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The Impact of Movement on Student Learning and Engagement

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THE IMPACT OF MOVEMENT ON STUDENT
LEARNING AND ENGAGEMENT

by

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A capstone submitted in partial fulfillment of the
requirements for the degree of Master of Arts in Education

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To my mother. Thank you for being my biggest cheerleader and always encouraging me even when I struggled or complained about the challenge. Your confidence in me convinced me that I was capable of much more than I had ever imagined. I have worked hard developing this Capstone to prove to myself that you were right. You will always be my sunshine.

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CHAPTER ONE

Introduction

Opening

Over the past decade the amount of physical movement, even physical education, has significantly decreased in public education. There is no outlet for physical release or movement for some students that are enrolled in smaller school districts. As a result, students are forced to sit for prolonged periods of time during their core subject courses and a majority of the rest of their day. The problem is that it can become difficult, even for adults, to remain engaged and enthusiastic when they do not move around. As adults the presentations we are viewing and the content covered within them is generally something we are passionate about. We are, more often than not, being paid for our participation. Even still adults can be caught dozing off, so presenters provide frequent breaks and movement opportunities. It is no surprise, then, that we struggle to engage learners when we ask that they sit for a majority of their day and for prolonged periods of time. It makes me wonder: what impact does movement have on student learning and engagement?

There are a variety of reasons that this question has been a topic of interest to me including knowledge of how the brain and our attention is altered by exercise. Another reason that this is my focus for research is requests from students for movement and physical education. They are always seeking opportunities to move around and have voiced an understanding that it positively affects their learning. During my time as a

teacher I have also been involved in a movement committee, as well as a brain and movement presentation that really piqued my interest in the topic. Possibly the greatest reason for a focus on this question is my personal experiences with learning and movement. Having seen such a dramatic decrease in physical activity during the school day the past several years concerns me, so I would like to investigate what impact, if any, it is having on student engagement and success.

Impact of Movement on the Brain

As most have read, and would agree, there are a great deal of biological benefits to movement and exercise. Boosted metabolism, weight loss, decreased risk of heart disease and diabetes are just a few. The obesity epidemic that our country faces might be enough reason to focus on movement opportunities for our students, but my focus rests on the less apparent reasons for the incorporation of movement in the school day. These lesser known, but still numerous, brain based benefits are the ones that I will focus on throughout this capstone.

Movement increases blood flow which awakens our cells so that we feel more alert and are able to focus our attention better afterwards. The hippocampus is especially worthy of note because it is the region of the brain that is responsible for learning and memory and is directly impacted by physical movement. Exercise is responsible for neurogenesis, which is the creation of new neurons. Because of the increased oxygen levels during exercise, the hippocampus is able to create new neurons which will be sustained even when the exercise has stopped (Erickson, 2010). In addition to the creation of new neurons, it is able to protect those that already exist. It is one of very few

areas in the brain that have the potential to create new neurons. These neurons are responsible for transmitting information to different areas of the brain and body (Mandal, 2014).

Requests for Activity and Movement

As mentioned, a majority of schools have drastically decreased the amount of physical movement available to students on a day-to-day basis via physical education. At the same time, with so many students in a classroom it is understandable that movement would be eliminated, or greatly minimized, to reduce the potential for disaster or distraction. Holding students in a small, contained area, limiting movement, and demanding undivided attention to less desired content areas sounds like a recipe for disaster. Several students have asked me if they can move or if there is a way that I can plan for them to move in the classroom more often. They are aware that they learn better that way, and have started advocating for their needs when it comes to their limitations and learning. Movement is an opportunity to engage more of a student's senses in the learning process, so I do my best to accommodate their needs. It is important that these opportunities be provided in our classrooms, even if we start on a small scale. With such limited opportunities to engage in physical activity throughout the day, the responsibility has fallen on us to pick up where physical education classes left off. Ultimately, it serves to benefit both the student and the appropriate function of our classroom.

At my current district we do not have well established physical education programs, but often one of the first questions from a new student is when physical education takes place. Sadly, the response is that there is no physical education class, and

instead we just have the core subjects. Additionally, over the course of the day the look of exhaustion on the students' faces increases hour by hour. After noticing this pattern, it became a point to incorporate physical movement, and kinesthetic learning, whenever possible. When these lessons take place, students are smiling, talking, working together, and noticeably enjoying their work more. The problem is that if there are only a handful of teachers in their lives that place an emphasis on movement, and find it to be integral, then they are still not receiving the movement they need to rejuvenate their bodies and re-engage themselves in their education. Since there is also minimal, if any, presence of physical education, students spend essentially seven hours a day, five days a week sitting in a chair trying to learn. This results in an alarming number of students falling asleep in class, despite having great respect for the teacher and a desire to perform well.

Movement Grant

Several years ago there was a grant awarded to my district to increase the amount of movement that took place in core subject classes. As one that had already noticed the concerning trend of decreased activity and increased expectation of motionless learning, I agreed to join the team. What I learned during my time on the movement committee was that many administrators do not see the value of providing physical movement opportunities for students, and there is an alarmingly small number of teachers that view physical movement as important. Thankfully, we were working alongside an administrator that was familiar with students that had special needs and the impact that movement can have on them. When I placed a real focus on incorporating more of these opportunities for my students, I often heard them referring to an activity that we did when

recalling information for a quiz. They would say “Oh, was that when we did the scavenger hunt?” It was powerful to see that it had stuck with them and that they could recall information from that scavenger hunt. The grant was awarded to see how it would help students learn. Unfortunately, there was not enough staff buy in to get a true sample. There were too many initiatives taking place that they could not focus on all of them with fidelity. We had been aiming to use kinesthetic learning and physical activity as a catalyst to make positive changes towards our school improvement plan of increasing reading test scores. It makes me wonder what the potential were had it been implemented with fidelity, which is why I plan to continue this research.

Movement and the Brain Presentation

While serving on the classroom movement committee, I participated in an after school professional learning presentation. During this presentation there was a great deal of information regarding the science of movement. The presenter described the impact that touching, moving, and interacting with materials had on how well a person learns something. They provided sample learning tasks for us without allowing us to use our sense of touch to see what impact it had. On the other hand, we were also provided opportunities to move and engage with the content to see how well we learned it. With few exceptions, the times we were able to engage somehow physically with the content, we were able to grasp it better. It did not seem possible that the timing was coincidental. My interest was piqued and so began my deep interest in investigating movement and engagement.

Personal Experience

Aside from my professional experience, there are a great deal of personal experiences that lead me to believe in the importance of exercise or movement in learning. When I was younger I would have considered myself a good student. I listened to lectures, did not speak out of turn, completed my homework, and respected my teachers as the experts that had something valuable to share. That being said, I often found it very difficult to stay awake. During long lectures, or even prolonged sitting during my 90 minute blocks, I found myself getting distracted and restless. There are times I remember zoning out for several minutes at a time, completely missing a concept. I would constantly shake my leg, or contort my feet and legs to provide myself some physical movement. As a very young student I could not focus or comprehend what I was reading when I was assigned to read a book unless I stood up and spun in a circle. Of course this would look strange, so I saved all of my reading for home so that I could spin in the kitchen. The point is, even what most people would consider a traditionally good, focused student would benefit from movement. Those with attention deficit/hyperactivity disorder (ADHD) or attention deficit disorder (ADD) are experiencing even more extreme versions of panic and frustration than I was and could benefit even more greatly.

On the other hand, the classes that involved a lot of movement or projects were always the most entertaining. They were also where I learned the most, intentionally or otherwise. It was easier to focus my energy on the task at hand when I was not worried about getting out the energy that I had stored. The moments and lessons that I remember most in school were the field trips, the cross-curriculum projects that required me to meet

with people and the activities that allowed me to be creative. There were also simpler lessons that required us to race to the whiteboard to answer a question. That was movement enough. The questions were the same as what would have been covered on a review worksheet, but we ran to the board. I still remember that day in health class. The concern for many content teachers, myself included, is how do we find projects or activities for each lesson? Well, sometimes that is not possible. Even if we can incorporate unrelated movement breaks, students will reap the benefits.

Conclusion

By exploring the answer to the question how does movement impact student learning and engagement, my hope is that a positive correlation may be drawn between movement and student engagement. From there it will be logical to seek new ways to incorporate movement in the day to day activities of our students. In doing so, it is my hope that students will feel more interested, rejuvenated, and capable of remaining engaged. Those methods would then be incorporated in my classroom as often as possible to improve students' feeling of success.

The basic biological responses to exercise suggest that there is a great benefit for student learning. With the creation of new neurons, the creation of new opportunities to learn are also born. The fact that exercise also promotes focus after the physical component has been completed is a great sign. Should movement prove ineffective, then one cause of unengaged behavior has been checked off of the list. If that proved to be the case, then research into alternative or improved adjustments to lessons and instruction may continue.

One talent in itself is a student's ability to display self-awareness and self-advocacy regarding their learning needs and limitations. Then using it to explain their need to move and be active speaks to the potential that their learning could be if we were able to meet their needs. There is not always the option of a physical education class in a district, but if nothing else, we can provide them an opportunity to move.

When the research begins, some of the variables in this situation include frequency of movement, length of movement, and time of movement. Outside of the physical realm, there are also variables involving subject areas such as past successes or failures, difficulty working with particular teachers, and the time of day that it is offered. Once these variables have been accounted for and isolated as effectively as possible, the impact of movement on students learning should be clear. From there it is possible to determine how to most effectively incorporate those opportunities into class each day.

CHAPTER TWO

Literature Review

Introduction

This chapter I will focus on providing research that addresses the major ideas surrounding the question, “What impact does movement have on student learning and engagement?” This chapter will share research and analysis of several major ideas which is broken into four sections. To begin, I will share some of the major changes that have taken place in terms of the level of physical activity students experience on a daily basis.

Next, I will provide research that discusses the biological impact of movement and physical activity on the brain. The articles address how specific areas of the brain are impacted, as well as how the brain as a whole is affected by movement and exercise. I will also consider how those biological influences can impact student focus, attention, and thus learning. The information is presented in this manner to provide a picture of the current state of typical student activity and contrast it to the massive impact that movement has on brain development. Some of the articles focus on kinesics in education. Specifically, they discuss how kinesthetic learning can influence interpersonal communication within the classroom and how they have the potential to further enhance learning because of a broadened bank of resources.

