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# Physical Movement and the Impact on Pre-Literacy Skills

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**Physical Movement and the Impact on Pre-Literacy Skills**

by

Sandra M. Kiekow

A Thesis

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Science in

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### **Abstract**

The purpose of this study was to determine if 10 minutes of additional physical movement every school day for 18 weeks would affect cognitive development (pre-literacy skills) of Kindergarten students and to determine what areas of pre-literacy test scores were affected.

Twenty Kindergarten students from one Kindergarten classroom located in a central Minnesota public school participated in the study for 18 weeks. The 20 students were randomly divided into two groups, an experimental group and control group. The experimental group participated in the structured daily movement program, which was Stimulating Maturity Through Accelerated Readiness Training (S.M.A.R.T.) in a separate room and the control group did not participate in the movement program, but engaged in free play activities in the classroom. Free play consisted of the students having the option to use the same academic materials as the experimental group and play academic games, but in an unstructured setting. Both groups had adults to assist them with the academic pieces if needed. Pre-literacy skills were measured by DIBELS Next assessment for all Kindergarten children in September, 2017, and again in January, 2018. The skills assessed included Letter Naming Fluency and First Sound Fluency; the assessment also calculated a composite score for those skills. The mean score of each group was calculated in each area and compared pre-study and post-study.

Results of this study indicated participation in 10 minutes of S.M.A.R.T. movements daily over an 18-week period had a positive impact on pre-literacy test scores in the area of Letter Naming Fluency. In the area of First Sound Fluency, the results of the study indicate the additional movement activities did not have a positive impact on pre-literacy test scores. The

overall average composite score reveals participation in the S.M.A.R.T. movement curriculum did not have a positive effect on all pre-literacy skills.

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### **Dedication**

This thesis is dedicated to my loving husband, Lonny, and my two boys, Zach and Alex, for their overwhelming amount of love, support, and encouragement they have given me during this project.

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## Chapter 1: Introduction

### Project Background

As children's bodies and brains grow and develop, professionals working with children, typically monitor their developmental progress throughout early childhood. The areas of development early childhood educators focus on include Cognition, Communication, Motor, Social-Emotional, and Adaptive skills. While each area is assessed separately and intervention may focus on separate developmental domains, they are inextricably connected to each other throughout development. For example, Cognition and Social Emotional domains rely on movement to develop; Adaptive domain relies on movement and communication. According to Dr. Antronette Yancey, a UCLA public health professor and advocate for children's exercise, students can pay better attention, exhibit less disruptive behaviors, and feel better about themselves through raising their self-esteem, avoiding depression, and lessening anxiety when they have been active. All of those feelings can negatively impact academic performance and attentiveness (Medina, 2014). As research has determined, a variety of physical movements which get the heart pumping and deliver oxygenated blood to the brain, have a positive effect on cognition and social emotional domains (Stevens-Smith, 2016).

Communication and cognition are also mutually influenced; a language enriched environment supports greater cognitive skill development of the child. According to Suskind (2015), during the first 3 years of a child's life when the brain is rapidly developing, talking (to a child) is the brain's essential nutrition. In 1995 researchers Betty Hart and Todd Risely found a strong correlation between the number of words children hear in the first three years of life and later academic performance. Children living in a language poor environment lacked school readiness skills and had poor academic performance. They also determined children who heard

fewer words heard harsher, more prohibitive speech, less complex vocabulary, and had less conversational give-and-take (Suskind, 2015). Even though the brain develops at a faster rate during the first 3 years of a child's life, learning and brain development occur across all domains and are dependent on each other from birth through adolescence (Brotherson, 2009).

Not only do teachers and medical professionals (doctors, psychologists, etc.) have to consider developmental domains and their interrelationship, they must be aware of how the brain develops and cognition progresses. In years past, researchers believed a child's brain was fully developed and predisposed to their learning based solely on genetic make-up (Brotherson, 2009). Later studies found that notion to be false. A child's brain is formed at birth, but the human brain develops through the many accumulated experiences with the external world (Fields, 2011). These experiences allow the brain to build neural pathways (also known as synapses and/or "wiring" of the brain), thus constituting an increase in cognition, otherwise known as learning. A child's brain continues to develop more efficient, high speed neuro transmissions from birth into adulthood. Experiences that use a child's senses (hearing, sight, touch, smell, taste, balance, and intuition) are the best ways to help a child learn. The senses work together to deliver information to the brain to begin making efficient neuronal connections, therefore increasing cognitive growth (Connell & McCarthy, 2014).

Not only do children's combined experiences increase cognition and learning, researchers have determined physical movement also increases cognition (Connell & McCarthy, 2014). There are two ways in which physical movement increases cognition/learning. First, movement is as vital for human brains and learning as nutrition is for the human body and brain (Stevens-Smith, 2016). When a child (or any human) engages in voluntary physical movement, the heart pumps oxygenated blood to the brain, which is essential for successful brain functioning and

learning (Hannaford, 2005; Stevens-Smith, 2016). Second, studies have determined that the cerebellum is responsible for regulating and coordinating motor movements and cognitive functions such as language, indicating physical movement contributes to learning (Hannaford, 2005).

### **Problem**

While our bodies are made for moving and studies indicate the benefits of physical movement on the human body and brain, contemporary society has shifted toward more sedentary lifestyles due to our access to and use of technology (Hillman, 2014). It is estimated children spend about 5.5 to 7.5 hours per day engaged in sedentary activities such as playing videogames, watching television, or playing on their computer or handheld device (Ratey, 2008; U.S. Department of Health & Human Services, 2017). This accounts for much of the time children are at home. Likewise, movement opportunities in public school are also becoming rare.

Children attending public schools are expected to continually improve on literacy, math, and other tests. However, while a significant body of research reflects the positive correlation between movement and cognition, schools across the nation are reducing young students' time spent engaged in physical movement, such as physical education classes, recess, and free play in order to spend more time on academics (Ratey, 2008). With the amount of curriculum a teacher needs to address daily, it is becoming increasingly difficult to carve out time for students to move. So, in addition to sitting for hours at home, children come to school and are required to sit longer, which can have an inverse or negative affect in cognitive skills development and learning ability.

**Purpose of the Study**

The students with whom I work are fortunate to have the opportunity to participate in 30 minutes of a structured physical education class 5 days per week and 10-20 minutes of unstructured outdoor recess on the playground, which is 10-20 minutes short of the recommended 60 minutes of physical exercise daily. The purpose of this study was to determine if 10 minutes of additional physical movement every school day for 18 weeks will affect cognitive development, specifically pre-literacy skills, such as letter naming fluency and first sound fluency, on Kindergarten students as measured by DIBELS Next pre and post assessments.

**Significance of the Study**

As an early childhood special education teacher, I work with children who have deficits in one or more developmental areas (motor, cognitive, communication, social-emotional, adaptive) and are considered delayed in their development. When I teach, I need to observe the whole child, not just one area, such as academics, to build cognitive skills. Even though this study is focusing on the relationship between cognitive skills and physical movement (motor skills), research also indicates physical movement can help both typically developing and impaired children (and adults) who are experiencing anxiety, stress, and/or depression, affecting their social-emotional development (Ratey, 2008).

Physical movement is more than getting your body in shape, it is also about shaping the mind. Physically fit children can identify visual stimuli more quickly and concentrate better than their sedentary peers (Medina, 2014). Not only does physical activity work the brain and the body, it has also been shown to have a positive effect on mood, attention, self-esteem, and social skills, which are areas in which many students also suffer (Medina, 2014; Ratey, 2008).

In addition to searching for additional supports to teach the whole child, I am always investigating techniques to help my students acquire more academic skills. With the added pressures of increased test scores, and less time to move, I am searching for opportunities to add movement back into the classroom. Not only do I want my students to learn through movement, I want movement to influence their lives to move more which can lead to healthier adult lifestyles. I want to help my students learn to the best of their potential by giving them all the tools that can support their ongoing development and be used throughout their lives.

### **Research Question**

This study was conducted to answer the following research questions:

1. Does 10 minutes of S.M.A.R.T. movements practiced daily in school over an 18 week period have an effect on pre-literacy test scores, specifically letter naming fluency and first sound fluency, as measured by DIBELS Next for Kindergarten students?
2. What areas of pre-literacy test scores are affected by SMART movements practiced daily in school for Kindergarten students?

### **Conclusion**

Movement has an important impact/influence on child development, notably cognitive skills. With the increase in sedentary lifestyles at home and school, children are moving less while expected to learn more. This study examines the importance of movement on cognition.

In the following chapter, the literature pertaining to the research of the positive correlation between movement and learning is reviewed. I discuss how the brain develops (structurally and the “wiring”), what influences brain development, how movement stimulates learning and brain development, along with supporting research. Lastly, the chapter discusses implications of the movement research for educators.

## **Definition of Terms**

*Amygdala:* the portion of the brain located within the limbic system.

*Ancestors:* a person related to you who lived a long time ago.

*Anthropologist:* a person who scientifically studies humans and their customs, beliefs, and relationships.

*Anxiety:* an uncomfortable feeling of worry about something that is currently happening or might happen in the future.

*Axon:* the long threadlike part of a neuron cell which carries signals/impulses from the cell body to other cells. Depending on the location of the cell, the length of the axon can vary.

*Balance:* the ability of humans to equally distribute weight between their two feet and remain upright and steady, is one component of the Vestibular system that plays a vital role in our everyday living.

*Brainstem:* the portion of the brain located at the base of the skull and controls basic life activities, such as breathing, heart rate, digestion, blood pressure, body temperature, sleeping, waking, and primitive reflexes.

*Central Nervous System (CNS):* it is part of an individual's nervous system and is comprised of the brain and spinal cord. It receives sensory information from the nervous system and controls the body's responses.

