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Physical Activity in the Secondary Classroom

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Abstract

The purpose of this thesis is to review literature related to exercise breaks in the secondary classroom. There is a current nation-wide effort to increase active behavior in our youth. Secondary teachers and administrators are finding new methods to incorporate exercise in the classroom based on professional and personal interests and Comprehensive School Physical Activity Programs. Research reviewed on exercise breaks includes cognitive and attentional benefits and variables to consider when planning exercise breaks. Most research identifies a positive correlation between exercise breaks in the secondary classroom and increases in cognitive or attentional benefits for students. No major negative impacts of added exercise were found. In conclusion, including exercise breaks in the secondary classroom could enhance student cognition, attention, and other health benefits which increase academic achievement.

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CHAPTER I: INTRODUCTION

History

We are all familiar with the idea that physical activity improves our health. Not only are doctors and fitness professionals telling us this, but also the government of the United States of America is recommending physical activity for all ages. (U.S. Department of Health and Human Services, 2019). However, brain research has shown that physical activity is not only important for improving our health, but also for enhancing our learning process (Jensen, 2000).

Throughout American history, activity has been incorporated into school. The importance of keeping youth fit has been a priority. For centuries, there has been a belief that if students are healthy, they will contribute to their communities. The President's Council on Sports, Fitness and Nutrition has existed since 1956, under Dwight Eisenhower. At that time, a published study had shown American youth to be less fit than their European counterparts. (U.S. Department of Health and Human Services, 2019). This news urged the government to bring the focus of health into schools. Hence, the Presidential Physical Fitness Awards were born. Many of today's adults may remember these fitness awards signed by the president. Over the years, the President's Council on Sports, Fitness and Nutrition morphed and changed with the administration and the current societal focus.

Many schools have had to cut physical education due to budget constraints. Today's students spend more time focused on improving standardized test scores in a sedentary state. It is important to wonder why in a society where childhood obesity is on the rise, is it really in students' best interest to be cutting activity out of the school day? Many teachers have been

feeling the need to take the lead and facilitate activity breaks themselves to add physical movement into the students' day in the classroom.

According to Jensen (2000), who has spent many years researching the brain in relation to education, movement is important for students for several reasons. Movement increases the heart rate which leads to more oxygen going to the key areas of the brain; the increased physical arousal narrows our attention to target tasks (2000, p. 34). He also states that a human brain is designed to learn information in short segments followed by time to process that information (2000, p. 34). Jensen's claims (2000) lead to the assumption that short movement breaks in the classroom could impact not only attention, but also overall cognition, leading to improved academic performance.

There is significant research about elementary age students needing movement breaks or physical activity breaks to improve attention during the school day. These breaks sometimes called "Brain Breaks" or activity breaks are woven into the classroom and led by their grade-level teacher rather than in a gym facilitated by a physical education teacher. Teachers do this often in elementary school classrooms. Several online resources to guide the movement breaks are available to elementary school teachers.

Middle and high school students often struggle with attention. They have several classes and many students have a heavy workload. I believe physical activity in the classroom would also benefit these older students. The amount and extent of research surrounding movement breaks in the secondary classroom is vast and inconclusive. It is even sometimes contradictory. Interestingly, adolescent students are arguably those who should have the most focus because

"the middle school years are the most important phase of socializing people for lifetime physical activity" (Doolittle, 2016).

Movement Breaks

Movement breaks can be defined as a short segment of physical activity performed in the classroom. Many studies refer to a single short segment of physical activity as an "acute bout". This is a term used in contrast with "overall physical fitness" which would be a level of sustained fitness in an individual over a long period of time. Through this paper, I will examine research about students with attentional disorders such as Attention Deficit and Hyperactivity Disorder (ADHD) and how physical activity affects these students.

Much of the research around movement breaks focuses on the intensity (ex. moderate, vigourous) or duration (ex. 10 minutes) of physical activity. Activity has been measured by researchers (Schmidt, Benzing & Kramer, 2016) to differentiate between the beneficial effects of cognitive engagement as compared to physical engagement; exercises which are strictly to take your mind off of academic work. In this paper I will explore and compare the research about coordinative and aerobic exercise. Coordinative exercise can be defined as exercise which exerts a mental challenge and coordination (Budde, Voelcker-Rehage, Pietrabyk-Kendziorra, S., Ribeiro, & Tidow, 2008). An example of coordinative exercise is balancing on one foot or raising your left arm and raising your right leg simultaneously. Aerobic exercise is specifically designed to get the heart-rate up and is continuously performed with simple movement that does not require additional mental challenge (Schmidt et al., 2016).