Then I will outline the impact that the high level of student inactivity can have on a young person. There are myriad of issues that can arise from inactivity which are

primarily physical. The articles in this section will suggest that the issues that arise physically will be of significance mentally and emotionally. Though the physical toll that a sedentary lifestyle may have on students does not directly cause mental deficits, research will show that the secondary effects on the brain are not conducive to proper learning and engagement.

The chapter will close by covering the view that staff has as it relates to the concept of movement and learning. Articles address what it is that staff find beneficial and concerning in terms of engaging students physically. Not many studies have been done specifically on staff, but interviews and related research begin to at least scratch the surface of staff feelings as they pertain to activity in their classrooms.

Recent Changes to Activity Levels in Students

Hillman, a professor of kinesiology and human health at the University of Illinois Urbana-Champaign, suggests several societal changes that have impacted the health of our youth. The suggested daily amount of activity for children aged 6-17 is 60 minutes, according to both the United States Department of Agriculture and Centers for Disease Control and Prevention. Over the course of the past several years there have been a significant number of changes in the educational system that has impacted physical education in schools, a decrease in what Hillman refers to as active transport, and an increase in the utilization of technology for entertainment (Hillman, 2014) which has made the recommended 60 minutes of accumulated movement increasingly difficult to achieve. This, Hillman claims, has an impact on the cognitive abilities of students.

Although sitting in chairs is “a relatively new invention in human history, only used for the last 500 generations” (Jensen, 2000, p. 35) the amount of time that students are expected to remain seated is on the rise. It is not our natural state, and yet it is the way that most students spend their entire day. As of 2014 only about 30% of students are given the opportunity to participate in daily physical education (Hillman, 2014). The article goes on to state that nearly 50% of students are not given an opportunity to utilize physical education classes at any point during the week. Making the lack of physical education availability even worse is the decrease in common forms of transportation to school for youth such as walking or biking. According to a study of these methods of transportation over the past several decades, the rate of active transport has dropped from 40.7% in 1969 to a number closer to 12.9% (McDonald, 2007). McDonald suggests that a significant increase in student distance from school, as well as a concern for safety are two factors that may have led to this dramatic decrease. Because students resided further from their school they were less likely, or able, to commute to school by their own means as distance would be an issue. Also, because of the increased distance that would need to be covered, students would remain in a dangerous position for longer periods of time riding alongside the road. Between an increased distance taking additional time and increasing risks to student safety, the frequency of active transport has decreased. Regardless, though, the lack of physical activity students are seeing throughout the course of their day is concerning.

The increasing utilization of, and interest in technology has also promoted a more sedentary lifestyle for young people. According to the U.S. Department of Education

National Center for Education Statistics, nearly 40% of teachers stated that their students used technology often, and another 29% suggested their students sometimes used technology (2010). This is of note because, according to Hillman, the average student spends eight hours a day utilizing technology in their free time (Hillman, 2014). If students are sedentary in leisure, and utilizing technology during school instead of being physically active, there is very little time remaining in the day for them to achieve the recommended 60 minutes of activity.

Movement and Cerebellar Development

The importance of the cerebellum and its development cannot be overstated in terms of student learning. According to the National Institute on Aging, as the part of the brain that contains over half of the neurons, it serves an important role in learning as it transmits information throughout the body (2008). The part of the brain that is responsible for educational processing and deep learning is also responsible for processing movement (Jensen, 2005). The link between activity within the cerebellum and many cognitive tasks including memory, attention, and language systems, among other things, has been shown in several studies.

Essentially, the cerebellum is home to a majority of the neurons within our bodies. The cerebellum must be utilized frequently, and strengthened, in order to optimize the effectiveness of the neurons that it holds (Jensen, 2005). There are a variety of exercises that can be utilized to support cerebellar development. Any exercises that require focus, sustained attention, or very intentional physical movements will serve to benefit the strengthening and development of the cerebellum (Weissman, 2014).

According to Weissman, cerebellar function can be improved through accompanying mental and physical exercises. There is a noteworthy connection between physical and mental acuity, so pairing them can strengthen both simultaneously (2014). What this means is that in order to grow, improve, and strengthen the portion of the brain that is responsible for student learning, students must be forced to engage in physical movement that requires focus. These movements will force students to focus thus helping the neurons work as efficiently and effectively as possible.

Function of the Prefrontal Cortex

The prefrontal cortex of the brain is responsible for the executive functions. It is in charge of planning and directing a variety of tasks including motor, cognitive, affective, and social behaviors (Kolb, et. al., 2012). Suffice it to say that the prefrontal cortex has a great deal of power in the daily functions of the human body. A group of eight and nine year old students were enrolled in an after school program that aimed to incorporate slightly more than an hour of intensive activity and determine what, if any, impact it had on the brain (Conyers, 2015). The students were given a test and brain scans before and after the program took place. When the tests were given, the results were compared and there was improvement shown in both. First, the test scores for those enrolled in the movement focused program increased after the nine month program. Additionally, the brain scans showed that the prefrontal cortexes of the students were working more efficiently than they had been prior to the nine month program (Conyers, 2015). This portion of the brain is responsible for higher order thinking skills, as well as execution of those skills. It is important, then, that it be provided the opportunity to

function at the greatest level of efficiency possible. Through moderate exercise it has been shown to have an increased level of performance.

Function of the Hippocampus

Another important area in the brain is called the hippocampus. In humans there are two hippocampi located in the interior of the brain. As with most portions of the brain, the hippocampus serves many functions. For the purpose of researching the answer to the question about learning and engagement, the focus will be on mood and long term memory (Mandal, 2014). The hippocampus allows humans and other mammals to establish and maintain memories. Any damage that is done to the hippocampus can also have the reverse effect, and leave the person missing memories or abilities previously secured. Though injury can result in amnesia, it will not prevent the development of new memories (Mandal, 2014).

For a student, the hippocampus would be important in developing new memories as it relates to material being learned. They would also be able to create memories and associations between the learning context and content. Again, exercise is shown to increase the volume of the hippocampi (Erickson, 2010). In a study published by Proceedings of the National Academy of Sciences of the United States of America (PNAS), the correlation between cardiovascular exercise and growth and maintenance of the hippocampus was clearly defined. The study looked at the impact of cardiovascular exercise versus stretching, and the results showed that both benefitted growth but that cardiovascular exercise was more beneficial to the participants (Erickson, 2010). The research showed that the hippocampus was more positively impacted when the

participants engaged in a more physically involved task such as running. Improvements were shown through lower impact exercises such as stretching. Though we cannot have students running through the classroom on a regular basis, it is possible to find less obtrusive ways to include some cardiovascular elements in class. The function of the hippocampus, alongside the results of this study, support that the more frequently movement can be built into classes the stronger student memory will become.

Physical Activity and the Brain

The benefits of exercise for adults have been widely publicized. Often the focus is not placed on how exercise can have an effect on young people, specifically students. Regardless of who is exercising, the biological outcomes remain essentially the same. The first major outcome that exercise has on the brain relates to oxygen. Oxygen is essential for the survival of all cells and organs within the human system. The brain, being another organ, requires oxygen to perform its duties efficiently, and effectively for the human body (Jensen, 2005). Exercise has been shown to increase the level of oxygen to the brain. Additionally, it releases hormones that help with healthy brain growth.

Aside from an improvement in the efficiency and effectiveness of brain functions from consistent movement, it leads to an ability to analyze, process and problem solve higher order questions and problems (Reilly, 2012). An aim of education is to create learners that can apply skills to real world situations. The basis of traditional education is rooted in preparing students for factory based careers. Our current world situation requires more problem solving and critical thinking processes of our workforce and, thus,

our students. It is integral that the brain is supported in preparing to think more deeply about concepts.

The articles *Movement in the Classroom: Boosting Brain Power, Fighting Obesity* by Reilly, Buskist (2012), as well as *Moving with the Brain in Mind* by Jensen (2000) agree that more movement is required with the classroom. It addressed the importance of incorporating movement into regularly scheduled class periods, and not necessarily having them be a separate event (Reilly, et. al, 2012). Often staff feel that shifts in policy translate to additional work; instead the focus is on incorporating physical activity seamlessly into class. Even when a new concept is shared or implemented and has the best interest of the students in mind, there can be teacher push back. In these instances it can sometimes feel overwhelming because teachers view it as an additional requirement that necessitates more work and time dedicated to it. This notion is far from the reality in this instance. Something as simple as stretching before class allows the body to refocus itself. This requires minimal, if any, planning, research, or front end work. Stretching allows students to rest their muscles and eyes to refresh themselves and feel more prepared to learn. This also helps to improve blood flow to the brain and improve focus on one topic (Jensen, 2000).

Along with stretching, another relatively unobtrusive movement strategy is to resituate students in the classroom. Often students sit in the same place in a classroom each day. Jensen suggests that having students move and learn in a different space can improve how they learn because they have new surroundings to associate with the

learning (Jensen, 2000). Simple rearrangements can impact how a student will absorb and process information because the brain has a new environmental reference point.

It is also worth noting that our brains are only able to handle so much new information at a time. With recent curriculum changes there is often the feeling that one must cover as many standards as possible, thus utilizing every minute within the hour for content coverage. Our brains will eventually reach a saturation point. As many learn during teacher education, students have an ability to maintain focus on one particular task for roughly 15 minutes. The suggestion is to change the activity frequently to sustain interest and attention. A room rearrangement could serve as the movement necessary to increase oxygen flow to the brain; additionally, it allows for the new environmental reference points addressed by Jensen. Time we spend not being exposed to new information is integral to the learning process (Pelligrini, 1995). In other countries students have scheduled breaks for physical activity. One such country that has scheduled movement and exercise breaks throughout the day is China. The beginning of the day starts with students taking part in group calisthenics. Throughout the course of the school day students are also guided in eye exercises. It is not large muscle movement, rather hand and eye movement, but they are given a break to stretch and help improve circulation. The students have regularly scheduled physical education classes, as well. Chinese students are consistently among the highest rated in terms of test scores, and as of 2012 were ranked higher than the United States in both science and math test scores (Fensterwald, 2013).