*Cerebellum:* the portion of the brain located behind the brainstem and is responsible for most physical movements (motor skills), balance, muscle control, muscle memory, and supporting cognitive functions (learning new tasks), coordinating thoughts, emotions, and social skills. It may also be responsible for maintaining alertness, attention, and planning and regulating behavior.

*Cortex:* the most complex portion of the brain. It is the top layer of the brain and is responsible for regulating decision-making, and controlling thinking, reasoning, and language.

*Dendrites:* the short thread like parts located at the edge of a neuron that are responsible for carrying messages to the cell.

*Depression:* a feeling of unhappiness or type of mental illness that causes long periods of sadness.

*Developmental Domains:* the areas professionals, such as teacher, doctors, etc. examine when assessing children's development. The domains include cognition, communication, motor, social-emotional, and adaptive.

*Genes:* a specific chemical pattern on a chromosome (cell structure) that is received from the parents and controls development of some characteristics in humans, animals, and plants.

*Head Start Program:* it is preschool education program in the United States designed to provide comprehensive early childhood education, emotional, social, health, nutritional, and psychological needs to low-income children and their families. It was designed to break the cycle of poverty.

*Integrated Primitive Reflexes:* primary reflexes which develop into more mature reflexes.

*Intuition (proprioceptive):* instinctive knowledge or belief that is not obtained through reason or perception. It is made of proprioceptive sensors.

*Literacy:* the ability to read and write.

*Limbic System:* the portion of the brain located in the central part of the brain and controls emotions, attachment, and memory. The limbic system is also home to the amygdala, which not only controls emotions, but has the ability to remember them.

*Midbrain:* the portion of the brain located at the top of the brainstem and controls motor activity, appetite, and sleep (Brotherson, 2009).

*Neural Pathways:* neuron connections within the brain which enables a human to learn. Also referred to as synapses, highways, and “wiring” of the brain.

*Neurons:* specialized cells in the brain which send and receive information to/from other nerve cells, muscle, or gland cells and facilitate human learning. Neurons are also known as nerve cells.

*No Child Left Behind Act of 2002:* under this law, states were required to test students in reading and math in grades 3-8 and once in high school. All students were expected to meet or exceed state standards in reading and math by 2014. The major focus of this act was to close the race and class-based achievement gaps with students. This act is no longer in effect in this country as of December, 2015. It was replaced by “Every Child Succeeds Act.”

*Phonological Awareness:* an early literacy skills that requires individuals to be conscious that oral language is made up of smaller units of sound and have the ability to focus and manipulate the individual sounds in spoken words. Example of phonological awareness is rhyming, first letter sounds, etc.

*Prefrontal Cortex:* the portion of the brain located at the front of the cortex. It is responsible for the regulation of complex cognitive, emotional, and behavioral functioning. More specifically, it is responsible for planning, sequencing, rehearsing, evaluating, and understanding. It is also the home of the working memory, which is crucial for decision-making.

*Pre-Literacy Skills:* skills needed to read and write. They include the development of oral language, alphabet knowledge, print awareness, and emergent writing skills.

*Proprioceptive Sensors (proprioceptors):* a nerve endings in human muscles, tendons, joints, ligaments and in the inner ear and is stimulated when the body moves or changes positions. These sensors send informational messages to the brain about an individual's position in space, his relationship to that space, current conditions of the environment, and objects he encounters.

*Retained Primitive Reflex:* primary reflexes, which have not disappeared at the correct age.

*Sedentary:* refers to doing or involving a lot of sitting and involves little exercise or physical activity.

*Self-Regulation:* behaviorally, it is the ability to act in your best interest. Emotionally, it is defined as the ability to calm oneself down or cheer oneself up.

*Spatial Reasoning:* a reasoning skill that allows an individual to think about objects in three dimensions and draw conclusions about them with limited information. Individuals with good spatial reasoning abilities are able to look at an object and think how it will look when rotated.

*Stress:* it is mental tension/worry caused by a difficult situation, such as problems in your life, work, etc.

*Synapse:* neuron connections within the brain which enables a human to learn. Also referred to as neural pathways, highways, and "wiring" of the brain.

*Vestibular System:* it is structures located in the inner ear, which provides an individual with a sense of balance and spatial orientation (a sense of whether you are right-side up or upside-down) so they can coordinate movements with balance.

*Wiring of the Brain:* neuron connections within the brain which enables a human to learn.

Also referred to as synapse, highways, and “wiring” of the brain.

## **Chapter 2: Literature Review**

### **Introduction**

“Johnny, please sit down so you can finish your work. If you do not get done with this work, you cannot go outside today.” Many educators find themselves routinely saying the same thing or something similar to their students. With a seemingly steady increase in content standards and expectations for children and educators, more time is needed to complete daily academic work. This causes educators to compress more academics into the day, while shrinking the physical components such as recess, free play, and/or physical education class. This paper addresses current findings on the development of children’s brains, which includes the relationship between early childhood developmental domains, brain construction and construction of neural pathways (also known as synapses and/or “wiring” of the brain), influences that affect cognition, and the correlation between physical movement and learning. Lastly, the literature review addresses the relationship between contemporary culture and movement, along with the meanings of these findings for educators today.

### **Child Development and the Brain**

In order to understand the development of a child and the importance of movement in a child’s life, individuals must first understand brain development in a child. Brain development is the most amazing feature of child development. As a child’s brain develops, he acquires skills in the five domains of child development: Cognition, Communication, Motor, Social-Emotional, and Adaptive. These skills include the gradual, yet rapidly developing abilities to crawl, walk, speak, eat, laugh, play with others, independently eat, dress, bathe, and use the toilet, among many other skills. This section will help readers understand brain development by detailing examples of information researchers know about the brain, how it develops, and its construction.

Brotherson (2009) reported researchers are disputing old ideas as they learn more about brain development. For instance, researchers in the past believed a child's brain development was completely dependent on their genes. This idea were labeled a myth as researchers determined that even though genes may play a part in brain development, early experiences and interactions are most important in a child's brain development. Healthy brain development is the effect of caregivers providing the child with an enriched learning environment. An example of providing an enriched learning environment is to have a conversation or interaction with a child rather than sitting them in front of the TV. Talking to young children exposes them to language in a way that a TV cannot. Researchers Betty Hart and Todd Risely found the correlation between the number of words children hear in the first three years of life and academic performance. Children living in a non-language enriched environment lacked school readiness skills and had poor academic performance; whereas, the study indicated children living in language enriched environments reached their potential in math, spatial reasoning, literacy, self-regulation, and perseverance (Suskind, 2015). The best way to provide a communication-enriched learning environment and aid in healthy brain development is by talking, reading, singing, and continuously explaining to your child what you are doing. (Brotherson, 2009).

Researchers also previously believed a child's brain was fully developed at birth. However, after extensive studies, scientists determined brain development continues long after birth and its outcome is based on the child's experiences. Children's brains from birth to adolescence have been compared to a "super sponge," absorbing new information through experiences. Even though the child's brain and brain cells are formed before birth, the neural connections ("wiring") are constructed after a child is born during the early childhood years;

however, the child does not need special help, and/or costly toys for brain development to occur (Brotherson, 2009). The brain needs experiences to build connections.

### **Construction of the Brain**

In order to understand how the brain develops connections, individuals must first understand some basics of brain development. This paper focuses on the five main areas of the brain, which control different major functions. The areas are: the brainstem, the midbrain, cerebellum, limbic system, and the cortex. These areas develop while in-utero, but during the early childhood years, those areas learn to work together to create human thought, movement, feeling, and expression (Connell & McCarthy, 2014). The brain grows in order from least complex area (brainstem) to the most complex area (cortex).

The least complex area of the brain and first area to develop is the brainstem. The brainstem is located at the base of the skull and controls basic life activities, such as breathing, heart rate, digestion, blood pressure, body temperature, sleeping, waking, and primitive reflexes (Brotherson, 2009; Connell & McCarthy, 2014; Medina, 2014). The brainstem works without conscious thought most of the time, but works consciously when the brain senses danger or stress, such as a strange sound or an unexpected event. As soon as the brain senses danger or stress, it directs the energy to the brain stem for immediate action and in extreme cases can shut down other parts of the brain until the situation can be stabilized. According to Sutherland (2006), these series of events in the brain explain why it is nearly impossible to reason with an upset child. The complete formation of this portion of the brain in utero is essential for survival outside of the womb (Connell & McCarthy, 2014).

The next area of the brain to grow and develop is the midbrain. The midbrain is at the top of the brainstem and controls motor activity, appetite, and sleep (Brotherson, 2009). This

area also assists humans in processing hearing, vision, and controlling voluntary movements.

Even though sensory processing does not reside in any single part of the brain and is important in brain connections, professionals often refer to the midbrain when considering the five senses (seeing, hearing, smelling, tasting, touching) (Connell & McCarthy, 2014).

The third area in the brain to develop is the cerebellum. It is located behind the brainstem and is responsible for most physical movements (motor skills), balance, muscle control, and muscle memory, along with supporting cognitive functions (Brotherson, 2009; Connell & McCarthy, 2014). The cerebellum is the part of the brain that learns how to use every muscle and stores that information in muscle memory for later use. Through repetition children are able to learn to move their muscles automatically, which is one of their biggest development priorities in early years (Connell & McCarthy, 2014).

Even though the cerebellum is known for its importance in motor development, researchers Savina, Garrity, Kenny, and Doer (2016) and Diamond (2000) determined it also plays a key role in developing cognitive skills, such as learning new tasks. Based on the research relating movement and cognition, Calcott, Hammond, and Hill (2015) described there is a peaking interest in using movement as a way to teach other cognitive skills. Other researchers, such as Koziel, Budding, and Chidekel (2012), stated the cerebellum may also be responsible for children to maintain alertness and attention, along with planning and regulating behaviors, while Ratey (2008) stated the cerebellum also appears to coordinate thoughts, emotions, and social skills. Piek, Dawson, Smith, and Gasson (2008) described the interrelationship between sensory-motor development and cognitive development as providing the foundation to link motor development to learning. Based on this research, the cerebellum appears to play more of a major role in child development and well-being, than what was earlier believed.