Defining Attention and Cognition

Much of the research involving attention and cognition is performed by brain scientists and researchers who use specific terminology and methods of testing. The Merriam Webster Dictionary (2019) defines the term “cognitive” as: “of, relating to, being, or involving conscious intellectual activity (such as thinking, reasoning, or remembering).” In this thesis, the term cognition is used to define a process of learning. These terms are broken down further in the explored research. Attention is defined by Budde et al. (2008) “as the capacity to focus on one stimulus while suppressing awareness to competing distractors” (p. 220). Attention is also measured scientifically through certain types of testing.

Scientific Testing

The Eriksen Flanker Task is utilized often in brain research regarding physical activity. This task or a modified Flanker Task, requires selective attention and executive control. In this task, irrelevant stimuli have to be inhibited or restrained in order to respond to a specific stimulus. (Voelcker-Rehage, Niemann, Hübner, Godde & Winneke, 2016). Another common task is the Stroop Task, which requires the cognitive abilities of selective attention and inhibition control. In the Stroop Task, the color of the ink that the word is printed in must be named by the participant. For instance, the word green may be printed in blue ink. If ink and color name do not match, the reaction times increase because of this interference. (Voelcker-Rehage et al., 2016). The Wisconsin Card Sorting Test is designed to measure a type of executive functioning called cognitive flexibility or shift-setting. It is also used to measure task persistence (Teubner-Rhodes, Vaden, Dubno, & Eckert, 2017). Other cognitive performance tests include the Trail-Making Test which utilizes software that measures speed of

processing and switching between tasks, known also as shift-setting and the Tower of London planning and problem-solving task. The Trail-Making Test (Piepmeier et al., 2015) asks participants to quickly place circles, which contain a number inside, from a random sequence to numeric order (e.g., 1, 2, 3). The second half of this test includes circles which contain a letter or a number and they must be placed in order of (e.g., 1, A, 2, B, 3, C). The Tower of London software allows the screen to be split for participants to see the working area and the goal. The goal is what the participant needs to build. Several colored circles are stacked up to make the goal image (Piepmeier et al., 2015).

Implementing Activity Breaks

The implementation of activity breaks in the classroom widely vary due to several factors influencing teachers. With all of their curricular demands, teachers who want to incorporate activity breaks need to feel there are benefits for the students. Many teachers who implement these breaks have a professional and personal interest in physical activity. However, many teachers perceive barriers to implementing activity breaks such as lack of time or resources (Dinkel, Schaffer, Snyder & Lee, 2017). Subjective studies have been included in this literary analysis to understand teachers' perceptions of including activity breaks in the classroom.

Research-based programs have been implemented to help students obtain more physical activity during the day. These programs include CATCH, Take 10! Active Schools, Let's Move It and other comprehensive school physical activity programs. This literary analysis will examine research performed at the schools participating in these programs.

This topic is of personal and professional interest to me. As an educator and certified fitness instructor, I know that it is not only elementary aged students who may academically benefit from exercise. I will examine research about movement breaks potentially improving attention, cognition and overall academic performance in adolescents. I will include ways to incorporate activity into the classroom for adolescent students in an efficient and beneficial manner.

For this thesis, I will seek to address the following questions within academic literature: How can exercise breaks be incorporated into the secondary classroom? Do movement breaks improve attention and cognition in adolescents? What variables should be considered for planning secondary classroom exercise breaks?

CHAPTER II: LITERATURE REVIEW

Overview of Literature Reviewed

The literature reviewed for this analysis is mostly peer-reviewed journal articles based on empirical research conducted in quantitative studies. The terms used for searching included: exercise breaks, cognition, attention, physical activity, engagement, acute exercise, coordinative exercise, adolescents and secondary. There were several more resources found that were referenced within the journal articles found on the scholarly research database. There was sufficient information found with quantitative studies to examine the proposed question: Do movement breaks improve attention and cognition in adolescents?

Qualitative reviews were also consulted to examine how exercise breaks have been incorporated into the classroom. Much of this was survey-based with teacher's opinions included. Few online articles from experts in the medical and educational field were also consulted for information on medical definitions as well as, exercise breaks, activity breaks, and engagement and how to incorporate activity into the classroom.