Because movement has been shown to help students feel more alert and focused in class, more movement opportunities should be provided to students beyond just recess and physical education. The current availability of physical education, and the rate of active transport, is not sufficient to sustain the necessary amount of activity to stimulate the brains of students. By doing minor movements we can increase blood and oxygen flow to the body. Ultimately, this means that the brain will be better supplied with the nutrients that it needs to grow and perform optimally.

More than simply cognitive benefits, students also felt a stronger sense of self after completing physical activities (Conyers, 2015). The positive personal impact that physical activity has also worked to improve the brain and its function. By feeling more empowered, students will take more risks and challenge themselves on a regular basis. This is what Conyers refers to as a positive feedback loop (Conyers, 2015). Feeling empowered and capable of learning and gaining knowledge supports student risk taking abilities. By taking greater risks, students are able to expose themselves to more information and educational opportunities. Successes eliminate, or reduce, one variable that can work to prevent the acquisition of knowledge, namely, fear.

Attention Deficit/Hyperactivity Disorder and Attention Deficit Disorder

Attention deficit/hyperactivity disorder (ADHD) is a developmental disorder that results in a person being impulsive and often becoming distracted from the task at hand (Traver, 2015). The cause of ADHD is a combination of genetic and environmental factors. Often those living with ADHD are prescribed medication to assist them in maintaining their focus. Increasingly, families are looking for alternative management

techniques. Students with ADHD have problems with their executive functions such as impulse control, critical thinking, focus, and organization (Traver, 2015). All of these are skills developed in specific areas of the brain namely the cerebellum, prefrontal cortex, and hippocampus as previously mentioned.

The research presented by Traver et. al. suggests that there are a lot of factors related to parenting and the environment play a role in the existence of ADHD in students. Parents and family environment are to be considered when determining how to best serve and support the student. That being said, exercise has the potential to play a very important role in helping the child as well. It can increase the volume of the memory building area of the brain (Erickson, 2010). It can help the prefrontal cortex perform at its peak which, as stated, is responsible for higher order functioning (Conyers, 2015). Last, through exercise the cerebellum will show growth and this is where new connections are constantly being made and allowing learning to happen. There is value in exercise and movement for students in general, but especially for those with ADHD. The processes that are benefited by exercise are those that are not working optimally for students with ADHD.

Kinesics in Learning

Kinesthetic learning has long been a part of the learning process for teachers during teacher education and training. Utilizing as many senses as possible helps reinforce the skills and information being used. It can also improve information recall capabilities (Madden, 2012). Even beyond that, incorporating tactile interaction with content in a meaningful way can lead to great strides and breakthroughs for the student

educationally. Additionally, students may even find social benefits which may lead to additional academic support.

There has been a great deal of research that maintains that learning activities that require movement are quite effective in assisting the learning process. When movement is maintained for more than just a moment it has the greatest impact on student achievement (Shoval, 2011). Learning new material can be likened to learning a new language. New content, like a foreign language, is something otherwise unfamiliar to the student. According to Sheltered Instruction Observation Protocol (SIOP), to be successful in a new language one must interact with it in as many forms as possible. Regularly speaking, writing, hearing, and listening to a new language is necessary. Interacting with the language by using it in context in public, or holding tangible versions of the word helps build an even stronger association. The same strategies can be used for teaching new content in other subject areas.

By incorporating movement into classrooms so that it is not separate from the lesson itself, we can strengthen the connection between certain skills and specific activities that took place within a specific learning environment. Researchers have also noticed that the socio-kinesthetic link correlated to better performance on assessments of the material (Shoval, 2011). It is also of note that the frequency of interactions with the material had an impact on how well students were able to absorb and connect with it. The study presented by Shoval was unique compared to a major of studies involving movement, kinesics, and learning which often focus on the biological impact that it has on the student and their brain. Several of these studies, and the articles in which they

were published, have been addressed. In this case, the study focused more closely on how often the students interacted with the material. Higher achievement was linked to higher frequency of interactions, as is the case with a second language.

Focusing on kinesthetic learning is also one way to help close the achievement gap according to several researchers. In an older study of students that were considered high risk, based on their responses to questions related to their kindergarten achievement, were compared to those considered non-risk. A non-risk and an at-risk student were paired based on similar initial test scores where at-risk students were defined as students that provided 60% or less positive responses about their success in kindergarten. These students were considered to be at a higher risk of failure during their future education. All students were then provided the same material to learn such as reading, writing and spelling. The difference was that the experimental group was provided more hands-on, kinesthetic learning opportunities than were the other students. Though the follow-up test scores were still not equal, the disparity between the non-risk and at-risk students was closing. In fact, the gap was reduced in all areas that were being measured (Grant, 1985).

A similar conclusion was reached regarding the achievement gap by researchers for the Journal of School Health (Basch, 2011). In trying to determine what was negatively impacting student achievement, the focus was tightened to a handful of concerns. Some of those concerns were physical activity, attention, and hyperactivity. These are areas of concern for those student groups that typically score significantly lower on standardized tests, namely urban minorities. Though it may be difficult to entirely revamp a system, little changes can occur throughout the day to provide some

novelty, as well as action, within the classroom. Movement does not necessarily need to be large muscle movement, all day, all the time. When possible, it is wise to provide a greater amount of physical activity for those that do not typically receive enough. When that is not possible it is important that we provide kinesthetic learning opportunities to get them moving if only slightly, and to interact with the material again, but in a different way.

Kinesics and Student Interaction

Aside from the obvious immediate benefit of moving the body and starting some biological processes that assist in the learning experience, students also experience other benefits. Having a classroom that focuses on kinesics, movement, and interaction can lead to an atmosphere of teamwork and trust (Guarino, 2014). When working in a classroom that emphasizes kinesics, students are often asked to interact with people that are otherwise unfamiliar. Often, but not always, kinesthetic learning requires active engagement with the surroundings of the student. This may include physical objects, content materials, or tools to help them better understand the materials. Sometimes the teacher will create a method by which students serve as one of the resources, or tools, for learning. In order to fully engage in a kinesthetic lesson, students may need to interact with unfamiliar peers. By creating these relationships students are more likely to take risks and ask for clarification (Guarino, 2014). Rather than being restricted by fear of judgement from the teacher, students will be more willing to ask questions freely and often. Instead of avoiding conversations with the teacher about content the relationships built will have helped develop an environment that is encouraging of dialogue and

discussion. With an increasing development of these relationships among peers, students have a larger pool of candidates to direct their questions toward (Shoval, 2011). They are more willing to take risks, engage with and involve others.

Movement and kinesics in the classroom also requires self-awareness and spatial awareness (Guarino, 2014). Though not directly biological, moving about the room and interacting with others will also improve learning. Students will hear explanations from people they would never have otherwise thought to talk with. Further exposure to different ways of interpreting material, and a variety of interactions with said material, serves only to reinforce the concepts being learned.

Physical Effect of Decreased Activity Level in Students

With decreased levels of activity and movement there is, inevitably, an increase in the amount of time spent sitting in a chair. In recent years, office equipment has seen a definite emphasis placed on ergonomic design. Employers have observed long term costs associated with poorly designed equipment as it leads to an increase in medical needs of their staff. The same can be seen as true for young people using standard seating. A couple of physical concerns arise with students spending an excessive amount of time in the seated position. First, it places a great deal of pressure on the spine. Of course this pressure will be felt even standing, but it is 30% greater when seated (Jensen, 2000). This pressure results in fatigue which makes it difficult for students to engage even when they are entirely interested in the content. Though ten minutes seems minimal, it is enough to set in motion the series of events that impact focus. By being physically uncomfortable,

students find themselves distracted and unable to focus on the content. They are less receptive to the content and miss out on learning and may even act out (Jensen, 2000).

Another concern that arises from students remaining in a seated position is the restriction that it places on organs and, subsequently, blood flow to the brain. Students have a shorter line of sight than do adults. By sitting in a desk, students often assume a hunched position which places unnecessary pressure on their organs (Jensen, 2000).

What follows is a reduced amount of blood flow to the brain. The reduction of blood flow causes a decreased level of oxygen to the brain, something that has been shown necessary to maintain and develop neurological connections. By hunching over their desks in order to see across the room, students are slowing their learning process. Additionally, they are hunching their spine which can result in malformation and ultimately a sustained decrease in blood and oxygen to the brain, and other organs, over time.

A study looked at the cognitive outputs of children aged 10-11 and compared various aspects of their health. Several different brain functions were assessed including the ability for the children to control cognition (Hillman, 2014). Those students with a higher body mass index (BMI) for their age showed a significantly lower ability to control their cognition. Additionally, they were less capable of controlling their prefrontal cortex which is, again, responsible for complex thinking and analysis. Students that were overweight also had a slower response to correct errors in processing. This study shows that there is a noticeable relationship between obesity and various brain functions (Hillman, 2014). Though the focus of this study is on obesity, the link between movement and physical activity is clear. If the level of physical activity offered in the

daily lives of students during the school day were increased, the health benefits would improve. Based on the study cited above, this would then result in positive cognitive results, as well.

Instructor Views

To date there does not appear to be much research about the views that teachers themselves hold regarding movement and education. Informal conversations among colleagues often result in agreement. There is a very real need for movement as students typically show excitement and enthusiasm about moving, and even advocate for it. In a more formal interview process, teachers were asked about their use of physical activity and movement in their classroom. Those teachers that worked to make it an emphasis for their classes noted that it became a part of their overall teaching style (Benes, 2016). They saw their students benefit in that they were able to uniquely connect with the content, or abstract concept, with which they were working. It is also worth noting that a common thread of refocusing came up when asked about when and why they utilized movement. The majority of those teachers interviewed said they utilized movement as a way to restore focus within the student and within the classroom (Benes, 2016). The fact that the benefit being sought is focus is intriguing because one of the only concerns that teachers have had with physical activity in the classroom is losing control, or focus, in the classroom (Reilly, 2012).