The fourth area of the brain to develop is the limbic system and is responsible for controlling emotions, attachment and memory (Brotherson, 2009; Connell & McCarthy, 2014). The limbic system is also home to the amygdala, which not only controls emotions, but has the ability to remember them. It allows you to feel rage, fear, and pleasure, along with creating memories of past experiences of rage, fear, or pleasure. This area is much larger in men than it is in women, but researchers have not concluded if the size differences have a significant role (Medina, 2014). In young children, this region is very immature, so their emotional reactions tend to be black and white. This could explain why a child goes running out of the room when he sees or is asked to eat a food he dislikes. It also explains why children may become attached to a toy or blanket and will not release it (Connell & McCarthy, 2014).

The cortex and the prefrontal cortex are the last and most complex areas of the brain and are the top layer of the brain (Brotherson, 2009). The prefrontal cortex is the front portion of the cortex. If the cortex was unfolded, it would be the size of an unfolded newspaper, with a thickness ranging from paper to heavy duty cardboard (Jenson, 2008; Medina, 2014). The cortex is responsible for higher level thinking (formal and abstract), symbolic understanding, decision-making and language (Brotherson, 2009; Connell & McCarthy, 2014). For example, the cortex has the ability to develop a new idea (imagination and creation), the ability to determine consequences of different choices (projection and prediction), and has the ability to use and understand symbols, such as letters and numbers in order to learn academics (interpretation of symbols) (Connell & McCarthy, 2014). This area contains 80% of all the neurons in the brain, but is the least developed part of the brain at birth. This area of the brain continues to develop beyond adolescence; therefore, the cortex is more sensitive to experiences (the connections between different areas of the brain taking place and how learning happens) than any other part

of the brain (Brotherson, 2009). The cortex constantly communicates to the interior of the brain through neurons.

### **“Wiring” of the Brain**

What exactly are neurons? According to the Society for Neuroscience (2012), neurons (also known as nerve cells) are defined as specialized cells that send and receive information to/from other nerve cells, muscle, or gland cells and facilitate something as complex as human learning. According to Jenson (2008), the brain consists of 50 to 100 billion neurons and are the functioning core of the brain. However, having billions of neurons does not guarantee a person being smart; the neurons need to make connections through constant communication with each other via neural pathways, referred to as synapses or highways (“wiring” of the brain) (Jenson, 2008; Medina, 2014). These connections are what enable a human to learn (Brotherson, 2009; Medina, 2014). Medina explained what communication “looks” like between neurons: “neurons spark to life, then suddenly blink off, then fire again. Complex circuits of electrical information crackle in coordinated, repeated patterns, racing to communicate their information along large neural highways that branch suddenly into thousands of exits.” These branches are “wired” differently in every single human being, including twins.

Neurons are the functioning core of the brain (Brotherson, 2009). The brain consists of approximately 200 billion neurons, but only a small amount of those neurons are connected at birth, such as the neurons associated with breathing, blood pressure, reflexes, and digestion. The rest of the brain needs to be “wired,” which occurs through life experiences (Connell & McCarthy, 2014). Each neuron cell body is about one-hundredth the size of the period at the end of a sentence and consists of a cell body, dendrites, and an axon (Brotherson, 2009; Society for Neuroscience, 2012). According to Brotherson, “The dendrites pick up chemical signals across a

synapse (the contact point where one neuron communicates with another), the impulse travels the length of the axon. Each axon branch has a sac containing neurotransmitters at its tip. The electrical impulse causes the release of the neurotransmitters, which, in turn, stimulates, or inhibits dendrites, like an on-off switch.” Medina (2014) used an analogy of two uprooted trees to help visualize how two neurons interact in the brain. He said to imagine two trees being uprooted by giant hands and turned 90 degrees so the roots face each other. The tree roots (like dendrites) should be close, but not touching. Many of these neurons need to make connections in order to develop pathways (“wiring the brain”) for the brain to learn.

In the past, researchers thought brain development and “wiring of the brain” were determined by genetics and the brain followed a biologically predetermined path (Brotherson, 2009). According to Fields (2011), the human brain develops after birth through experiences with the outside world. The brain continues to wire itself from birth through adolescence. That is why everyone’s brain is different; two people may have the same experiences, but perceive them in different ways causing “wiring” to be different among the two individuals.

### **Influences that Affect Brain Development (Wiring and Cognition)**

Some wiring of the brain begins prior to birth, so pregnancy and prenatal care have a direct impact on the wiring of a child’s brain. The brain and the central nervous system begin to develop quickly after conception and are sensitive to a number of influences and exposures from the lifestyle of the mother and father. The expectant parents’ lifestyle can be defined as, but not limited to what they eat, drink, breathe, smoke, pop, sniff, their emotional state, their socioeconomic status, and stress level. According to Diamond and Hopson (1999), poverty, poor

nutrition, drugs, alcohol, and violence can have a direct effect on eggs and sperm before the child is conceived. So, prospective parents' past lifestyle can have an impact on their future children.

Studies have been conducted that verify the importance of prenatal care and lifestyle choices. One study of American children found that one in five children developed problems with learning, behavior, or emotions as an effect from their physical and emotional environments before and after birth. Another study examined babies born with deficits and found that 65-70% of those babies had a higher probability of being born without deficits if the parents avoided exposures such as medicinal drugs, recreational drugs, alcohol, tobacco smoke, stress, and toxic agents either at home or work. Avoiding harmful substances, increasing folate in the expectant parents' diet (prior to and after conception), getting exercise and adequate sleep, plus reducing stress are the simplest and most beneficial way to give aid to a child's neurological growth and well-being in-utero (Diamond & Hopson, 1999; Karr-Morse & Wiley, 2012). As stated by Karr-Morse and Wiley, "Your best gift to your baby is to take care of yourself and surround yourself with people who honor that priority."

After birth, a number of outside factors influence not only a baby's cognitive brain development (wiring of the brain), but all the early childhood domains of development and learning. Examples of factors that influence early brain development and domains of early childhood include: food and nutrition, responsiveness of caregivers, daily experiences, physical activity, and love (Brotherson, 2009). The National Association for the Education of Young Children's (NAEYC; 2009) position statement *Developmentally Appropriate Practice in Early Childhood Programs Serving Children from Birth to Age 8* specifies that "all domains of development and learning--physical, social, emotional, and cognitive--are important, and they are closely related. Children's learning in one domain influences and are influenced by what

takes place in other domains” (p. 11). For example, when babies begin to explore the world through crawling, their motor skills affect cognitive development and autonomy. The position statement also instructs teachers to “plan curriculum experiences that integrate children’s learning within and across all of the developmental domains (physical, social, emotional, cognitive) and the disciplines (including language, literacy, mathematics, social studies, science, art, music, physical education, and health)” (p. 21). The latter of the two position statements can extend out to parents and caregivers, so they create positive early learning experiences across domains.

Learning is not only influenced by the closely related domains, but through the use of a baby’s senses to learn and expand neural brain connections. Babies and young children are thinking, moving, feeling, tasting, touching and interacting individuals; this is how they learn, through their senses. Most individuals are familiar with the five senses (sight, hearing, smell, taste, and touch), but two important sensory tools, balance (vestibular system) and intuition (proprioception), must also be considered when talking about the senses (Connell & McCarthy, 2014). Essentially, children learn about their environment through their seven senses.

Balance, the ability of humans to equally distribute weight between their two feet and remain upright and steady, is one component of the Vestibular system that plays a vital role in our everyday living. It supports a majority of everything we do from small tasks, such as standing upright, to large feats, such as reading a book while hanging upside down. Individuals are not born with a sense of balance; it must be learned through a variety of movements (many times and many different ways) (Connell & McCarthy, 2014). According to Connell, Pirie, and McCarthy (2016), balance works together with intuition (the seventh sense), so individuals always know which way is up.

The seventh sense is intuition, which is also referred to proprioceptive (Connell & McCarthy, 2014). Intuition is automatic and most easily explained by thinking of it as the body's internal GPS system or the subconscious sense of you; meaning your body knows where you are in space even when you do not (Connell et al., 2016). Intuition is made up of proprioceptive sensors (proprioceptors), which are present on nerve endings in human muscles, tendons, joints, ligaments and in the inner ear. These sensors send informational messages to the brain about an individual's position in space, his relationship to that space, current conditions of the environment and objects he encounters. The information sent to the brain answers questions about their physical self, such as: What do I look like?; What is my body made of?; How big am I?; Do I fit in this space? (Connell & McCarthy, 2014). Once individuals have an understanding of their physical self, intuition then allows a person to begin to understand themselves in relation to their environment. For example, intuition aids in answering the question: "How hard do I need to pull to open the door?" (Connell et al., 2016). The information delivered to the brain through intuition and the other six senses allow the brain to begin making neuron connections (wiring), which aids in increased cognition (Connell & McCarthy, 2014).

A baby/child cannot learn only through the senses; they also need physical movement. The physical movement both stimulates and motivates the senses. For example, when a child wants a ball, he figures out a way to get it. So, the senses begin the process (by the child seeing the ball) and movement finishes the process by the child reaching for the ball he desired. In this example the senses motivated movement. The senses can also be stimulated by movement. For example, by the simple motion of the child reaching for the ball, it awakened other senses, such as touch. When the child saw the ball and reached for the ball, the sense of touch enabled the child to touch the object. On the outside it may look like a simple movement, but in the child's

brain early clues help the child discover deliberate movements. Not only can he see the ball, but he can reach the ball and use his fingers to touch the ball. Senses and physical activity are necessary for experiences and experiences are what helps the child to learn, develop, and master new skills (Connell & McCarthy, 2014).

