one smooth side and one bumpy side and are filled with air. The reasoning behind the use of disc cushions is that they help the proprioceptive and vestibular systems which are related to balance and body position. The studies were interested in whether students would be more focused and show on-task behaviors as a result of using the cushions. Merritt's (2014) study had two morning preschool classrooms with 26 students total participating in the intervention groups that used the disc cushions during whole group literacy instruction to see if it would improve both their literacy skills and time on-task. The control groups were two afternoon preschool classes with a total of 25 students. Merritt used the Get It, Got It, Go assessment to assess literacy scores and an Off-Task Recording Sheet to assess student behavior. Prior to the start of the intervention, observational data was collected for two weeks in both the intervention and control groups to see how often the teacher had to stop instruction due to off-task behavior. Merritt found that there was no significant change on the posttest for literacy skills, but there was a significant difference in how many times the teachers reported having to stop instruction to address behaviors in the intervention group when compared to the data collected earlier. In order to address the literacy skills, the researcher could have continued this study for a longer duration and worked with additional age groups as well. Increasing the duration and expanding the age groups could help to see what age range the cushions will work best for

and to determine if the cushions help more with on-task behaviors than academics. Also, this was not a randomized trial and it used teacher reported data as part of the results; this could result in bias. However, the finding is encouraging that something like the disc cushions could do enough for the proprioceptive and vestibular systems to increase time on-task.

Pfeiffer, Henry, Miller, and Witherell (2008) looked at the use of disc cushions to see if they would allow students enough dynamic movement to increase on-task behavior. For this study, 61 second-grade students who displayed attention concerns, such as being easily distracted by noise, having uncontrollable behavior that cannot be changed with a few reminders, and demonstrating an inability to sit still, were the ones that used the cushions for the two-week intervention period. Students were selected for the trial based on their score on the Behavioral Rating Inventory of Executive Function (BRIEF). They were randomly assigned to either a treatment or control group. The treatment group used the disc cushions two hours a day for two weeks and the control group used chairs. Results showed that students using the cushion had increased on-task behavior. Findings from the BRIEF data also showed increases in problem-solving and self-regulation skills. On the metacognition index of the BRIEF, which represents a student's ability to plan, use working memory, and organize information, it was found that students were also able to self-manage tasks and their performance better. While researchers did find that there were gains in on-task behavior, they saw that the effect size was small, which could have been because the cushions don't provide enough proprioceptive and vestibular input to keep students engaged or because the intervention was only for two hours a day for two weeks. However, this finding does show that having some movement through the use of the disc cushions can help students that

struggle with on-task behavior in the classroom. In order to have more concrete evidence, this study could be extended past two weeks.

**Use of Stability Balls**

Burgoyne and Ketcham (2015) looked specifically at the use of stability balls for increasing on-task behavior and giving sensory stimulation to the proprioceptive and vestibular systems. Nineteen students in a second-grade classroom participated in the study and were observed on three different occasions. During the first observation, students used chairs; during the second and third observations, the students used the stability balls. Three independent researchers came in to observe the students using a chart to document academic task, effort level, attitude, interactions, seated behavior, and intensity during the first two observations. During the third observation, they removed effort level, attitude, and intensity from the list of behaviors documented, and instead assessed the kind of seated behavior. Researchers found that on-task behavior significantly increased with the use of the stability balls based on the results from the three observations. Researchers conclude that with the use of stability balls, students can have greater vestibular and proprioceptive input, which engages the brain in more ways, allowing them to stay focused in class. This finding of the effectiveness of using movement with the stability balls shows that students can have more on-task behaviors during instruction. Limitations to this study are that researchers did not use a separate control group or random assignment. Also, on the third observation, researchers looked at some different behaviors than during the first two observations, which could affect the comparisons that were made between them.