Concerns Regarding Movement

As with many unique approaches to education, there are concerns presented by those implementing them. Movement in the classroom is not something that takes place

frequently in a traditional class. Typically, students are required to sit for extended periods of time and maintain their attention and focus during instruction. There are some teachers that are concerned about keeping students on task during class if they are allowed, or encouraged, to move about the room (Reilly, 2012). Concerns are expressed regarding how much activity is too much. The thought of adrenaline after movement is one reason that some staff wonder how much, and how often, students should engage in physical activity during non-physical education classes.

Rationale

The question being researched is “What impact does movement have on student learning and engagement?” When beginning my research there appeared to be a potential connection between the brain and exercise. The benefits of running, lifting weights, and otherwise moving or exercising are often heard through various mediums. Many of these benefits are directly related to mental capacity. This led to the research topic of what to research the importance of the brain became immediately apparent. With that research underway, other related topics that provided insight on movement in the classroom began to surface. The brain is directly impacted by the biological changes movement creates; the connection between a strengthening of the brain and an educational result are directly connected. One such example is the connection between the development of executive functions in the prefrontal cortex and the ability to pay attention, focus, and exercise flexibility during instruction (Pless, 2015). Looking into this area, though, also required considering what happens if students are not provided an opportunity to move.

The investigation of kinesics was another area of importance in terms of how a student's education is changed. When engaging in kinesthetic learning it really changes the way a student connects with content. It also plays a part in helping students develop social skills which are so important for success. As one will learn in adulthood, having a network of resources is integral for success in a workplace. With students, it is much the same. If a student has a network of friends or classmates, it equates to more assistive resources, thus improving their ability to complete their work with accuracy and confidence. The question, though, is whether or not this really does affect student education. If it does, is it positive or negative?

It is important to investigate what teachers have perceived the influence of physical activity to be on their students. The people that notice a difference in students from day to day are teachers. Going through the research, another area of importance that arose was how teachers felt that movement affected their students. It was interesting to see that most found it beneficial and wanted to find other ways of incorporating movement, while admitting that they are hesitant because it boosts students' energy level.

Conclusion

Already there is a wealth of information regarding movement and education. There are multiple articles and studies that provide data about brain function and how that can influence learning. The biological connection between movement and the brain seems very solid. There are multiple areas of the brain including the cerebellum, prefrontal cortex, and the hippocampus which all have a variety of functions that assist in learning, as mentioned in this chapter. A great deal of resources also note the benefit of

kinesics and kinesthetic learning for student success and understanding. The result that not moving and exercising regularly has on a student's capacity to succeed is concerning, and teachers seem to be able to see that this is true. Teachers and staff agree that kinesthetic learning serves to provide a lot to students both educationally and socially, which also leads to educational successes. All of the research and data seem to suggest that movement has a positive impact on student learning and success. If we are able to implement more movement in our classes, we will find students more engaged, interested, and intrinsically motivated to learn. The concern is that perhaps there is such a thing as providing too much movement in a class period, as it can become a distraction for that student and to others in the class.

What I would like to investigate is how does it affect students now, in the current day and age of technology and increasingly sedentary lifestyle? This investigation will look at what the real, current impact of movement is on student learning and engagement. In the next chapter I will outline the student population, the setting of the study, and provide an overview of my methods. The next chapter will provide a summary of the study itself including how I will collect and analyze the data, the length of the study, as well as a description of the student population.

CHAPTER THREE

Methodology

Introduction

This chapter will explain how data was collected and used to analyze the question: What impact does movement have on student engagement and learning? This question arose from observing how noticeably distracted, disinterested, and seemingly tired many students were throughout the day. These observations also brought to light how infrequently students physically moved their body throughout the day. In trying to determine what it was that could help reverse their disengaged and exhausted behaviors, I wondered what effect there might be if students were given more opportunities to move throughout the day.

Throughout this chapter I will discuss how I performed the research and data collection necessary to answer this question and why I chose that method. Additionally, I will address the setting and community where this research was conducted. Finally, I will describe my procedures for data collection, and how I subsequently compiled and analyzed said data. The focus of this chapter is to clarify how and why the research was performed the way that it was and to describe the participants in the study.

Research Paradigm

The research paradigm I have chosen to focus my energy on is quantitative. Throughout the research of literature and former studies conducted on similar topics, quantitative methods were most common. It is difficult to argue the inaccuracy of numbers, and the methods by which I collected data imply that quantitative research is the most fitting option.

When considering what impact a certain strategy has on students, it is difficult to argue with numbers. If all variables are considered and appropriately planned for, the data will paint an appropriate picture of how well or how poorly movement impacts student learning. I drew conclusions from my results and determined whether a correlation exists between movement as a teaching strategy and improved learning in the classroom. Because I planned to assess the potential correlation or causation, a quantitative approach was best (Reale, 2014).

Using surveys and collecting data sets regarding breaks, redirections, and positive notes also implies that quantitative research is best. Because I was interested in determining the relationship between two things, namely the implementation of movement and student engagement, the University of Southern California suggests that a quantitative approach is most appropriate. Surveys, formative assessments, and tracking of breaks and positives were the standard by which it was measured.

For this situation I used a small subset of students to study the larger population. One of the characteristics of quantitative research is that it can be used to predict future occurrences or apply results to a larger population (Creswell, 2009). Based on my

research I can decide whether or not incorporating movement is more beneficial or harmful for our unique student population.

Setting and Participants

The participants for this study were students between the ages of 13 and 20 years old. They were young men that have been committed by the court to attend this treatment facility. This is a resident population comprised mostly of African American students, as well as a small number of Hispanic, Native American, and Caucasian students. Each of these racial identities were represented during the time the research was conducted. Often the students are from a lower income socioeconomic status. Additionally, they have had some interaction with the legal system, which is what brought them to our program. Some of the students are English language learners (ELL), and a large number of students, at any given time, have an individualized education program (IEP).

The students are in a unique situation as they live in cottages on campus and attend school full time during the day. The program is quite small with roughly 50 students currently enrolled. This study examined the responses of 28 students, as well as the secondary analyses of their formative assessments, warm-up questions, as well as positive and negative logs. Students frequently enter and exit this program as they are discharged when they have completed the assigned length of time. Those times also vary greatly, so the enrollment fluctuates often throughout the year. It is difficult to determine exactly how many students are on an IEP or are considered ELL are enrolled at any given

time. During the time that this study was conducted, there were two ELL students and 12 students on an IEP.

The setting for this study was within a school system that is located in a suburb of the Twin Cities. The campus itself was on a very large and rural piece of land surrounded by wilderness and wildlife. Though there was a considerable amount of nature surrounding the campus, the students had limited freedom to explore those areas. It was also a unique school because there were far fewer teachers than a traditional high school located in the suburbs of the Twin Cities. During the summer session of this program, which was when the study was conducted, there were four instructional staff with additional support staff in the form of specialists and educational assistants. Even during the school year there are only 6.5 full time instructional staff, so students tend to form quite close bonds with the teaching staff.

Procedures

In order to determine what impact movement had on student learning and engagement, I first needed to gather baseline data. In order to do so it was necessary to secure the proper documentation of approval to perform the study. From there I made adjustments to my lessons, teaching strategies, activities, and assessments. After collecting data throughout this time period I compared the baseline data to that which was most recently collected.

Human Subjects Committee Requirements In order to ensure that my research could take place without issue, it was important that I get consent from a few different parties. First, I needed to send home consent forms to be signed by the parents or legal

guardians (Mills, 2000). This form can be found in Appendix A. Because my students live on campus, they are not allowed a home pass; therefore, I had to talk with their individual staff about how to obtain consent. Additionally, I had to get approval from the facility staff to determine what information can and cannot be released. They must abide by strict HIPPA standards, so it is also necessary that I abide by the same standards as I interacted with their students. Last, I asked permission of students. They are the people that I studied, so it was important that they were willing to participate.

Baseline I began by ensuring that I concluded at least one lesson each week with a formative assessment. This typically happens more often, but doing so at least once a week provided me with an understanding of how well students comprehended the information we covered in class. The following class period I began with an opening question to see what the retention rate was for that same lesson.

Next, I gave students a survey asking them to self-assess engagement, comprehension, and enthusiasm about the content based on personal reflection of the class period. This survey was completed on a numeric scale. In a quantitative approach, surveys are a useful method to compare studied groups; in my case, the baseline and post-intervention surveys (Creswell, 2009). Having students reflect allowed me to see how well they believe they understood the content and compare or contrast it to their formative assessments. The formative assessments were viewed from a secondary analysis perspective. In no way were the assessments associated with the surveys that were completed. Instead, I viewed the overall class performance on the formative

assessments alongside the survey responses regarding understanding at the end of the class period.

During this baseline data collection time I also counted the number of redirections given. This included breaks being self-prescribed or teacher prescribed. It also included prompting students to refocus their attention.

Post-Intervention Once the baseline data was collected, I did the same thing as I began to incorporate more movement into my lessons. On days that I had movement woven into my lessons I made sure that I gave a formative assessment, asked them to self-assess how they felt in the class, and tracked redirections. I did not entirely exclude lessons that lacked movement, though. They were still involved in the data collection process. That way it was possible to see what impact it was having on their performance in the class, not just when a particular type of lesson was happening. This helped gauge whether there has been a change in their overall class performance and understanding.

Access to the internet is quite limited for the participant population, so this approach will require that I had copies of the above mentioned survey available. There was a manila envelope in class where students were asked to place their completed survey. This ensured that I was not able to see their responses even if accidental. It also allowed my educational assistant immediate access to that the information could be quickly and accurately recorded at the end of the day while maintaining anonymity.

Data Collection

These two categories of data were collected and from there an analysis was able to begin. Once surveys were collected from students I calculated the average, as well as

growth between the baseline and post-intervention data. These numbers represented familiar and reliable measures of center that readers are most likely to understand that also accurately describe the data. The calculations took place for the values provided on student surveys.

After the student surveys were collected, calculations began. An average is a good method for calculating a measure of center because most are familiar with what it represents. It creates a more precise view of how student responses to the survey questions were spread. This helped describe how closely gathered survey responses were, or how spread out they were. The mean is a very concise value that tells where the middle of the student responses lies. These values were calculated for their responses to their level of engagement, comprehension, interest and enthusiasm, frequency of redirection, positive remarks provided, and the accuracy of the formative assessments completed by students.