### **Physical Activity and Learning**

Not only do outside influences affect brain development, but physical activities can also affect brain development and learning. To understand how physical activities aid in brain development, first examine our ancestors and their movement patterns in correlation to brain development. Anthropologists and scientists claim that our evolutionary ancestors physically moved their bodies daily: moving at a fast pace, moving often and far, in order to survive. Survival required them to roam the land to stay safe from predators, physical dangers, and search for food through hunting and fishing. Scientists estimated that human males traveled on foot between 6 and 12 miles per day, while the females' estimate was half that amount. Data show not only were our ancestors physically fit, but their healthy bodies supported development of their brains (Medina, 2014).

How can movements and physical activity support brain development? According to Stevens-Smith (2016) and Hannaford (2005), the human brain needs two basic elements to successfully function; those elements are oxygenated blood and water. Even though the brain makes up only one-fifteenth of a human's body weight, it uses one fifth of the oxygen in the body. The brain, which weighs between 2-4 pounds in a healthy adult, uses more oxygen, an essential element for learning, than any other organ in the body (Jenson, 2008; Stevens-Smith, 2016). Therefore, movement serves as a way to carry oxygen to the brain to enable learning and is vital for human brain development (Stevens-Smith, 2016).

Not only does physical movement assist with transferring oxygenated blood to the brain, which is needed for learning, researchers have discovered the portion of the brain that is responsible for movement is the same portion of the brain, that is responsible for learning reading, writing, and mathematics (Hannaford, 2005); it is the cerebellum. Through children's brain scans, researchers were able to identify the effects of physical movement on cognition. When children physically move, it stimulates the neurons and electrical wiring in the brain to get "fired up," which help children take in information and learn. This information causes researchers to conclude children learn best when they are active and moving (Hannaford, 2005). Researchers consider movement to be like "cognitive candy" to human brains. To improve cognition, memory, attention, spatial perception and thinking, individuals (children and adults) must move their bodies (Medina, 2014).

Many studies have been conducted on the positive correlation between physical activity and learning from birth through adulthood. According to Janssen and LaBlanc (2004), in 2004 a panel of 13 researchers from different academic and medical fields, ranging from kinesiology to pediatrics, conducted a review of more than 850 studies about the effects of physical activity on school-age children. The majority of the studies examined the effects of 30-45 minutes of physical activity (moderate to vigorous), over a course of 3-5 days per week (Ratey, 2008). The studies investigated topics such as academic performance, obesity, cardiovascular fitness, blood pressure, depression, anxiety, self-concept, bone density. After examining academic performance, the research panel found evidence to support the California studies (mentioned below) that physically fit children score higher on academic assessments. The panel also arrived at the conclusion that physical activity had a positive effect on memory, concentration, and classroom behavior (Janssen & LeBlanc, 2004; Ratey, 2008).

Another investigation conducted by Calcott et al. (2015) studied preschool children (aged 4 and 5) who were exposed to 15-minute daily scripted lessons, which combined movement and explicit phonological awareness. The results indicated the group with the combined explicit phonological awareness lesson and movement outperformed the control group on measures of phonological awareness, invented spelling and spelling. The results support the correlation between physical movement and increased cognitive ability.

The California Department of Education (2016) reported that students in grades five, seven, and nine participated in a physical fitness test (PFT) called the FITNESSGRAM. The goal of the assessment is to help students start a life-long journey to physical fitness. Using the fitness results from the PFT and scores from the Stanford Achievement Test (assessment for reading), the California Department of Education conducted a study to determine if there was a correlation between physically fit students and their academic scores. In 2002, the CDE reported students with higher fitness scores also had higher academic achievement. In fact, children who were physically fit scored twice as well on academic assessments as their unfit peers (Ratey, 2008; Stevens-Smith, 2016). This study also factored in socioeconomic status of children. The results indicated the students in the higher socioeconomic class scored higher on academic exams, than students from lower income households. However, the results of the study indicated students who were more fit in the lower socioeconomic class performed better academically than the unfit students in the same socioeconomic class (Ratey, 2008).

Castelli, Hillman, Buck, and Erwin (2007) conducted a study to determine the relationship between physical fitness and academic performance amongst 259 third and fifth graders. The results indicated a strong positive correlation between aerobic fitness, standardized test scores, and grades.

In 2008, Piek et al. led a study to determine if the quality of motor skills in children birth-age 4 was an indicator of future motor and cognitive performance when the children reached school age. Their investigation revealed motor skill performance at a young age (birth-age 4) predicted cognitive development in school-aged children.

According to Miller, Franzen and Lieberman (2010), a non-profit organization, known as “A Chance to Grow,” designed a study to determine the impact of research-based motor activities on young children attending Head Start (a program for preschool students coming from a low income homes) throughout Minnesota. The organization modified their sensorimotor curriculum (S.M.A.R.T.: Stimulating Maturity through Accelerated Readiness Training) used with elementary school-age children, so it could be used with Pre-K students in Head Start programs. The results indicated participation in the motor program had a positive effect on early cognitive development; the children in classrooms which utilized the S.M.A.R.T. curriculum, scored higher on early literacy and school readiness assessments than the control group. Teachers also described the students participating in S.M.A.R.T. as able to learn faster, focus and concentrate better, and learn letters and shapes faster. This study also determined that third grade students who participated in the program while in Head Start (preschool) maintained a higher academic level than peers who did not participate in the program. Studies support the notion that movement aids in learning, but modern society lacks the needs/wants for physical movement.

### **Modern Society and Movement**

Even though our bodies are made for moving and studies indicate the benefits of physical movement, on the body, and the brain, Hillman (2014) reported a cultural shift toward more sedentary lifestyles; lifestyles which allow individuals to provide excuses to be stationary, such

as video games or studying. Studies indicate many adults are aware of the health benefits of physical activity, but continue to lead less active lifestyles (Stevens-Smith, 2016).

Unfortunately, children are following in the footsteps of adults, according to the Center for Disease Control and Prevention (CDC; 2017). The CDC recommends children and adolescents (aged 6 to 17), should have 60 minutes or more of physical activity each day. However, only 21.6% of children and adolescents (ages 6 to 19) in the United States get 60 minutes or more of moderate to vigorous physical activity on at least 5 days per week. That means more than 75% of children and adolescents are not physically moving, which is having a direct effect on their cognitive performance, without their knowledge.

Children attending public schools in the United States are also getting less time for movement in school as schools need to make more time for academics. According to Savina et al. (2016), since the passage of the No Child Left Behind Act in 2011, 44% of United States public elementary schools reduced physical education and recess time for the students. The cuts were made in an effort to give students more time to study academics, such as math, science, and English, to assist them in passing exams set forth by the No Child Left Behind Act (Ratey, 2008). According to the School Health Policies and Programs Study (SHPPS) (2014), 69.3% of elementary schools, 83.9% of middle schools, and 95.2% of high schools required students to attend physical education classes. Of those schools, only 3.6% of elementary schools, 3.4% of middle schools, and 4.0% of high school students received the recommended amount of daily formal physical education within the school setting. The Center for Disease Control and Prevention (CDC) recommends that all elementary school students participate in at least 150 minutes per week of physical education and that all middle and high school students participate in at least 225 minutes per week of physical education per week for the entire school year (36

weeks). In addition, the U.S. Department of Human Services (2017) reported only six states (Illinois, Hawaii, Massachusetts, Mississippi, New York, and Vermont) require physical education in every grade from Kindergarten through grade 12.

As a result of less physical activity and more studying in school, Donnelly and Lambourne (2011) reported children spend approximately 6-8 hours of sitting while at school, which does not include time sitting at home due to increased sedentary lifestyles and time spent sitting on the school bus. The lack of physical exercise has even spread to early childhood classrooms; preschool children spend about 43 minutes of every hour sitting (Savina et al., 2016). In addition to sitting at school to learn, it is estimated children spend between 5.5 hours to 7.5 hours per day in front of a screen, such as computer, television, video games, or handheld device (Ratey, 2008; U.S. Department of Health & Human Services, 2017).

As research presents, children of this day and age spend a great deal of time sitting or participating in non-physical activities. However, what parents, teachers, and even older students do not realize is while a person sits for 20-30 minutes, 80% of blood pools in the hips. Research dictates humans need oxygenated blood going to the brain to learn, so if the blood is in the hips and not helping the brain, learning becomes more difficult (Stevens-Smith, 2016).

The facts about reduced physical activity and the sedentary lifestyle are disturbing and seem to reflect the notion that movement and physical activity are not important for academic success. However, research shows learning is enhanced by physical activity (Savina et al., 2016). In fact, as stated earlier in this paper, the same portion of the brain (cerebellum) responsible for movement has also been found to be responsible for learning. Adding extra physical time does not decrease academic performance. In fact, quite the opposite occurs; additional movement increases cognition (Savina et al., 2016).

## **Implications for Educators**

So, what does this research mean for early childhood and Kindergarten teachers? The bottom line is educators need to get their students moving in the classroom. Use movement breaks, such as Brain Gym, yoga, etc. to incorporate movement into the classroom and get the students' blood flowing. When children are moving, they are not only developing their motor skills, they are developing cognitive skills (Hannaford, 2005). As stated earlier, The NAEYC (2009) recommended that teachers plan their curriculum experiences to “integrate learning within and across all domains (physical, social, emotional, and the disciplines (including language, literacy, mathematics, social studies, science, art, music, physical education, and health)” (p. 21).