Gaston, Moore, and Butler (2016) found similar results with on-task behavior in their study of 41 second-grade students using stability balls. The control classroom had 18

students and the intervention classroom had 23 students. The assessment tools were the National Initiative for Children's Healthcare Quality (NICHQ) Vanderbilt (teacher) Assessment Scale, as well as a questionnaire asking students and teachers their opinion of using the balls. The goal of this study was to see if using stability balls would decrease inattention, hyperactivity, defiant behaviors, and anxiety/depression over the course of a school year. Their results showed significant differences for inattention at the 8-week and 5-month observation with the intervention group having fewer instances of inattentive behavior. For the other three categories, there were no significant differences by the end of the trial. Results of the survey demonstrated that the use of the balls had a resounding approval from both students and teachers. This finding of using an object that promotes movement suggests that there are positive benefits of using them to increase attention in class. Some limitations of this study include having teachers that were involved with the study complete the questionnaires because they are not blinded to the study and it could create some bias, having baseline data that was already low, and not using a large population.

## Summary of Findings

This chapter discussed the research of using movement throughout the day in early childhood classrooms. The first section focused on movement that can be incorporated with core subjects such as literacy and math to increase academic achievement and understanding. Researchers found that using gestures, full-body movement, and signals would help students connect abstract ideas surrounding literacy and math. When using full-body movements, students were able to have better spatial reasoning and to internalize the learning. Using gestures and hand signals helped students connect abstract ideas and explain their reasoning.

The use of different modalities within the classroom gave students more ways to understand the academic curriculum.

The second section focused on using physical activity breaks to increase focus and self-regulation skills. Researchers found that by adding more breaks to the day, students had better focus in the classroom which also improved academic achievement. Also, researchers found that movement activities and games can increase self-regulation in order to help students behaviorally and cognitively in the classroom. There were several studies that suggested the use of movement through games, yoga, and aerobic exercise in order to help develop self-regulation skills.

In the final section, dynamic seating was discussed as a way to consistently incorporate movement throughout the day. The studies presented focused on using disc cushions or stability balls in order to engage the vestibular and proprioceptive systems to increase time-on-task. Each study found positive effects when using the disc cushions or stability balls.

# Chapter 3

## Conclusions and Recommendations

The topic of movement in early childhood education has been at the forefront of my thoughts this year. I have a classroom with many varying needs, including children that need to move due to a variety of reasons. With the amount of time for recess and physical education being cut down and time spent on academics increased, I have seen a shift in behaviors, even with the short time I have taught. I was quite certain that there had to be research to show the cognitive and behavioral benefits of using movement in the classroom. Throughout my research, I saw time and time again that using physical activity, movement objects, and kinesthetic learning could increase students' math and literacy knowledge by engaging the brain as well as helping them to be more on-task and attentive. I have concluded that students need to be allowed opportunities to move around, whether it is during instruction or just for movement's sake, in order to function better in the classroom.

The research focused on how movement could be implemented throughout the day in order to increase academic achievement and behaviors, such as self-regulation skills and focus in class. The first section, benefits of movement, discusses the cognitive and behavioral benefits of using movement. The next section, how to incorporate movement, discusses recommendations for implementing the research in the literacy and math curriculum, as well as with physical activity breaks, and dynamic seating. Finally, this chapter discusses possible changes to educational policies and future research.

## Benefits of Movement

The research presented in this paper found many benefits of using movement in the classroom. Researchers found that literacy and math scores increased, self-regulation skills

were more developed, and time on-task increased by using movement in the core subjects, using physical activity breaks, and using dynamic seating. The finding of using full body movement within literacy to increase academic understanding suggests that teachers should include more kinesthetic approaches to literacy instruction. This recommendation is supported by the research showing that students had increased understanding of comprehension strategies by using Comprehension Process Motions (CPMs) (Block et al., 2008). Also, research has found that including curriculum that engages the whole body when learning about phonics will help students make better connections as opposed to a basal curriculum (Rule et al., 2006). That same idea is supported by research from Callcott et al. (2015), concluding that students using movement, as well as decoding practice, will make larger academic gains in literacy. All the research presented in chapter two surrounding literacy and movement was positive when looking at the results. Due to the movement activities, students were able to grasp literary concepts more easily.