Summary

I worked with an urban population living in a suburban school setting, and students often requested doing something active, or taking a physical movement break. They do not have much opportunity for movement, and it seemed that there could be a positive impact on their learning if it were more regularly incorporated. In order to determine what effect it might have had on these particular participants, it was necessary that I provided surveys to be completed by students. It also required that I collect and grade formative assessments.

To effectively determine the impact, I wanted to first collect baseline data on movement in the classroom. Once the surveys were completed, the lessons that include movement were implemented. Then, during these lessons, additional surveys were completed by both parties. It served to investigate how engaged students were during lessons with movement, as well as how well they understood the material. From there I began with the calculations and compared the before and after surveys, positive notes, and redirections. Based on those calculations, I saw what the true impact of movement is on our student population. Moving forward into chapter four, the outcomes of the study will be shared and explained. These results will then be related back to the foundational research and literature that guided my investigation, and how one might move forward from here.

CHAPTER FOUR

Results

Introduction

The purpose of this investigation and the development of this study was to assist in answering the question: what impact does movement have on student learning and engagement? The intent of this chapter is to share, explain, and describe the data that was collected over the course of the study. Information shared in this chapter will describe what impact, if any, movement has on how well students learn and engage with the course content.

There were several different mediums used to measure the changes in student engagement and learning throughout the course of the study. Student behavior logs were tracked and examined as a secondary source of information, as were warm-up questions and formative assessments. To ensure that the information and data shared is clear, an explanation of the behavior logs will be provided. The primary source of data collection was anonymous student-completed surveys (Appendix B). It is worth mentioning that in

order to maintain anonymity of the student participants, these mediums could not be partnered and compared side-by-side. Nonetheless, there was quite a bit to be learned by comparing the different forms of data.

Review of Chapter Three

The participants in this study were students that were attending school and are between the ages of 13 and 20 years old. Not only is the student population quite diverse in terms of age, but in terms of race. Involved in the study were students that identified as African American, Hispanic, Native American, and Caucasian. There were also two students that were considered ELL and 12 students with an IEP. In this program, students are residents of the campus and have been referred to the program by the court.

The program itself is unique in comparison to a typical high school program, but strives to provide the same learning opportunities. In addition to academic goals, there are social and emotional targets developed for the students. The major content areas are covered during their school day, and social and emotional learning needs are addressed throughout the course of the day. To better help students understand the consequences of the decisions they make, they earn positive and negative behavior logs which will be described more in depth.

In order to understand what effect movement had on student engagement and learning, several different forms of data collection took place. Students were asked to complete a survey at the end of each class period. On this survey they rated their level of

interest and understanding both before and after the lesson on a scale of 1-5. They also rated their level of effort and participation, also on a scale of 1-5, and were told not to make stray marks or otherwise make their paper uniquely identifiable. In addition to the surveys, the positive and negative behavior logs were tracked for the group, as a whole, as were formative assessments and warm-up question scores. The aim was to compare the changes in these different areas and look for possible correlation.

Description of Positive and Negative Logs

It is helpful to understand the positive and negative behavior logs that were being tracked. Students in the program have school goals to exhibit self-discipline, tolerance, integrity, and responsibility. When they are able to successfully display these behaviors they receive positive consequences in the form of tickets, and subsequent rewards in their cottage after school. On the other hand, when students are not behaving in a way that displays self-discipline, tolerance, integrity, or responsibility they receive negative consequences. The negative behavior logs typically result in a reduction of their free time after school. The students seem to respond very well to these behavior logs because they are immediate reactions to an action they have just taken.

Difference and Ratio of Behavior Logs

There were noteworthy changes in the behavior logs that were recorded during the baseline data collection, and the post-intervention data collection. To be clear, post-intervention means data that was collected while movement was being implemented into the daily lessons. The increase in positive behavior logs can be seen in Figure 1. During the baseline data collection, there were 11 positive behavior logs recorded

throughout the course of the two week baseline data collection period. After incorporating more movement in the classroom the positive behavior logs increased to 29 over the course of the next two weeks.

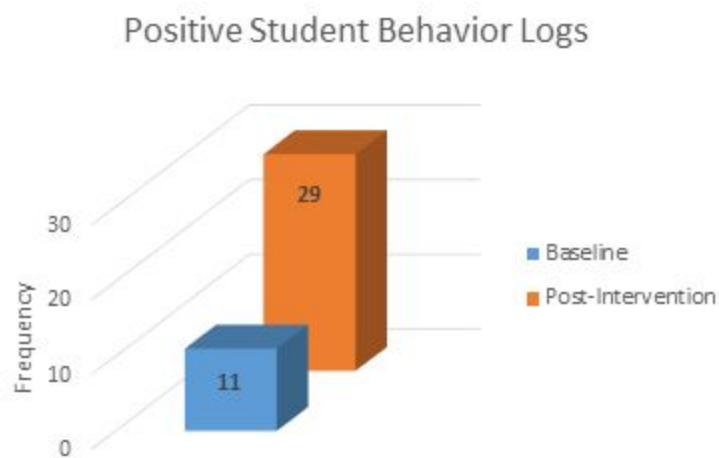


Figure 1: Frequency of Positive Student Behavior Logs

As the literature mentioned, with increased opportunities to interact with others, students were able to grow personally. Academic growth was suggested as a possible effect of social interaction as students would have a broader resource base. That being said, the improvement in positive logs shows that students were able to appropriately engage with students if they were simply given the opportunity. The literature that suggests that a socio-kinesthetic interaction with the material, and more frequent interactions may be linked to higher achievement (Shoval, 2011). The change in understanding of the content, which will be addressed shortly, seems to support this idea. It is important to note that this suggests students do not react negatively to movement, but instead, are able to successfully display their positive social interaction skills more often.

While aiming to increase the positive behavior logs a simultaneous, yet parallel goal, is to decrease the frequency of negative student behavior logs. During the first two weeks of baseline data collection, there were seven negative behavior logs reported. While implementing the post-intervention lessons with incorporated movement, there were four negative behavior logs recorded. The change in the reported negative behaviors can be seen in Figure 2. A decrease of 42.9% between the first two weeks and the second two weeks indicates that the concern presented in the literature may not be applicable in this particular setting.

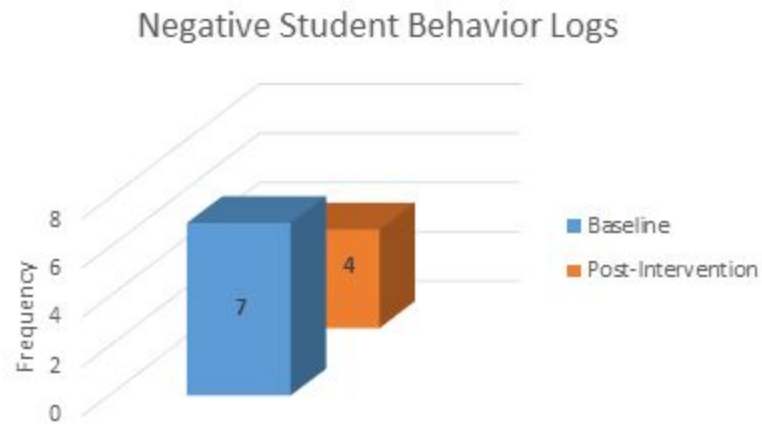


Figure 2: Frequency of Negative Student Behavior Logs

In addition to counting the frequency of positive and negative logs, the ratio of positives to negatives is important to calculate. During the baseline data collection there was a positive to negative ratio of 1.57:1. This means that for every negative log recorded, there were 1.57 positive logs. The ratio of positives to negatives should be much higher in order to ensure that students see the feedback as constructive. When calculating the post-intervention ratio it improved to 7.25:1. Again, this means that for

every one negative log recorded, there were 7.25 positive logs recorded. Social and emotional skills are more challenging for teachers to teach because there is no textbook, no linear way to progress socially. There is also no way to assess mastery of a given social skill. An improvement in their ability to utilize those skills is fantastic and suggests the potential for academic growth, as well.

Concerns among teachers were difficult to unearth, but one that was found is the fear that students will get out of control and all hope would be lost for the remaining class period (Reilly, 2012). This seems to suggest quite the contrary. Not only did students fail to display unruly behavior, they were able to successfully display growth in their social and emotional learning in addition to an improvement in their course related assessments.

Improved Warm-up Scores

Another source of data that was analyzed in this study was the scores that students achieved on their warm-up questions. Each day there was an opportunity to earn three points on warm-up questions. These questions were directly related to the material covered in the lesson the previous day. The intent with this data collection was to determine how much information could be recalled 24 or more hours after initial contact with the material.

As mentioned in the literature review section of this capstone, the hippocampus is responsible for memory making and long term recall of information (Mandal, 2014). By measuring the accuracy of responses over a longer period of time than the standard 45 minute class period, it may be possible to see progress and growth in hippocampal learning and processing. Exercise has been shown to increase the size of this section of

the brain (Erickson, 2016). By engaging in active learning processes the aim was to determine if it impacted the students' ability to recall information.

Throughout the initial baseline data collection process, students scored an average of 1.9 points out of a possible three points on the warm-up. This corresponds to 63% accuracy in student responses to questions from material that had been covered the previous day. During the post-intervention weeks, that grew to 73% accuracy. By the second two weeks students increased in their accurate responses by 0.3 points, on average. The change in these values can be seen in Figure 3. There was one lesson, in particular, that had taken place before a long weekend. Prior to leaving for the weekend students participated in an activity that required them to move throughout the room for a significant length of time in response to questions. The following Monday, students were able to accurately answer warm-up questions with an average of 2.4 points out of three. This corresponds to 80% accuracy in student responses. This was especially impressive as these responses took place more than 72 hours after initial contact with the course material.