## **Conclusion**

This paper addressed how children's brain development relates to their five domains of development--cognitive, motor, communication, adaptive, and social-emotional. It described the construction of the brain and how the brain is wired, pointing out the influences that affect wiring and cognition. It demonstrated the importance of physical movement on integrating reflexes, learning and cognition, and provided research to support the importance. Lastly, it explained how our modern society is engaging in more sedentary/less physically active lifestyles and what all of this information means to an educator.

In the following chapter, I review the purpose of my study to determine if 10 minutes of additional physical movement every school day for 18 weeks affects cognitive development (pre-literacy skills) on Kindergarten students. I discuss the research design, research question, setting, and participants. Lastly, the chapter includes data collection procedures and data analysis of this study.

## **Chapter 3: Methods**

### **Opening**

In the years from birth leading to adolescence, a child learns through stimulation and sensory experiences, indicating that movement is major component for learning. However, with the seemingly steady increase in school content standards and expectations for children to perform at higher levels academically, the focus is on academics with less time is available for movement activities, such as recess, free play, or physical education class. Considering the extensive research on child development, learning and brain development occur across all domains and are dependent on each other from birth through adolescence. For instance, gross motor skills affect cognition and social emotional skills, while language development can impact cognition and social skills too. The purpose of this study was to determine if 10 minutes of additional physical movement every school day for 18 weeks affects cognitive development, specifically pre-literacy skills, such as letter naming fluency and first sound fluency, on Kindergarten students as measured by DIBELS Next pre and post assessments.

### **Research Design**

The research design involves the participation of 20 students, with parental consent, from one Kindergarten classroom located in a central Minnesota public school. Out of the 20 students, 10 students were randomly chosen as the experimental group to participate in the S.M.A.R.T. course movement curriculum and the remaining 10 students were the control group. All 20 students were administered the DIBELS Next Assessment, which assesses pre-literacy skills (first sound fluency and letter naming fluency) in Kindergarten at the beginning of the 2017-2018 school year. These scores were used as the baseline to determine if additional movement activities increase cognition. After the pre-assessments were completed, the

experimental group began participating in the structured physical movement curriculum lead by a trained professional in a separate classroom (the “motor room”), while the control group utilized their time in the general education classroom engaging in free play for 18 weeks. Free play consisted of the students’ options to use the same academic materials as the experimental group, and playing academic games, but in an unstructured setting. Both groups had adults to assist them with the academic pieces if needed. After the DIBELS Next post-assessment in January, 2018, the assessment scores were obtained. The quantitative data collected from the DIBELS Next assessments were compared to determine whether the experimental or the control groups increased in their DIBELS scores. After the DIBELS Next pre-assessment in September, 2017, the assessment scores were obtained and the mean scores of the groups (experimental and control) were calculated in the areas of First Sound Fluency, Letter Naming Fluency, and Composite Score. The DIBELS Next post-assessment was administered in January, 2018, and the mean scores were calculated in the areas listed previously. Then the scores from both assessments were utilized to calculate the mean percentage increase in scores in the same three areas.

### **Research Question**

The research questions for this study are as follows:

1. Does 10 minutes of S.M.A.R.T. movements practiced daily in school over an 18 week period have an effect on pre-literacy test scores, specifically letter naming fluency and first sound fluency, as measured by DIBELS Next for Kindergarten students?
2. What areas of pre-literacy test scores are affected by SMART movements practiced daily in school for Kindergarten students?

## **Setting**

The study was conducted within one Minnesota Kindergarten classroom located in central Minnesota. The control group remained in the Kindergarten general education classroom and participated in free play, while the experimental group participated in the S.M.A.R.T. curriculum in the “motor” room. Free play consisted of the students having the option to use the same academic materials as the experimental group to play academic games in an unstructured setting.

## **S.M.A.R.T. Course Movement Curriculum**

According to Miller et al. (2010), S.M.A.R.T. (*Stimulating Maturity through Accelerated Readiness Training*) is a physical movement curriculum that uses specific movements to provide brain stimulation associated with increased learning, specifically in the areas of learning readiness and early literacy skills. This program is a multi-sensory approach to learning designed to be completed 30 minutes daily by children (80 hours during the school year). Children can participate in 30 minutes of S.M.A.R.T. course activities in one 30-minute block of time or the 30-minute time span can be broken into segments throughout the day. The S.M.A.R.T curriculum consists of individual exercises set up in the form of an obstacle course with each exercise designed to promote the development of skills necessary for reading. The obstacle course can be set up in a regular classroom or a specific location/room for these activities. The specific movements used are designed to promote the development of visual tracking, auditory skills, enhance body awareness, eye-hand coordination, balance, fine motor abilities and integrate primitive reflexes. Physical movements used in this curriculum include crawling, spinning, balancing, jumping, hanging from a bar, and yoga poses, just to name a few.

Students in the experimental group of this study will participate in the S.M.A.R.T. course 10 minutes daily after arrival to school for 18 weeks in a separate classroom called “the motor room.” The S.M.A.R.T. course will be changed monthly to ensure the course is fun and challenging for students. Activities in which they will participate/engage include the helicopter spin, alligator crawl, walking on the balance beam, hanging from a bar, using the slap track, jumping on a trampoline, just to name a few. Refer to Appendix B for a listing and description of activities used during the months of September through January.

### **Participants**

Participants in this study included 20 Kindergarten students, ranging in age between 5 and 6 years old. These students attended a public school in central Minnesota all day (8 a.m.—3 p.m.), Monday through Friday during the school year and on scheduled school days. Participants were randomly chosen for the experimental group to participate in the S.M.A.R.T. course curriculum. The 10 students in the experimental group consisted of five boys and five girls. Of the 10 students, six students came from two-parent homes, four students from a split household, three students received special education services, and two students received Title 1 Intervention services. The control group consisted of four girls and six boys. These students all came from a two-parent home; one student received special education services, and four students received Title 1 Intervention services. Elementary school district consensus information for the 2017-2018 school year indicates the families attending school in the district were 2.3% minorities, 30.7% of families received free or reduced lunches, 18.2% received special education services, and 0% are English Language Learners.

## **Data Collection**

DIBELS Next is the assessment tool that was used for data collection for this study. All 20 Kindergarten students included in this study were tested on First Sound Fluency (FSF) and Letter Naming Fluency (LNF) at the beginning of the year to obtain baseline data. They were assessed again in the middle of the school year (January) for FSF and LNF to obtain data to compare growth between the experimental group and control group.

DIBELS Next stands for Dynamic Indicators of Basic Early Learning Literacy Skills and is a widely used standardized assessment tool used to measure the acquisition of early literacy skills from kindergarten through sixth grade. This tool is administered individually to students from trained professionals (not the students' teacher) three times per year (beginning, middle, and end of the year). It is designed to help teachers identify students having difficulties acquiring basic early learning literacy skills and monitor students' literacy growth over the school year.

At the beginning of the year, Kindergarten students are administered the First Sound Fluency (FSF) and Letter Naming Fluency (LNF) assessments, which takes about 3 minutes per student to complete. In the middle of the year (January), kindergarten students are administered the previous two assessments, plus Phoneme Segmentation Fluency (PSF) and Nonsense Word Fluency (NWF), which takes approximately 6.5 minutes to administer to each student. At the end of the school year, students are administered Letter Naming Fluency (LNF), Phoneme Segmentation (PSF), and Nonsense Word Fluency (NWF), which takes about 5 minutes per student to administer.

The DIBELS Next assessment provides two types of scores: a raw score for each assessment area administered and a composite score, which is a combination of multiple

DIBELS scores. The composite score provides the best overall estimate of students' early literacy skills and/or proficiency. The scores are used to determine students who are meeting grade level standards and those who are struggling. The individual raw test scores also give the teachers and school administrators an opportunity to recognize the specific areas of literacy the students need additional support.

### **Data Analysis**

The quantitative data collected from the DIBELS Next assessments was compared to determine if either the experimental group or control group had a higher percentage of increase in their DIBELS scores. After the DIBELS Next assessment in September, 2017, the assessment scores will be obtained and the mean scores of the groups (experimental and control) were calculated in the areas of First Sound Fluency, Letter Naming Fluency, and Composite Score. The DIBELS Next assessment was again administered in January, 2018, and the mean scores were calculated in the areas listed previously. Then the scores from both assessments were utilized to calculate the mean percentage increase in scores in the same three areas.

## Chapter 4: Results

### Overview

Two research questions were posed for this study to determine the effects, if any, of movement on pre-literacy skills. The questions were:

1. Does 10 minutes of S.M.A.R.T. movements practiced daily in school over an 18 week period have an effect on pre-literacy test scores, specifically letter naming fluency and first sound fluency, as measured by DIBELS Next for Kindergarten students?
2. What areas of pre-literacy test scores are affected by SMART movements practiced daily in school for Kindergarten students?

To address these research questions, the students were given the DIBELS Next assessment during the second week of school in September, 2017, in the areas of Letter Naming Fluency (LNF) and First Sound Fluency (FSF). The assessment yielded scores in in those areas, along with a composite score. After the assessments were completed and scores were compiled, the experimental group participated in the S.M.A.R.T movement curriculum in a separate room from the control group for 10 minutes daily for 18 weeks, while the control group participated in free play in the classroom. The group that participated in free play had the option and availability of the same academic materials used with the experimental group and played academic games, but in an unstructured environment. After the 18-week study concluded, the students were assessed again using DIBELS Next in the same two areas of pre-literacy and also obtained a composite score. The results of the pre- and post-study assessment results are compiled and the results of this case study are presented in the following sections.

## **Narrative Results**

The experimental group and control group of students in this study were from one Kindergarten class in central Minnesota and consisted of 10 students each, who were administered the DIBELS Next Assessment yielding scores in Letter Naming Fluency (LNF), First Sound Fluency (FSF) and an overall composite score for the pre-literacy skills. In an effort to answer both questions posed for the study, the results of the DIBELS Next assessments for the experimental and control group were segmented into the three areas listed above, which were covered by this standardized test.