Next, the findings of using embodied cognition and gesturing during math instruction to increase student achievement suggests that teachers should provide opportunities for students to explore mathematical concepts through the use of the whole body and explain their thinking by using movement. This recommendation is supported by research showing that having a full scale number line that students use to move from one number to another will increase their spatial knowledge. After walking along the number line, students had better estimation skills and could add numbers more quickly (Link et al., 2013). Ruiter et al. (2015) also supports the idea of a physical number line in order to understand that numbers can be broken into parts. Finally, research by Cook et al. (2007) supports the recommendation of using body movement to explain thinking by incorporating gesturing to

solve math problems. Their research found that students had better retention of math concepts when taught to gesture while they explained their reasoning.

Furthermore, the findings of using physical activity breaks or movement to increase attention and self-regulation skills suggests that teachers should include breaks from academics in order to help students be more engaged. This recommendation is supported by research that showed physical activity breaks helped students to be more focused once the instruction resumed. Also, students made academic gains (Carlson et al., 2015; Ericcson, 2008; Erwin et al., 2012; Wiebelhaus & Hanson, 2016). Further, research supports using movement, such as yoga, games, or aerobic exercise, in order to increase the self-regulation skills of inhibitory control, working memory, and self monitoring (Davis et al., 2011; Razza et al., 2013; Tominey & McClelland, 2011).

Finally, the positive findings when using disc cushions or stability balls to increase time-on-task suggests that teachers should allow for dynamic seating in their classrooms. This recommendation is supported by research showing that when using disc cushions or stability balls, students were more focused on the task (Burgoyne & Ketcham, 2015; Gaston et al., 2015; Merritt, 2014; Pfeiffer et al., 2008).

## How to Incorporate Movement

My second research question asked: What are strategies and activities teachers can use to incorporate movement and increase behavior and academic performance? The recommendations that will be presented are practical and simple so that teachers can implement them into their daily classrooms routines.

### Movement and Instruction

Teachers need to seek out opportunities to incorporate movement into their daily instruction. In order to increase movement within literacy and math, there are a number of things teachers can do. Teachers in early childhood classrooms can incorporate lessons that use different types of movement to help engage students. Teachers can use small simple movements, such as gestures and signs, as a way to help students make connections with abstract ideas. This could be done by using CPMs as a formative check during read-alouds or independent reading time. Using signals when reading can help teachers know which comprehension strategies are being used and if they are being used correctly. Teachers can also use simple movements for phonics instruction, such as hand signs, when learning about vowels or songs/poems that increase language acquisition or gestures when learning about math equations. These simple gestures can aid in helping students explain their reasoning and possibly make more connections.

Also teachers can use large body movements in different ways. If teachers are tied to a basal curriculum, they should infuse opportunities for students to move or show understanding through movement. This can be done with acting out vocabulary words or using props to retell a story. Teachers could also incorporate a number line that students can walk as a simple adjustment to their classrooms. This could be done during morning work, calendar time, or the beginning of a math lesson. By starting such activities with young students, it could help them to make better abstract connections about where numbers are located.

**Movement Breaks**

Using physical activity breaks showed promising results in regards to helping students develop self-regulation skills and increase their focus. The following

recommendations consist of ways to use physical activity as a way to give students a break and would be simple to implement in the early childhood classroom. First, teachers should find logical times during their day to give physical activity breaks (Carlson et al., 2015). This would allow students a chance to move around and reset their focus. Also, during morning work or the opening time of the day, teachers could implement games or yoga that focus on developing self-regulation skills, as these have been found to impact student behavior and learning (Razza et al., 2013; Tominey & McClelland, 2011).