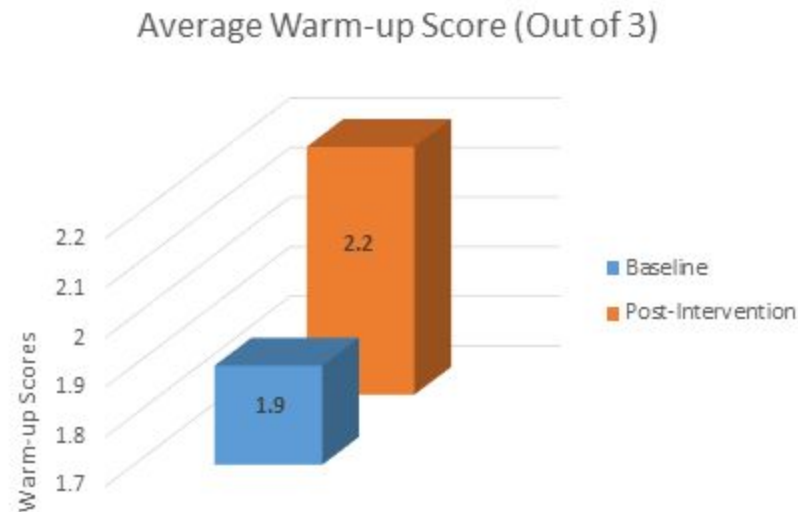


Figure 3: Average Warm-up Score

Though this may not seem mathematically significant, a 10% increase in student recollection skills in a matter of several weeks is nothing to be ignored. With such an increase in a matter of weeks, long term incorporation of movement may have an even more significant impact. Depending on how related the lesson itself is to the movement within it, students may have more or less dramatic increases in their retention of the material. This is worth investigating further during future lessons, and beyond this capstone project.

Student Rated Level of Understanding

During this study students were also asked to reflect on their own learning via a survey. This is something new and unique to many students. In a typical classroom it is relatively infrequent that students are asked to reflect on how well they feel they understood the material. Instead, it is far more commonplace for a teacher to ask

questions of students about the material and, based on those responses, determine how well they grasped the material.

The surveys that students completed asked them to rate their level of understanding before and after class on a scale of 1-5. On average, during the post-intervention timeframe, students showed an increase of 2.33 points in how well they understood the content. To clarify, this means that how well they understood material from that day had an average improvement of 2.33 points out of 5 by the end of the class period. Essentially, students were 46% more confident in their understanding of the content from that day. This increased understanding supports what the literature suggests regarding improved neurological connections when students are not stuck in a hunched position, thus limiting oxygen to the brain (Jensen, 2000).

Improved Interest Rating

Throughout the review of literature there did not appear to be many, if any, obvious articles related to how much movement can impact a student's inherent interest in a topic. They may not find a particular concept more exciting, but in learning about it they may find components that are more thought-provoking, or that touch on other topics that they are passionate about. The question was, can movement engage students enough to expose them to those tangential topics that they are passionate about?

Based on the survey results, it seems the answer is yes. At the beginning of the class period students were asked to rate their level of interest in the topic to be discussed that day. At the end of the period they were asked to provide the same rating based on what they had learned in class. The goal was that students would either realize that with

movement being incorporated even dull material can seem more interesting, or that they may learn a new aspect of a topic that makes it more exciting. Comparing the before and after rating showed an average increase of 2.41 points on a scale of five. This is an average increase of 48.2%. That is to say that student interest increased by nearly 50% after engaging in lessons that involved movement and activity.

Correlation Between Variables

Similar to rating their understanding, students are not familiar with the process of self-evaluation. When students were first asked to reflect on the lesson, they asked what they should state for the level of effort and participation. They were told that it was up to them to determine whether or not they believe they participated as much as they could and gave as much effort as possible. After reminding them that their grade is not impacted by their responses, they put their heads back down and finished their survey.

Having gathered data from the surveys the difference between their rated level of understanding and their rated level of effort was calculated. These differences were then squared to eliminate positive and negative values offsetting one another. After that the values were square rooted and averaged. In this instance, a large value would suggest that there was a significant difference in their level of participation and understanding. That is, if they participated the entire time, but still had minimal understanding the difference would be higher. On the other hand, if they did not participate, but understood the material entirely, it would also result in a large number.

When the difference between understanding and participation was calculated, the average turned out to be only 1.31. This means that there was a reasonably strong

correlation between the level of participation and the level of understanding as evaluated by the student. The same calculation was completed to compare the level of understanding and the level of effort put forth. In this instance, the average turned out to be 1.62 points. Again, this suggests a strong correlation between the level of effort and understanding of the course material.

Growth in Formative Assessments

One of the quintessential methods for determining student comprehension and understanding of a lesson is through formative assessments. In order to decide whether a topic has been accurately conveyed or needs to be retaught, one must first assess the pupil. To be able to look for growth in student achievement on formative assessments, it was important to create similar assessments each day. It was necessary to have the same length of assessment so as not to intimidate students to the point that they avoid answering questions for fear of failure, while simultaneously creating questions challenging enough to truly test the depth of understanding. As the literature states, long term memory is a function of the hippocampus, the size of which increases through physical activity (Erickson, 2010). The prefrontal cortex was also examined using these formative assessments as it is responsible for higher order thinking (Conyers, 2015). Though the number of questions on the formative assessment was small, the students were pushed to test their depth of understanding.

There was growth shown from the baseline formative assessment, to the post-intervention formative assessment scores. On average, students scored 2.4 out of 5 points during the baseline assessments. In the next two week period, students scored an

average of 3.65 points. This is an increase of 1.25 points, or 25%. A visual representation of this information can be seen in Figure 4. There is definite growth, and it appears that movement and exercise did strengthen their prefrontal cortex, and develop their hippocampus. Students were more capable of recalling information and answering more of the higher order thinking questions. Without having scans of student brains, it is a bit of a leap to suggest there were significant changes in a two week period. Between changes in the prefrontal cortex and hippocampus, if only minor, and the increased level of interest, it seems students were better able to engage with the material. This resulted in an increased average formative assessment score.

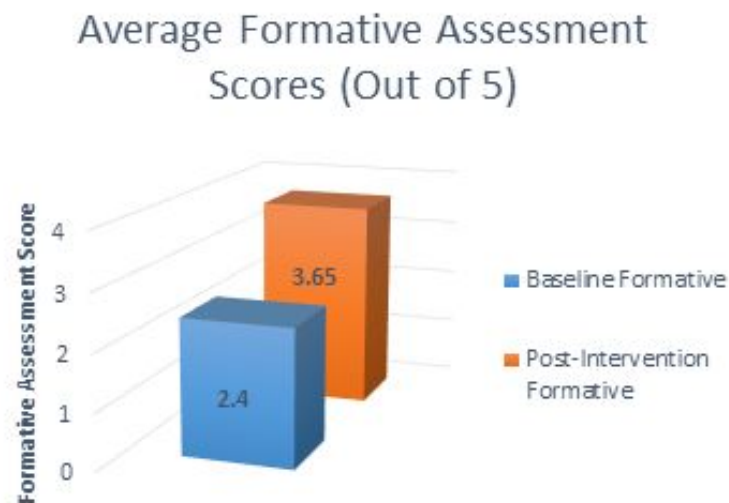


Figure 4: Average Formative Assessment Scores

Summary

Based on the information that was collected, analyzed, and compared it appears that movement and physical activity that is incorporated into a classroom does impact student learning and engagement. The students were excited to participate in a study that

focused on including more physical activity in the classroom, and were very willing to participate in the activities. Students can be very surprising at times, and this study was a perfect example. When the research began it seemed that there would likely be a decrease in at least one area being measured, but each increased. While some were more significant increases than others, they still all showed improvement.

It is hard to argue that movement should not become a part of a well-functioning classroom after seeing that formative assessment scores increased by 25% over the course of two weeks. For many districts this is the major signifier of student and teacher success. Aside from formative assessment, next day recall of content seemed to improve as well considering the warm-up score improvement of 10% over the same period of time. Scores are something that are very familiar to teaching staff, and administrators. This is tangible evidence that students showed improvement.

Students were also more successful socially when given the opportunity to participate in physical activities. After the physical activities were introduced, students saw the instances of negative logs decrease by nearly 50%, while the frequency of positive logs increased by more than 260%. If nothing else, this is a wonderful way to ensure that students remain engaged in the course content. This may prevent students from disconnecting because they feel unappreciated, or unjustly scolded. Keeping the ratio of positives to negatives high goes a long way in reassuring students that it is a safe environment and they can keep trying.

Even students self-assessed that they were being better students. They understood the content better by the end of class, and were showing more interest in the concepts

covered. They were also astonishingly honest in terms of their effort and participation ratings. All of this data goes to support the literature which also suggests that physical activity, exercise, and movement help adolescent brains and bodies grow and develop into a better human. A human better prepared to learn, interact with, and absorb material that is bequeathed upon them for such a large portion of their day. It is a challenging task, but by providing movement opportunities it seems we are setting them up for the greatest likelihood of success.

There was a lot to be learned from this study both as a researcher and as a teacher. It became clear to me just how important it was that students be allowed to move, and that they continually reflect on their learning, and my teaching. While I learned a great deal about how to supplement my teaching to benefit students, I also learned a lot about researching and the process that one goes through. In the next chapter I describe in more detail how I would alter the study, and some of the lessons I learned as a teacher and as a researcher.

CHAPTER FIVE

Conclusion

Introduction

The previous chapter summarized and discussed research that was conducted using quantitative data collection techniques. The data collected was interpreted alongside a secondary analyses of several other artifacts that are gathered as a part of the typical operation of a classroom. This information was being used to answer the question: what impact does movement have on student learning and engagement? Based on the research that I conducted, I have determined that a majority of the students in class show some signs of increased interest and understanding in a lesson when movement is provided within the lesson. Additionally, the frequency of negative logs decreased while

positive logs increased. Within this chapter I will reflect upon how the research process and the development of the capstone. There were certainly a few discoveries I made that were surprising, but some aspects were a little more predictable.

Next, I will discuss how my research relates to the literature review that was developed prior to my own investigation. This comparison will cover new connections that I have personally made to the literature review that did not exist. Additionally, I will discuss which components of the literature review aligned with my own findings and those ideas that deviated.

After that I will cover any long term implications of the study. There are changes that, if adopted by all teachers, school buildings, or school districts, may benefit student performance and engagement. Unfortunately, there are also boundaries and limitations associated with movement in the classroom. With the approval or implementation of school policies related to physical movement it is possible that we may see a noticeable shift in student success and achievement.