In the area of Letter Naming Fluency (LNF), the experimental group generated a mean score of 23.6 pre-study (September, 2017) and a mean score of 44.6 post-study (January, 2018), which yielded an average increase in LNF score of 89%. The control group earned a pre-study mean score of 28.5 and a post-study mean score of 47.6, achieving an average increase in LNF score of 67%. Based on assessment results, 10 minutes of S.M.A.R.T. movements daily over an 18-week period had a positive effect on pre-literacy test scores in the area of Letter Naming Fluency, as measured by DIBELS Next assessment. See Table 1 in the next section for more information on Letter Naming Fluency.

In the area of First Sound Fluency (FSF), the experimental group generated a mean score of 18.7 pre-study and a mean score of 40.5 post-study, which yielded an average increase in FSF score of 116.5%. The control group earned a pre-study mean score of 16.7 and a post-study mean score of 43.5, achieving an average increase in FSF score of 160%. Based on assessment results, 10 minutes of S.M.A.R.T. movements daily over an 18-week period did not have a positive effect on pre-literacy test scores in the area of First Sound Fluency, as measured by

DIBELS Next assessment. See Table 2 in the next section for more information on Letter Naming Fluency.

Based on the mean composite scores, which were calculated by adding the mean total scores from LNF and FSF, the experimental group generated a mean score of 42.3 pre-study and a mean score of 85.1 post-study, which yielded an average increase in the composite score of 101.2%. The control group achieved a pre-study mean score of 45.2 and a post-study mean score of 91.1, achieving an average increase in the composite score of 101.5%. The assessment results indicate 10 minutes of S.M.A.R.T. movements daily over an 18-week period did not have a positive effect on pre-literacy test scores on the composite score, as measured by DIBELS Next assessment. See Table 3 in the next section for more information on the composite score and the tables and graphs in the following section for visual comparisons of the scores.

## Numeric Results

**Table 1**

### Mean Score of Letter Naming Fluency DIBELS Next Assessment Results

Student Group	Number of Participants n=	Experimental Group Mean Scores of Letter Naming Fluency (LNF)		
		September 2017 (pre-study)	January 2018 (post-study)	% Increase of scores
Experimental	n=10	23.6	44.6	89%
Control Group	n=10	28.5	47.6	67%

**Table 2****Mean Score of First Sound Fluency DIBELS Next Assessment Results**

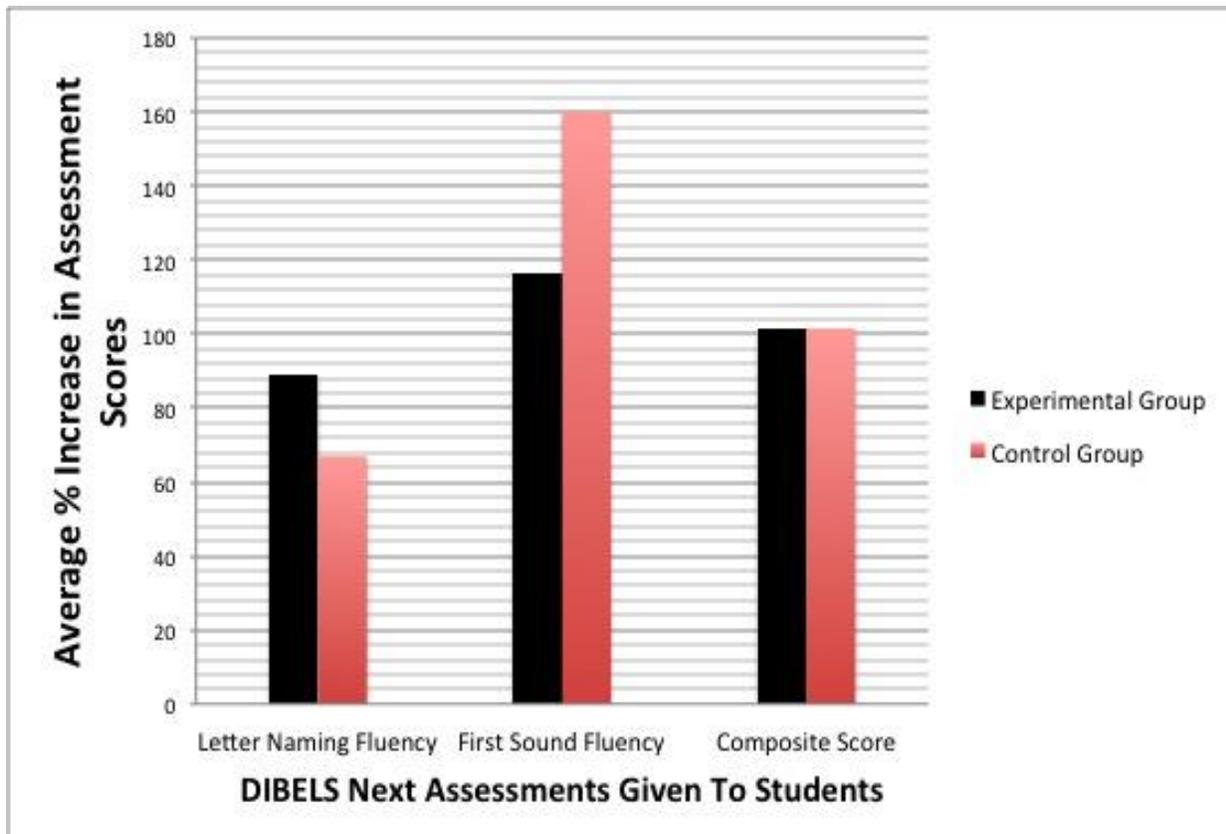
Student Group	Number of Participants n=	Experimental Group Mean Scores of First Sound Fluency (FSF)		
		September 2017 (pre-study)	January 2018 (post-study)	% Increase of scores
Experimental	n=10	18.7	40.5	116.5%
Control Group	n=10	16.7	43.5	160%

**Table 3****Mean Score of Composite Score on DIBELS Next Assessment**

Student Group	Number of Participants n=	Experimental Group Mean of Composite Scores		
		September 2017	January 2018	% Increase of scores
Experimental	n=10	42.3	85.1	101.2%
Control Group	n=10	45.2	91.1	101.5%

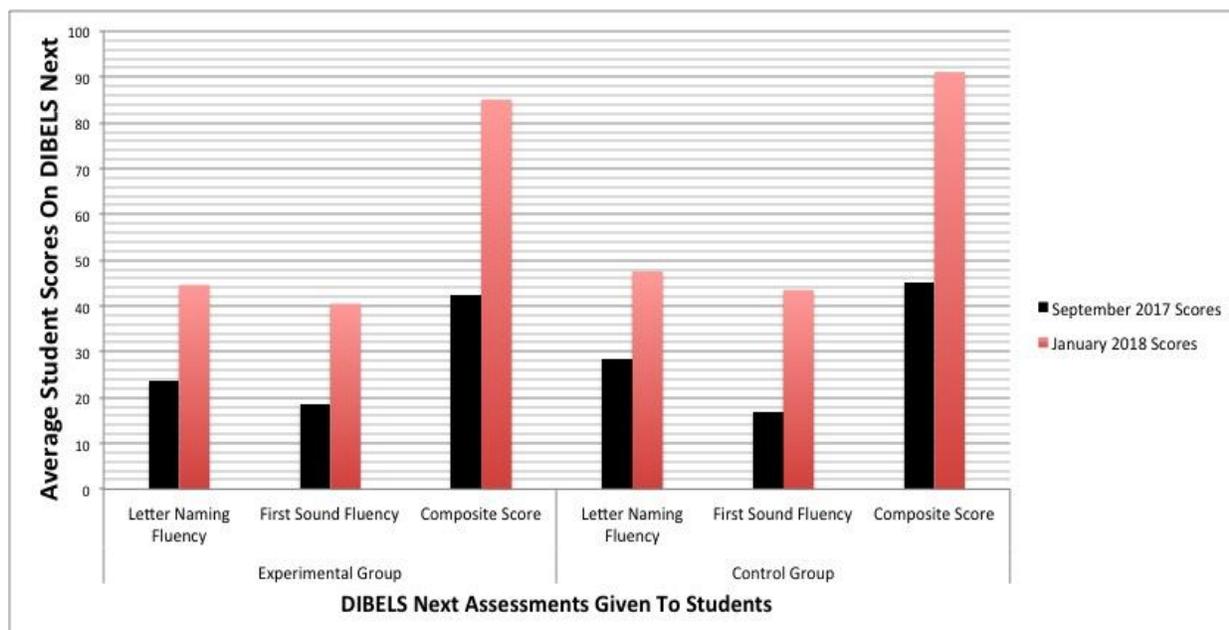
Figure 1

## Mean Percentage of Increase on Assessment Scores



**Figure 2**

**Mean Student Scores on DIBELS Next Assessments - Divided into Experimental and Control Group**



**Conclusion**

Results of this study indicate participation in 10 minutes of S.M.A.R.T. movements daily over an 18-week period had a positive effect on pre-literacy test scores in the area of Letter Naming Fluency. In the area of First Sound Fluency, the results of the study indicate the additional movement activities did not have a positive impact on pre-literacy test scores. The overall average composite score reveals participation in the S.M.A.R.T. movement curriculum did not have a positive effect on all pre-literacy skills.

## Chapter 5: Discussion

### Overview

The primary purpose of this study was to determine if additional specific physical movements would increase students' cognitive abilities in the area of pre-literacy. As an early childhood special education teacher, I am continuously searching for additional methods and techniques to teach the whole child, meaning all developmental areas. With the added pressures to increase test scores, with less time to move, I continue to investigate different opportunities to add movement back into the classroom. Not only do I want my students to learn through movement, I want to have an influence on their lives to get them moving more, which can lead to a healthy adult lifestyle.