Incorporating Exercise Breaks into the Classroom

After analyzing research that supports the cognitive benefits of exercise, teachers and administrators need to decide how best to integrate exercise breaks into the school day. The U.S. Department of Health and Human Services (2008) recommends that adolescents engage in 60 minutes of moderate to vigorous physical activity a day. However, 73.9% of high school youth did not meeting this recommendation in 2017 (CDC). Therefore, schools could be offering more physical education and recess, however both of these areas have declined in recent years in order to cover additional time in academic instruction. These observations are well-stated:

> Given the mounting evidence of a positive correlation between students' engagement in PA (physical activity), their general state of physical fitness, and academic achievement, a decrease in structured PA (physical activity) during the school day may actually be counterproductive to the principal mission of the educational system of increasing academic success. (Delk, Springer, Kelder & Grayless, 2014. P. 722)

If much research is promoting cognitive and health benefits of physical activity, why is it not being used more frequently in the classroom? Several studies (Cothran, Kulinna, & Garn, 2010; Delk et al., 2014; Dinkel et al., 2017; Warehime et al., 2019) examined the reasons teachers were encouraged to engage in a classroom physical activity program and reasons why teachers were inhibited from those efforts.

Encouragement to Use Physical Activity in the Classroom

The highest-ranked reason (Cothran et al., 2010) that encouraged teachers to integrate physical activity into their classroom was because they felt it helped meet students' wellness needs (See Table 2, Appendix). Closely following this reason was that the teacher themselves were interested in wellness. The third finding in this study was that teachers felt that integrating physical activity into the school day would help motivate students academically (Cothran et al., 2010). This study was conducted during a year-long curriculum change implementing physical activity in their schools. The process involved interviews of 23 teachers in ten Southwestern United States schools located in a Native American community. Roughly half of the teachers were elementary and the other half secondary licensed, with no license to teach physical education. Teachers were given outlines of basic standards-based plans that integrated physical activity with traditional academic content. They were asked to use at least

ten lessons which incorporated pedometers in these content areas. The teachers were also assigned to work with a mentor-teacher who was experienced with using physical activity in the classroom.

More than half of the teachers surveyed responded that they genuinely cared about the students' well-being. Many of the teachers also stated they were already concerned with the state of health of their students claiming that diabetes was already prevalent in school-age children. Several teachers alluded to increased attentiveness that they perceived to be due to the physical activity infused into the school day. One teacher was quoted as saying that she still finds better results with the students if she keeps them active. She perceives that they are a little more likely to learn and pay attention. The students expect that they will be up and moving and then doing other activities. She believes she has better results if she mixes-up movement-based activities and seated work (Cothran et al., 2010, p. 1385).

Consistent findings of Cothran et al. (2010), were found in a study by Dinkel et al., (2017). This study found that the perception of preschool- 8th grade teachers was mostly favorable toward physical activity in the classroom. In this instance, physical activity was defined as taking a short break, typically three-five minutes, within the classroom to perform physical movement or integrating physical movement into academic concepts (Dinkel et al., 2017). Three hundred and forty-six teachers from five districts in mid-sized cities across the Midwest were selected for an online survey about physical activity use, then they were interviewed if they were interested in participating.

More than 90% of teachers responded to the survey that they already use physical activity in the classroom (Dinkel el al., 2017). These teachers reported implementing physical

activity breaks for behavioral, physical and cognitive improvements. They also reported that students overall enjoyed the classroom physical activity. Interestingly, also in alignment with Cothran et al. (2010), this study found that more than 90% of teachers were active three or more days a week, indicating that teachers who already were implementing physical activity in the classroom was due to their own personal interest in wellness. These teachers reported feeling confident about the method of incorporating classroom physical activity.

There were specific programs these teachers reported using to implement physical activity into their classrooms. Over half of the teachers reported using GoNoodle, a website with a variety of classroom physical activity videos with which students are able to physically engage. Also, more than half of the teachers reported using diffing forms of general movement, for example jumping jacks or content games which require movement around the classroom.

A recent study was conducted specifically looking at physical activity use in secondary science classrooms (Warehime et al., 2019). Eleven secondary science teachers from a Midwestern metropolitan area were interviewed to explore the use of physical activity in their classrooms. The definition of physical activity in study differed slightly in that it was defined as "integrating any type of PA (physical activity), at any level of intensity within general education classrooms during normal classroom time" (Warehime et al., 2019. p. 203). All but one of the eleven participants reported already utilizing classroom physical activity in the form of in-class physical activity breaks, outdoor activities, and to support curriculum with movement. Of the 11 teachers, four reported to implement physical activity into their classrooms daily, whereas four additional participants reported using physical activity in the classroom between one and

four days a week. The primary reason for these teachers implementing daily classroom physical activity was for behavioral improvements, leading to better attention.