### Movement and Dynamic Seating

As stated above, studies of the benefits of two dynamic seating options (i.e., disc cushions and stability balls) found that incorporating these options can increase time on-task and provide a way to have consistent movement throughout the day. To implement the recommendation of allowing dynamic seating, teachers can begin to bring in seating options that allow movement. This could be done over time so it is affordable, or teachers could search out grants to help monetarily. Also, teachers could start by having students with the greatest needs use the dynamic seating first (Pfeiffer et al., 2008). To incorporate dynamic seating, teachers may need to think about the entire arrangement of their classroom. Students will need different types of dynamic seating based on their needs. For example, some may need the stability ball to give them more vestibular and proprioceptive input. Some may need the small movement provided by the disc cushions, and others may need the option to stand or move around more freely. Teachers should arrange their rooms in a way that is manageable, but also allows for movement throughout the day.

## Educational Policies

In order for movement to gain attention, policy makers need to be informed of the issues. They need to be made aware of the impact that movement can have on students' attention, self-regulation, and academics. One way that policy should be changed is through curriculum. School districts, especially low-income districts, should consider adopting research-based curriculum that pays specific attention to teaching self-regulation skills. One example for preschool is The *Tools of the Mind* curriculum. It would give students a chance to develop self-regulation skills that may not have been nurtured at home. "It may be that the strongest difference between the *Tools* curriculum and others is the extent to which it directly addresses the idea that learning traditional academic content can be inefficient or difficult if children lack underlying cognitive skills such as self-regulation" (Barnett et al., 2008, p. 302).

Additionally, school districts should examine the way classrooms are designed in order to allow for better integration of movement. It should be the district's responsibility to provide seating for students that will help them engage more with the learning in the classroom. While students with an Individualized Education Plan or a 504 plan (a plan that affords students with an identified disability the right to accommodations in the classroom) may have access to dynamic seating, not all students currently do. This should be available for all students to ensure they are learning at their highest level.

## Future Research

The topic of movement in education is highly studied when looking at the health benefits, but there is far less research about movement in regards to behavior or academics. In general, there needs to be more studies that make use of random assignment and that are conducted over a longer time period. Researchers should also control extraneous variables,

provide both pretest and posttest information, and conduct follow-up testing regarding the lasting effects.

More specifically, there is little research on other dynamic seating options than the two presented in this paper. Another avenue that researchers could look into would be standing desks for students above kindergarten age, or stand-up tables for students in kindergarten and below. . Knowing more about the potential benefits of standing desks or stand-up tables would give teachers another way to incorporate dynamic seating along with disc cushions and stability balls.

Lastly, there is some research about using movement within the academic curriculum, but there could be more information on specific strategies or movements used in literacy and math. The studies presented in this paper do have some specific strategies such as CPMs, moving on a number line, or gesturing, but teachers would benefit from having a variety of strategies to use with literacy and math in order to increase movement, engagement, and understanding.

## References

Barnett, W. S., Jung, K., Yarosz, D. J., Thomas, J. Hornbeck, A., Stechuk, R., & Burns, S. (2008). Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly 23*(3), 299-313.

Becker, D. R., McClelland, M. M., Loprinzi, P., & Trost, S. G. (2014). Physical activity, self-regulation, and early academic achievement in preschool children. *Early Education and Development, 25*(1), 56-70.

Blair, C. (2002). School readiness. *American Psychologist, 57* (2), 111-127.

Block, C. C., Parris, S. R., & Whiteley, C. S. (2008). CPMs: A kinesthetic comprehension strategy. *Reading Teacher, 61*(6), 460-470.

Burgoyne, M. E., & Ketcham, C. J. (2015). Observation of classroom performance using therapy balls as a substitute for chairs in elementary school children. *Journal of Education and Training Studies, 3*(4), 42-48.

Callcott, D., Hammond, L., & Hill, S. (2014). The synergistic effect of teaching a combined explicit movement and phonological awareness program to preschool aged students. *Early Childhood Education Journal, 43*(3), 201-211.