This chapter will close with suggestions and recommendations for future studies that are related to movement in the classroom, as well as classroom adjustments that would benefit students based on the data analysis that has been conducted in my classroom. I will also summarize the biggest take-aways that I have gained from the development and research of how movement impacts student learning and engagement.

Lessons Learned

Throughout the process of developing and writing this capstone I have learned a great deal about myself as a researcher, student, and teacher. The capstone process is an

intensive, detailed, and precise one. It allowed me an opportunity to grow and change with each hat that I wore.

First, through the process of creating and developing a scientific research process, I learned that my affinity for details and forethought were finally paying off. During the early stages of this process, and even now, I still struggle to believe that I am capable of completing such a gigantic undertaking. By breaking the process down into pieces, though, I realized even a teacher can be a researcher. Though not a scientist, the sequence of steps, preparation, and planning remain the same. Even the most insurmountable tasks are possible when broken down into more manageable parts.

Aside from learning about myself as a researcher, I learned about myself as a student and a teacher. I find it difficult to separate these two versions of myself because the changes in one directly impact changes in the other. One of the biggest things that I learned about myself as a student is that I need logic. In order to be successful and truly understand what the expectations are, I need a clearly outlined formula or sequence of steps. This has impacted how I work as a teacher because in the past it has been easy for me to assume that my directions are clear and students understand what I expect the product to be. Rubrics are far more necessary than I ever would have thought. Though it does not directly relate to my research question, I have incorporated more rubrics in my teaching and it has helped me. Through the process of developing this capstone, I realized how heavily I relied upon rubrics to clearly guide my work. Along the same lines, examples were invaluable. The clearer I can make my expectation of the product, the

more confident students are in their ability to complete it. That was my experience with the capstone, as well.

The research I have conducted to investigate what impact movement has on student learning and engagement reminded me how important it is to move in the classroom. It is easy to forget when preparing lessons, grading papers, entering attendance, completing grades, and covering standards, that we are still working with children and teenagers. Learning is supposed to be fun. That is how lifelong learners are created. Thankfully, my research supports the idea that movement provides students with a greater opportunity to engage with and comprehend the material. To be sure, I will place a great emphasis on including movement activities in everyday lessons conducting my research; however there were several improvements or adjustments that I would make to the implementation of my research. Given the opportunity I would have preferred to conduct this study for a full semester, or even school year, with a consistent group of students. I would also like to be able to connect the formative assessments, warm-up questions, and survey responses to students while still somehow reassuring them that their grade would not be impacted by the survey. Including more sedentary lessons would be interesting because then I could see what happens on those specific days.

Literature Review

Before beginning my own research, the literature supported the idea that movement supported learning through improved brain function and increased connections. The literature review covered several areas of research as it related to movement, the brain, and the connection both have to learning. The literature discussed

different areas of the brain, their functions, and the role that each plays in learning. It also investigated physical movement as a part of education, as well as the impact that it has on learning.

Within the brain there were several areas that directly impacted the performance of the brain as it relates to comprehension and retention. The cerebellum is one area that was discussed. This portion of the brain contains a majority of the neurons within our brains and plays an important role in information transmission (Jensen, 2005). Interestingly this portion of the brain is also responsible for processing movement. Another area is the prefrontal cortex which is responsible for higher order thinking skills and retention (Conyers, 2015). By incorporating activity the efficiency of the cerebellum is improved, thus developing greater physical movement capabilities, as well as increased information transmission. Additionally, the prefrontal cortex was shown to develop during moderate exercise. My research for this study seems to support the literature, especially comparing baseline to post-intervention data. During my data collection there was a 1.25 point average improvement on formative assessments out of a possible 5 points as compared to the baseline data. Without having access to brain specific scans this seems to support the idea that with increased movement the brain can function more efficiently. The average growth was 1.25 points, but even from the first to the second week of post-intervention data collection, there was an increase of 1.1 points.

In the literature review, the function of the hippocampus was also covered. The hippocampus is most notably responsible for creating new memories and establishing context for the learning. The literature suggests that cardiovascular exercise is the most

effective way to increase the volume of the hippocampi (Erickson, 2010). As mentioned, having students run during my class was not an option. We were, however, able to do some calisthenics that required a smaller area. In an attempt to gauge the true impact of movement on the performance of my students' hippocampi, I asked warm-up questions each day following a new lesson. This was my way of seeing how well students were able to retain information from one day to the next. There was not as significant an increase from the baseline to the post-intervention data collection as there was on the formative assessments. The average warm-up score increased from 1.9 out of a possible 3 points, to 2.2 points. That is an increase of 0.3 points on warm-up questions. This suggests that material retention improved, if only minimally. Based on the collected data, one may say that it agrees with the literature, but it does not seem significant enough to suggest as a way to convince other staff to incorporate movement.

Aside from the biological impact movement has on the brain, it also affects the students' ability to recollect material based on a particular activity. It is often easy to remember something that happened when a noteworthy event or activity was taking place in our lives. In a classroom, it can work similarly for students. If there is something unique or novel about what is happening in a lesson, all the other details come flooding back. For the purpose of content recollection, movement can be very effective. The more difficult it is for students to isolate the content and learning from the activity they are participating in, the more effectively it will be instilled in their memory (Shoval, 2011). During my post-intervention data collection, there was one day in particular that students were asked to walk across the room for a variety of reasons. After this activity, we had a

three day weekend, so I would not be able to reinforce the new learning until 72 hours from that time. Still, they were able to recall the exact phrases that had been stated several days prior, and were able to answer the warm-up questions with an average score of 2.4 points out of three. This was one particular instance that I saw clearly, and undeniably, the value of moving in the classroom and incorporating it into the content.

Implications of Research

After conducting my research, I have determined that it is highly important that increased movement become the norm in each classroom. It may be difficult for classrooms that have a small amount of space combined with a high student to teacher ratio, but this seems to be where it is most important. The students in those classrooms are often missed because they are not actively engaged in their learning. The classrooms with high student to teacher ratios may have a teacher that is fearful to try something new and take the risk of losing control of their classroom. If all teachers feel that way, or believe someone else will take care of making sure they move, we send students home that have not experienced true learning and have not done their best for the day. In order to change this, I would like to look into grants that afford the opportunity for more movement related learning opportunities. In the past I have been a part of such a grant and it was wonderful to have support and a team of teachers with the same ideals. This is something that I intend to seek out in the coming years.

Along with researching movement grants, I would like to conduct some other formal studies, or recommend them for other teachers interested in movement and learning. It would be of interest to me to investigate the impact of movement that is

incorporated into the lesson as compared to activity and movement that is conducted alongside the lesson but not directly linked. I would be curious to see if movement that is not clearly linked to the material would be as impactful as movement as an activity in the lesson.

Moving Forward

Based on my research, I believe that movement definitely has its place in teaching and learning. I rediscovered that it does not need to be as intensive as many assume it may need to be. Moving during a lesson can be a very simple task such as walking to opposite ends of the room as a form of a response. It could also mean something more intense, if the situation allows, such as allowing students to act out a new concept. There are a variety of ways to incorporate movement, but the smiles on the students' faces are enough to encourage the continuation of the process. There are such limited opportunities for students to move during the day that it needs to be someone's responsibility to make sure they are allowed to do so. The improved student performance spoke for itself.

All teachers should attempt to include one lesson each month that includes movement. For me, the reaction from the students was enough to make me want to plan more of them. There was definitely a bit more planning and preparation required for the lessons that directly wove movement into the lesson. It required that I come to school a bit early to set prepare, and sometimes stay later to clean up, but in the long run it saved time. By having students participate in the activities, the retention was higher. This prevented me from spending a significant amount of time reviewing and re-teaching the same content day after day because of connections that were missed in the brain. The

time invested on the front end is worth the time saved on the back end, and worth seeing the smiles from students.

Conclusion

Of course, if using activity and movement were acceptable in all programs, and easy for everyone, I believe it would be the norm. The literature, as well as my own research, supports the idea that movement and learning should go hand in hand.

Movement supports the biological connections required to sustain learning and improve comprehension. That being said, there are times that the option may not be as readily available in some programs, or teachers may be fearful of trying something new. As mentioned, I believe that trying a lesson with movement will be enough to convince any teacher that it is a valuable tool. Though it may not start as something that is done daily, over time that can develop.

During the research process, there were a few unforeseen issues and variables that were difficult to control which may have impacted the outcome of the data, as well as some that were a little more apparent from the beginning. Despite being aware of some variables ahead of time, I did not feel that it would have such a dramatic impact that the study should be cancelled or redeveloped. The concerns were more those of consistency than anything.

The first issue is because the surveys were anonymous. There were some days that certain students were not present, but had been the day prior. That is to say, not all students were in every class every day, participating in every lesson, answering every

formative assessment, completing every warm-up question, and filling out every survey. I worry that this may have affected the data because the participants became a variable.

Second, I was concerned that the data may have been affected by some students that filled out the survey with intentions of being silly. Each day there was one survey that had the same number pattern. I was tempted to take those surveys out of the calculations, but if they really were truthful numbers and it just happened to be a coincidence I did not want to jeopardize the authenticity of the data. After having seen that, though, I hope that students took it as seriously as I asked them to.

Last, if given the opportunity I would conduct this study for a longer period of time. I will continue to gather data next year on the same topic to see what sort of information I gather. I cannot help but wonder how much students could have improved if they became accustomed to my teaching style. Students can sometimes fight back against a system that is different than what they are used to. I wonder if I began collecting data after they were adjusted what kind of growth I may see.

This was a wonderful experience. Though the process of writing the capstone was stressful at times, I feel I gathered information that was of value to myself, other teachers, but most importantly, students. If we can work together to incorporate more movement activities we can really improve the brain function of our students and, based on my results, their performance as students in a classroom. There were not many articles that encouraged the opposing viewpoint, but in at least one piece of literature it was suggested that teachers are afraid of losing control of their classrooms. It is worth noting that not only did positive logs increase during the time of this study, but negative logs decreased.

We need to give students the opportunity to prove to us that they are capable of being successful and taking advantage of those learning activities appropriately. I was pleasantly surprised by the respect and appreciation I felt.