Based on past research, a child begins to develop cognition in utero with the development of the brain. Brain development can be influenced by expectant parents' lifestyle, such as what they eat, drink, breathe, smoke, pop, sniff, their emotional state, their socioeconomic status, and stress level. Lifestyle choices, such as drug, alcohol, poor nutrition, and violence, prior to conception can also have a direct impact on eggs and sperm (Diamond & Hopson, 1999). Researchers also previously believed a child's brain was fully developed at birth. However, after extensive studies, scientists determined the brain continues to develop after birth based on the child's experiences (Brotherson, 2009).

Studies indicate the human brain develops after birth through experiences with the outside world (Fields, 2011). As a child's brain develops, he acquires skills in the five domains of child development: Cognition, Communication, Motor, Social-Emotional, and Adaptive. These skills include the gradual, yet rapidly developing abilities to crawl, walk, speak, eat, laugh, play with others, and independently eat, dress, bathe and use the toilet, among many other skills.

However, the development of skills can be influenced by outside factors, such as food and nutrition, responsiveness of caregivers, daily experiences, physical activity, and love (Brotherson, 2009).

More research has revealed the portions of the brain responsible for cognition are also responsible for movement. The cerebellum is known for the importance in motor development, but more recent studies indicate the cerebellum is also important for cognitive skills. The prefrontal cortex is related to cognition, but may play a role in motor function (Savina et al., 2016). These studies related to the brain indicate cognition and movement may be interrelated.

Many studies have been conducted on the positive interrelationship between physical activity and learning from birth through adulthood. The studies investigated topics such as academic performance, obesity, cardiovascular fitness, blood pressure, depression, anxiety, self-concept, and bone density (Janssen & LeBlanc, 2004; Ratey, 2008). These studies concluded physical activity had a positive effect on memory, concentration, classroom behavior, along with having a strong positive correlation between aerobic fitness, standardized test scores, and grades (Castelli et al., 2007; Janssen & LeBlanc, 2004; Ratey, 2008). Students participating in the S.M.A.R.T. curriculum preschool study scored higher on early literacy and school readiness assessments in letter naming fluency than the control group. Teachers described those students as able to learn faster, focus and concentrate better, and learn letters and shapes faster. Third grade students who participated in the S.M.A.R.T. curriculum while in Head Start preschool maintained a higher academic level than peers who did not participate in the program in preschool (Miller et al., 2010).

### **Thoughts on Study Findings**

Overall, this study indicated participation in 10 minutes of S.M.A.R.T. movements daily over an 18-week period had a positive effect on pre-literacy test scores in the area of Letter Naming Fluency. In the area of First Sound Fluency, the results of the study indicate the additional movement activities did not have a positive impact on pre-literacy test scores. The overall average composite score reveals participation in the S.M.A.R.T. movement curriculum did not have a positive effect on all pre-literacy skills.

The positive correlation between the movements and the higher pre-literacy test scores in letter naming fluency may be the result of the experimental group engaging in structured movement activities paired with one letter naming activity (out of 12-16 activities) daily. While the control group had access to the same materials, they were not required to use the materials and interact with them. Both groups had the same amount of support for the letter naming activities. If students in either group had a question regarding a letter in the activity, a teacher was available to answer their questions.

### **Limitations of Study**

Four limitations of this study were identified, which include lack of student attendance, limited daily exposure to the S.M.A.R.T. curriculum, length of the study and the sample size. The first limitation involves the lack of student attendance in the experimental group. One student was absent 11 days during the study, two students were absent 6 days, two students were absent 5 days, one student was absent 3 days, and two students were absent 2 days. Eight out of 10 students missed 2-11 days participating in the movement curriculum. Four out of 10 students in the control group were absent from school 1-2 days. Three students missed 1 day each and one student missed 2 days.

The second limitation is the S.M.A.R.T curriculum is designed for 30 minutes of specific movements daily for the school year, which equates to 80-90 hours of participation. My students participated in the S.M.A.R.T. curriculum a maximum of 15 hours, but many participated for less time due to attendance issues.

The length of the study is the third limitation. Studies relating to the increased effects of physical movement on cognitive skills are studied for a minimum of 1 school year. This study ended in 18 weeks, as the Kindergarten students began switching classrooms and teachers for reading based on their current skill level.

The small sample size of 10 students in each group is the last limitation to this study. Through a random drawing, students were placed in either the experimental group or the control group. The experimental group consisted of three special education students, two Title 1 intervention students, and four students coming from a split home. All of these situations can cause lower cognitive progress in academic situation. The control group consisted of three Title 1 intervention students, one special education student, and all students coming from a two-parent home.

### **Next Steps in Research**

More research needs to be conducted on the effects of movement on cognitive abilities. Many of these students in this study have varying ability levels, which is common when utilizing the help of students from one general education classroom. I propose to use the current pre-study data (with permission), group students in the experimental group and control group together based on the similar pre-study scores and then analyze the data to determine if the students in participating in the 10 minutes of S.M.A.R.T movements daily over an 18-week

period have an effect on pre-literacy test scores, specifically letter naming fluency and first sound fluency, as measured by DIBELS Next.

I would also suggest, using the current data from this study and analyze the math data of these two group to determine if utilizing the S.M.A.R.T. curriculum over an 18-week period had an effect on math test scores, as measured by AIMSweb standardized test.

The last step I propose is to complete this study again with classroom of students who are placed in a classroom based on their academic performance. For example, use a classroom of students who are deemed to have similar reading skills and placed in the same reading class/group. Half the class would be randomly chosen for the experimental group and the other half of the class would be the control group. While the experimental group went to the motor room to participate in the S.M.A.R.T. movement curriculum, the remainder of the class would have 10 minutes of free play.

## **Conclusion**

The results of my research study indicate that 10 minutes of S.M.A.R.T. movements daily over an 18-week period does have a positive effect on pre-literacy scores in the area of Letter Naming Fluency, but does not have a positive correlation with the scores of First Sound Fluency and the composite score. I believe that a longer research period would support current research in this area. This information will not discourage me, as I will continue to use the S.M.A.R.T curriculum with my special education students since research deems physical activity helpful in working the body and brain, along with having a positive impact on mood, attention, self-esteem, and social skills, which are disorders that many of students also suffer from.

I feel very strongly about keeping our children moving and active to promote learning and a healthy lifestyle, especially in a society that is shifting toward a sedentary lifestyle.

Children attending public schools are expected to continually perform better on literacy, math, and other tests, while getting less time to experience movement throughout their day. With the amount of curriculum a teacher needs to provide daily, it is becoming more difficult to give students time to move. So, in addition to sitting for hours at home, children come to school and sit even more, which I believe based on research unpurposefully negatively affects their cognition skills and learning ability. Physical movement is more than getting your body in shape; it is also about shaping the mind.

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## Appendix A

### IRB Approved Parental/Guardian Consent Form

#### Physical Movement and the Impact on Pre-literacy Skills Parental/Guardian Consent Form

Dear Parent(s),

Your child is invited to participate in a research study related to physical movement and the impact it has on pre-literacy skills. Your child was selected as a possible participant because he/she is a Kindergarten student at Foley Elementary School. This research project is being conducted by Sandy Kiekow, teacher at Foley Public Schools, to satisfy the requirements of a Master's Degree at St. Cloud State University. This form must be signed and returned to school before your child can participate in the study.

**Background Information and Purpose:**

The purpose of this study is to determine if additional movement activities during a child's school day will increase pre-literacy skills.

**Procedures:**

One Kindergarten class from Foley Elementary School will be selected for the study. Prior to the start of additional movement activities, all participating children will be assessed on pre-literacy skills using the DIBELS Next Assessment (all Kindergarten students will partake in even if they do not participate in the study). Once the parental consent forms are returned, the participants will be randomly placed in a "control" group and an "experimental" group. The "experimental" group will participate daily in a 10 minute motor curriculum called S.M.A.R.T (Stimulating Maturity through Accelerated Readiness Training) course for approximately 18 weeks. The S.M.A.R.T. curriculum is an obstacle course that will change monthly. The "control" group will finish morning work while the "experimental" group is going through the S.M.A.R.T course. At the end of the 18 weeks, both groups will be re-assessed using the DIBELS Next assessment and the results will be compared to see which group had a higher percentage of change in their DIBELS score.

**Benefits of the research:**

The data collected during this study will be used to compare pre and post test pre-literacy skills. The data collected will be used for educational purpose and possible future curriculum planning.

**Risks:**

There are no foreseeable risks associated with participating in this study.

**Confidentiality:**

Information obtained in connection with this study is confidential and will be reported using groups/numbers, in place of names.

**Voluntary Participation/Withdrawal:**

Participating in this study is completely voluntary. You can withdraw your child at any time during the study. The decision whether or not to participate will not affect your or your child's current or future relations with St. Cloud State University, or the researcher.

**Contact Information:**

If you have questions about this research study, please contact me, Sandy Kiekow at [rosa1302@stcloudstate.edu](mailto:rosa1302@stcloudstate.edu) or 320-968-6174. You may also contact my advisor, JoAnn Johnson at St.

Cloud State University at [jjohnson@stcloudstate.edu](mailto:jjohnson@stcloudstate.edu).

**Research Results:**

At your request, I am happy to provide a summary of the research results when the study is completed. Upon completion of my thesis, it will be placed on file at St. Cloud State University's Learning Resource Center.

Your signature indicates that you have read the information provided here and have decided to participate. You may withdraw from the study at any time after signing this form. A signed copy of the consent form will be sent home with your child.

Thank you in advance for your support as I work to complete my Master's Degree at St. Cloud State University.