Carlson. J. A., Engelberg, J. K., Cain, K. L., Conway, T. L., Mignano, A. M., Bonilla, E. A., Geremia, C., & Sallis, J. F. (2015). Implementing classroom physical activity breaks: Associations with student physical activity and classroom behavior. *Preventative Medicine 81*, 67-72.

Conyers, M., & Wilson, D. (2014, March 12). Move your body, grow your brain. *Edutopia.* Retrieved from www.edutopia.org

Cook, S. W., Mitchell, Z., & Goldin-Meadow, S. (2007). Gesturing makes learning last. *Science Direct, 106*, 1047-1058.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., … Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology, 30*(1), 91-98.

Dotson-Renta, L. N. (2016, May 19). Why young kids learn through movement. *The Atlantic*. Retrieved from https://www.theatlantic.com

Ericsoon, I. (2006). Motor skills, attention and academic achievements. An intervention study in school years 1-3. *British Education Research Journal, 34*(3), 301-313.

Erwin, H., Fedewa, A., & Ahn, S. (2013). Student academic performance outcomes of a classroom physical activity intervention: A pilot study. *International Electronic Journal of Elementary Education, 5*(2), 109-124.

Executive function & self-regulation. (2017). Retrieved from http://developingchild.harvard.edu/science/key-concepts/executive-function/

Gaston, A., Moore, S., & Butler, L. (2016). Sitting on a stability ball improves attention span and reduces anxious/depressive symptomatology among grade 2 students: A prospective case-control field experiment. *International Journal of Educational Research, 77*, 136-142.

Guerin, L. (2016, April 27). Meal and rest breaks: Your rights as an employee. *Nolo*. Retrieved from www.nolo.com

Guernsey, L. (2015, April 24). Early childhood education doesn't end with pre-k. *New America*. Retrieved from https://www.newamerica.org

Link, T., Moeller, K., Huber, S., & Fischer, U. (2013). Walk the number line – An embodied training of numerical concepts. *Trends in Neuroscience and Education 2*, 74-84.

McDonough, M. (2016, May 31). Standing desks boost productivity, not just health, study finds. *The Washington Post*. Retrieved from https://www.washingtonpost.com

Merritt. J. M., (2014). Alternative seating for young children: Effects on learning. *American International Journal of Contemporary Research, 4*(1), 12-18.

Pfeiffer, B., Henry, A., Miller, S., & Witherell, S. (2008). Effectiveness of Disc 'O' Sit Cushions on attention to task in second-grade students with attention difficulties. *American Journal of Occupational Therapy, 62*(3), 274-281.

Pica, R. (2010). Why kids need recess. *Pathways to Family Wellness*. Retrieved from www.pathwaystofamilywellness.org

Razza, R. A., Bergen-Cico, D., & Raymond, K. (2015). Enhancing preschoolers' self-regulation via mindful yoga. *Journal of Child and Family Studies, 24*(2), 372-385.

Rule, A. C., Dockstader, C. J., & Stewart, R. A. (2006). Hands-on and kinesthetic activities for teaching phonological awareness. *Early Childhood Education Journal, 34*(3), 195-201.

Ruiter, M., Loyens, S., & Paas, F. (2015). Watch your step children! Learning two-digit numbers through mirror-based observation of self-initiated body movements. *Educational Psychology Review, 27*(3), 457-474.

Strauss, V. (2014, July 8). Why so many kids can't sit still in school today. *The Washington Post*. Retrieved from https://www.washingtonpost.com

Shoval, E., (2011). Using mindful movement in cooperative learning while learning about angles. *Instructional Science: International Journal of the Learning Science, 38*(4), 453-466.

Tominey, S. L., & McClelland, M. M. (2011). Red light, purple light: Findings from a randomized trial using circle time games to improve behavioral self-regulation in preschool. *Early Childhood and Development, 22*(3), 489-519.

Wiebelhaus. S. E., & Hanson, M. F. (2016). Effects of classroom-based physical activities on off-task behaviors and attention: Kindergarten case study. *The Qualitative Report 21*(8), 1380-1393.