APPENDIX A

Letter of Informed Consent

June 2, 2016

Dear XXXXXXXX Cottage Staff,

I am your student's personal finance teacher and a graduate student working on an advanced degree in education at Hamline University, St. Paul, Minnesota. As part of my graduate work, I plan to conduct research in my classroom from June 20-July 21, 2016. The purpose of this letter is to ask your permission for the students in your cottage to take part in my research. This research is public scholarship the abstract and final product will be cataloged in Hamline's Bush Library Digital Commons, a searchable electronic repository and that it may be published or used in other ways.

I want to study how movement that has been built into a lesson impacts student learning and engagement. Throughout the last five years of teaching I have attempted to include movement and physical activity in my lessons as frequently as possible. I wanted to now collect specific data about student engagement and comprehension during lessons with incorporated movement. Over this four week study I will ask students to complete anonymous surveys at the end of every class to assess how interested they were in the topic, how engaged they felt, and how much effort they believe they put forth. After completing these surveys I will also do a secondary analyses of positive and negative logs recorded during the lesson, as well as accuracy of formative assessment responses. These secondary analyses will not be anonymous, but will be viewed alongside the ratings provided from the survey to assess the class performance as a whole when movement is involved.

There is little to no risk for your students to participate because the only addition to regular classroom instruction is completion of the daily anonymous survey. The survey questions ask students to provide a numeric response to engagement in the topic that are unlikely to cause distress. All results will be confidential, anonymous, and shall remain secure throughout the course of study, and subsequently destroyed. I will not record information about individual students, such as their names, nor report identifying information or characteristics in the capstone. Participation is voluntary and you may decide at any time and without negative consequences that information about your students not be included in the capstone.

I have received approval for my study from the School of Education at Hamline University and from the principal of XXXXXXXX, XXXXX. The capstone will be catalogued in Hamline's Bush Library Digital Commons, a searchable electronic repository. My results might also be included in an article for publication in a professional journal or in a report at a professional conference. In all cases, your students' identities and participation in this study will be confidential.

If you agree that your students may participate, keep this page. Fill out the duplicate agreement to participate on page two and return to me via the school office no later than June 15th. If you have any questions, please feel free to email or call me.

Sincerely,

Nina Bauernfeind

Informed Consent to Participate in Qualitative Surveys
Return this portion to Nina Bauernfeind via the XXXX office

I have received your letter about the study you plan to conduct in which you will be conducting anonymous surveys regarding student engagement during lessons including movement. I understand there is little to no risk involved for my students, that their confidentiality will be protected, and that I may withdraw or my students may withdraw from the project at any time.

Parent/Guardian Signature

Date

Researcher copy

APPENDIX B

Research Survey

Research Survey

The following survey is anonymous and will in no way impact your grade for this course. Please write a number from 1-10 for each of the following questions. In each case, 1 is the lowest and 10 is the highest. Please shade or circle the number that is most appropriate for you.

Remember:

- Do **not** write your name on this form
- Do not make comments on this paper that would allow anyone to identify who completed the survey
- When you are finished, please place the completed survey in the manila folder at the front of the room
- This survey will have no impact on your grade

1. Rate your **level of understanding** for today's topic **before class** began.

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

2. Rate your **level of interest** in this topic **before the lesson** began.

1	2	3	4	5	6	7	8	9	10
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3. Rate your **level of participation** in the days lesson.

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

4. Rate your **level of effort** in class.

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

5. Rate your **level of interest** in this topic at the **end of the class** period.

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

6. Rate your **level of understanding** for this material at the **end of today's lesson**.

1	2	3	4	5	6	7	8	9	10
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REFERENCES

- Basch, C. E. (2011). Healthier Students Are Better Learners: A Missing Link in School Reforms to Close the Achievement Gap. *Journal of School Health, 81*(10), 1-109. Retrieved March 12, 2016.
- Benes, S. s., Finn, K. E., Sullivan, E. C., & Yon, Z. (2016). Teachers' Perceptions of Using Movement in the Classroom. *Physical Educator, 73*(1), 110-135.
- Bright, R. (n.d.). Kids Who Can't Sit Still. Retrieved March 16, 2016, from <http://www.nea.org/tools/47003.htm>
- Conyers, M., & Wilson, D. (2015). Smart moves: Powering up the brain with physical activity. *Phi Delta Kappan, 96*(8), 38-42.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Los Angeles: Sage.

- Erickson, K. I., Voss, M. W., & Prakash, R. S. (2010). Exercise training increases size of hippocampus and improves memory. Retrieved April 02, 2016, from <http://www.pnas.org/content/108/7/3017.full>
- Fensterwald, J. (2013). U.S. scores stagnant, other nations pass us by in latest international test. Retrieved March 03, 2016, from <http://edsources.org/2013/u-s-scores-stagnant-other-nations-pass-by-in-latest-international-comparison/52052>
- Fiore, N. (2014, August 08). The Benefits of Movement in Schools. Retrieved March 17, 2016, from http://www.creativitypost.com/education/the_benefits_of_movement_in_schools
- Grant, M. (1985). The kinesthetic approach to teaching: building a foundation for learning. *Journal Of Learning Disabilities, 18*, 455-462.
- Guarino, J. (2014). Building Community with a Kinesthetic Classroom. Retrieved March 28, 2016, from http://www.nysut.org/~media/files/nysut/resources/2014/april/edvoice7_03_kinestheticclassroom.pdf?la=en
- Hillman, C. H. (2014). I. AN INTRODUCTION TO THE RELATION OF PHYSICAL ACTIVITY TO COGNITIVE AND BRAIN HEALTH, AND SCHOLASTIC ACHIEVEMENT. *Monographs Of The Society For Research In Child Development, 79*(4), 1-6.
- Jensen, E. (1998). *Teaching with the brain in mind*. United States of America: Association for Supervision & Curriculum Development.
- Jensen, E. (2000). Moving with the Brain in Mind. *Educational Leadership, 58*(3), 34.
- Jensen, E. (2005). Teaching with the Brain in Mind. Retrieved February 19, 2016, from

<http://www.ascd.org/publications/books/104013/chapters/Movement-and-Learning.aspx>

Klein, S. (2013, October 25). This Is What Happens To Your Body When You Exercise.

Retrieved March 12, 2016, from http://www.huffingtonpost.com/2013/09/04/body-on-exercise-what-happens-infographic_n_3838293.html

Kolb, B., Mychasiuk, R., Muhammad, A., Li, Y., Frost, D. O., & Gibb, R. (2012).

Experience and the developing prefrontal cortex. Retrieved March 28, 2016, from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3477383/>

Maddern, K. (2012). You fill up their senses. *TES: Times Educational Supplement*, (5021), 4-7.

Mahar, M. T., Murphy, S. K., Rowe, D. A., Golden, J., Shields, A. T., & Raedeke, T. D.

(2006). Effects of a Classroom-Based Program on Physical Activity and On-Task Behavior. *Medicine & Science in Sports & Exercise*, 38(12), 1-10.

Mandal, A. (2014). Hippocampus Functions. Retrieved April 03, 2016, from

<http://www.news-medical.net/health/Hippocampus-Functions.aspx>

McDonald, M. C. (2007). Active transport to school: Trends among U. S. schoolchildren,

1969–2001. *American Journal of Preventive Medicine*, 32(6), 509–516.

Mills, G. (2000). *Action research: A guide for the teacher researcher*. Upper Saddle River, N.J.: Merrill.

Mobley, K., & Fisher, S. (2014). Ditching the Desks: Kinesthetic Learning in College Classrooms. *Social Studies*, 105(6), 301-309.

National Institute on Aging. (2008). Neurons and Their Jobs. Retrieved

April 03, 2016, from <https://www.nia.nih.gov/alzheimers/publication/part-1-basics-healthy-brain/neurons-and-their-jobs>

Pellegrini, A. D., Huberty, P. D., & Jones, I. (1995). The effects of recess timing on children's playground and classroom behaviors. *American Educational Research Journal*, 32, 845-864.

Perkins-Gough, D. d. (2015). Secrets of the Teenage Brain. *Educational Leadership*, 73(2), 16-20.

Physical Changes During Puberty. (2015, November 21). Retrieved March 17, 2016, from <https://www.healthychildren.org/English/ages-stages/gradeschool/puberty/Pages/Physical-Development-of-School-Age-Children.aspx>

Pless, P. (2015). Executive Function and the Developing Brain. Retrieved July 19, 2016, from <https://depts.washington.edu/ccfwb/content/executive-function-and-developing-brain-0>

Reale, E. e. (2014). Challenges in higher education research: the use of quantitative tools in comparative analyses. *Higher Education*, 67(4), 409-422.

Research Guides. (n.d.). Retrieved April 16, 2016, from <http://libguides.usc.edu/writingguide/quantitative>

Reilly, E., Buskist, C., & Gross, M. K. (2012). Movement in the Classroom: Boosting Brain Power, Fighting Obesity. *Kappa Delta Pi Record*, 48(2), 62-66.

Schweitzer, J. (2015, June 10). The constant movement in ADHD may help children think, perform in school. Retrieved March 16, 2016, from <http://www.ucdmc.ucdavis.edu/publish/news/newsroom/10069>

Shoval, E. e. (2011). Using mindful movement in cooperative learning while learning about angles. *Instructional Science*, 39(4), 453-466.

Tarver, J., Daley, D., & Sayal, K. (2015). Beyond symptom control for attention-deficit hyperactivity disorder (ADHD): what can parents do to improve outcomes? *Child: Care, Health & Development*, 41(1), 1-14. doi:10.1111/cch.12159

U.S. Department of Education, National Center for Education Statistics. (2010). *Teachers' Use of Educational Technology in U.S. Public Schools: 2009* (NCES 2010-040).

Weissman, L.. (2014, February 27). Cerebellum Exercises - Learning Breakthrough. Retrieved April 03, 2016, from <http://learningbreakthrough.com/learning-breakthrough-blog/cerebellum-exercises/>

Wilson, D. (2014). Move Your Body, Grow Your Brain. Retrieved February 17, 2016, from <http://www.edutopia.org/blog/move-body-grow-brain-donna-wilson>