\_\_\_\_\_  
Student Name (Printed)

\_\_\_\_\_  
Parent(s)/Guardian(s') Name (Printed)

\_\_\_\_\_  
Parent(s)/Guardian(s') Signature

\_\_\_\_\_  
Date

St. Cloud State University  
Institutional Review Board  
Approval date: 8/10/17  
Expiration date: 8/09/18

## Appendix B

### S.M.A.R.T. Course Monthly Descriptions

#### September/October SMART Course Activities

1. As a whole group, do the popcorn (yoga pose). Students spread out in the motor room. I tell them to hug their legs with their arms and pull their head up to their knees. Then we count from 20 back to 1. After we say 1, we say “pop” and the students “pop” out of their position. Then they lay on their backs while they slowly count to 5 (for them to rest between sets). Repeat this movement 1 more time.
2. As a whole group, do Superman (yoga pose). Ask a student where they want to fly; then tell the group: “we are going to fly to \_\_\_\_\_. Arms up, legs up, let's fly.” Then count from 20 to 1; students should be counting with you. When you get to 1, they relax for 5 seconds while you count to 5. Then repeat the process, but tell them “we need to fly back to school. Arms up, legs up, let's fly” Count from 20 to 1. Relax for 5 seconds.
3. Students line up to walk on the “balance beam.” Walking heel to toe.
4. Hanging bar. Hang on the bar for 5 seconds (they count to 5). Their fingers are over the bar and thumb under the bar; then they hang there.
5. Slap track. They crawl on the mat, look at each picture and say the color while they slap the picture. They do this all the way across the mat.
6. Jump on half ball. They count to 10.
7. Alligator crawl. Stomachs are on the mat and they use their hands to pull and feet to push them along the clear track. Hands should reach toward the blue tape (center of the mat).

8. Mini Trampoline. They say the alphabet while bouncing on the trampoline. Some students may need help with this.
9. Alligator crawl again, but they go under the swing already hanging from the ceiling in the motor room.
10. Pencil roll. Using both hands, each child holds a ring above their head and keep their feet together while rolling the full length of the blue mat.
11. Green mat to do jumping. Students stand with feet together, bend their knees, swing their arms and jump. They work on landing on both feet together. They continue to jump the full length of the green mat. The students continue this obstacle course for 10 minutes and then line up to go back to class.
12. Repeat the course starting with the balance beam again (#3).

### **November SMART Course Activities**

1. Do helicopter spins. Students spread out in the motor room. They turn to their right for 15 seconds; stop for 15 seconds; then turn to their left for 15 seconds and rest for 15 seconds. This can be repeated 8-10 turns, but will start with only 2 turns (1 to right, 1 to left).
2. As a whole group, do Down Dog (yoga pose). They do this activity once and count to 20 while holding that position.
3. As a whole group do Table (yoga pose). Students do this activity once and count to 20 while holding this position.
4. Walk on colored balanced beam walking heel to toe and saying the colors as they walk on them.

5. Walk on colored balanced beam walking heel to toe and saying the colors as they walk on them.
6. Hanging bar. Hang on the bar while saying the shapes on the learning ladder (poster in front of hanging bar). Say shapes from bottom to top. Note: Students' fingers are over the bar and thumb under the bar; then they hang there.
7. Slap track. They crawl on the mat, look at each color word and say the color while they slap the picture. They do this all the way across the mat.
8. Jump on half ball. Jump on left foot while reading letters from one learning ladder (reading from the bottom up); then jump on right foot while reading the second learning ladder (reading from the bottom up).
9. Alligator crawl. Stomachs are on the mat and they use their hands to pull and feet to push them along the clear track. Hands should reach toward the center of the mat.
10. Crossing Midline and Counting. Student touches their right hand to opposite hand on poster; then their left hand to opposite hand on poster. Continue to do this while counting to 30.
11. Scanning for Turkeys. Stand on the X with your feet together. Draw a continuous line with pointer finger under each row of pictures and circle around every turkey.
12. Alligator crawl under the swing.
13. Bear crawl the length of the blue mats.
14. Green mat to do jumping. Students stand with feet together, bend their knees, swing their arms and jump. They work on landing on both feet together. They continue to jump the full length of the green mat.

15. Throw bean bags up. Students pick one bean bag and throw it up in the air with both hands and catch with both hands. While they throw it up, they should be saying the color, shape, letter, or number that is on the bean bag.
16. Vertical Line tracing. Stand on the “x” in front of the poster board. With both hands together and isolating pointer fingers from both hands (and locking other fingers), trace the lines with pointer fingers. Start with the lines on the left working to right and trace from the top to bottom.
17. Repeat the course starting with the balance beam again (#4).

#### **December SMART Course Activities**

1. As a whole group, do helicopter spins. Students spread out in the motor room. They turn to their right for 15 seconds; stop for 15 seconds; then turn to their left for 15 seconds and rest for 15 seconds. This can be repeated 8-10 turns, but will start with only 2 turns (1 to right, 1 to left).
2. As a whole group, do the popcorn (yoga pose). Students spread out in the motor room. Tell them to hug their legs with their arms and pull their head up. Then we count from 20 back to 1. After we say 1, we say “pop” and the students “pop” out of their position. Then they lay on their backs while you slowly count to 5 (for them to rest between sets). Then repeat this movement 1 more time.
3. As a whole group, do Superman (yoga pose). Ask a student where they want to fly; then tell the group: “we are going to fly to \_\_\_\_\_. Arms up, legs up, let's fly.” Then count from 20 to 1; students should be counting with you. When you get to 1, they relax for 5 seconds while you count to 5. Then repeat the process, but tell them “we need to fly back to school. Arms up, legs up, let's fly” Count from 20 to 1. Relax for 5 seconds.

4. Walk on the balance beam walking heel to toe. Try walking with arms at your sides.
5. Hanging bar. Hang on the bar while saying the shapes or color words on the learning ladder (poster in front of hanging bar). Say shapes from bottom to top. Note: Students' fingers are over the bar and thumb under the bar; then they hang there.
6. Slap track. They crawl on the mat, look at each color word and say the color while they slap the picture. They do this all the way across the mat.
7. Jump on half ball. Jump on left foot while reading letters from one learning ladder (reading from the bottom up); then jump on right foot while reading the second learning ladder (reading from the bottom up).
8. Alligator crawl. Stomachs are on the mat and they use their hands to pull and feet to push them along the clear track. Hands should reach toward the center of the mat.
9. Crossing Midline and Counting. Student touches their right hand to opposite hand on poster; then their left hand to opposite hand on poster. Continue to do this while counting to 30.
10. Scanning the winter scene. Stand on the X with your feet together. Draw a continuous line with pointer finger starting at the top of the picture on the black line and trace to the end of the black line.
11. Alligator crawl under the swing.
12. Crab walk the length of the blue mat. Start on your bottom and push up on to arms and legs and walk forward or backward maintaining bottom off of the ground.
13. Walk across stepping stones saying the colors of the stones.
14. Balance on each foot up to 5 seconds each.

15. Horizontal line tracing. Stand on the “x” in front of the poster board. With both hands together and isolating pointer fingers from both hands (and locking other fingers), trace the lines with pointer fingers. Left to right and top line to bottom tracing.
16. Repeat the course starting with the balance beam again (#4).

### **January SMART Course Activities**

1. As a whole group, do helicopter spins. Students spread out in the motor room. They turn to their right for 15 seconds; stop for 15 seconds; then turn to their left for 15 seconds and rest for 15 seconds. This can be repeated 8-10 turns, but will start with only 2 turns (1 to right, 1 to left).
2. As a whole group, do the popcorn (yoga pose). Students spread out in the motor room. Tell them to hug their legs with their arms and pull their head up. Then we count from 20 back to 1. After we say 1, we say “pop” and the students “pop” out of their position. Then they lay on their backs while you slowly count to 5 (for them to rest between sets). Then repeat this movement 1 more time.
3. As a whole group, do Superman (yoga pose). Ask a student where they want to fly; then tell the group: “we are going to fly to \_\_\_\_\_. Arms up, legs up, let's fly.” Then count from 20 to 1; students should be counting with you. When you get to 1, they relax for 5 seconds while you count to 5. Then repeat the process, but tell them “we need to fly back to school. Arms up, legs up, let's fly” Count from 20 to 1. Relax for 5 seconds.
4. Walk on the balance beam walking heel to toe. Try walking with arms at your sides.
5. Hanging bar. Hang on the bar while saying the shapes or color words on the learning ladder (poster in front of hanging bar). Say shapes from bottom to top. Note: Students’ fingers are over the bar and thumb under the bar; then they hang there.

6. Slap track. They crawl on the mat, look at each number and say the number while they slap the picture. They do this all the way across the mat.
7. Jump on half ball. Jump on left foot while reading letters from one learning ladder (reading from the bottom up); then jump on right foot while reading the second learning ladder (reading from the bottom up).
8. Alligator crawl. Stomachs are on the mat and they use their hands to pull and feet to push them along the clear track. Hands should reach toward the center of the mat.
9. Crossing Midline and Counting. Student touches their right hand to opposite hand on poster; then their left hand to opposite hand on poster. Continue to do this while counting to 30.
10. Wall pushups. Stand on the X with your feet together, put your hands on the wall and do push-ups against the wall. Do 20 of these and then move to the next station.
11. Alligator crawl under the swing.
12. Crab walk the length of the blue mat. Start on your bottom and push up on to arms and legs and walk forward or backward maintaining bottom off of the ground.
13. Walk across mini colored hurdles and say the colors as you step over them.
14. Balance on each foot up to 5 seconds each.
15. Horizontal line tracing. Stand on the “x” in front of the poster board. With both hands together and isolating pointer fingers from both hands (and locking other fingers), trace the lines with pointer fingers. Left to right and top line to bottom tracing.
16. Repeat the course starting with the balance beam again (#4).

To view pictures/purchase visuals of the many activities, go to [www.actg.org](http://www.actg.org) and click on products.