According to these secondary science teachers, Mondays and Fridays were perceived to be the most effective for implementing classroom physical activity. Mondays were cited as ideal because of student fatigue and Fridays were cited as ideal for behavioral reasons. In both of these cases, physical activity breaks were designed to increase attention or memory (cognitive functioning). Five of the teachers reported morning as an effective time to conduct physical activity breaks and more than half of the teachers reported a perceived improvement in student's academic performance and/or behavior. Most of the science teachers noted that they incorporated physical activity into the curriculum as part of experiments and labs. Outdoor science-related activities, as well as, non-academic brain breaks were also cited as methods of incorporating physical activity into the classroom (Warehime et al., 2019).

These studies analyzed the motivational reasons that teachers incorporate physical activity into the classrooms. A common theme is that the teachers who already use classroom physical activity breaks seem to find beneficial effects not only for attention, but for academic performance as well as students' overall health. These perceived benefits are a key factor in teachers' motivation to incorporate activity breaks into their classroom.

Perceived Barriers

Scientific evidence of benefits is not always enough for teachers to implement activity breaks in the classroom. Teachers in the same studies listed above (Cothran et al., 2010; Dinkel et al., 2017; Warehime et al., 2019) found challenges to implement activity breaks in the classroom. The most common barrier noted specifically by secondary classroom teachers

(Cothran et al., 2010; Dinkel et al., 2017) was time or scheduling. This makes sense because typically secondary classroom teachers have only a select amount of time with students. Unless the physical activity is planned into the curriculum, it could be challenging to take time away from content matter.

Another barrier mentioned by Cothran et al. (2010) was the pressure of standardized testing. At the high school level a teacher reported that students were coming into the classroom without some of the important basic skills of math, reading and writing. Teachers take time in class to help those students, especially those in low-income areas, that need the additional time within those state standard curriculum areas. This additional time spent on getting students up to speed on the core standardized subjects could thus, interfere with the time that might be spent on in-classroom physical activity breaks (Cothran et al., 2017). As standardized tests are a main focus for most schools, this could be a common barrier for many schools, especially schools where students are already performing below grade level.

Another barrier to integrating classroom physical activity perceived by more than half of teachers (Dinkel et al., 2017) was classroom management. Some teachers stated the students became off-task after the physical activity breaks. This does contradict the reason that some teachers are encouraged to use classroom physical activity. As stated earlier, many teachers use physical activity due to perceived improvements in student attentiveness. Also, one thought is that this off-task behavior could be more of an elementary-age student issue or perhaps a maturity issue for secondary students. Student reluctance to participate was also cited by some teachers as a barrier to incorporate classroom physical activity in the secondary classroom, although not often (Dinkel et al., 2017).

Infrastructural issues were also cited as barriers to implementing classroom physical activity. Specifically, classroom space and large class sizes were mentioned in Warehime et al., 2019. With class sizes increasing, classrooms are not large enough for students to physically move around. Structures such as tables and desks could be in the way and moving the objects isn't feasible as a daily option. Technology also falls into this category as a barrier (Dinkel et al., 2017). Teachers described issues with logging into the physical activity resource website. Lack of wi-fi speed was cited as a barrier by these teachers as well.

Even with the barriers the teachers in these studies identified, most teachers thought they could implement more classroom physical activity with additional resources. Teachers would like more literature about classroom physical activity as well as staff development opportunities that focus on implementing classroom physical activity. Overall, teachers believe that more collaboration with other teachers, as well as, clear support from school administration regarding classroom physical activity would be beneficial to incorporate more physical activity into the classroom (Cothran et al., 2010; Dinkel et al., 2017; Warehime et al., 2019). Community support was also brought up as a potential way to incorporate more classroom physical activity through partnerships and resources. (Warehime et al., 2019). Such partnerships could be with a community organization which is able to provide either monetary or physical resources or teacher training. An example of this type of partnership could be a community medical provider donating stability balls or doing a training for staff on how to include activity breaks into the day.

Physical Activity Integration Projects

How do classroom physical activity breaks relate to the overall theme of healthy students performing better in school? Integrating physical activity projects into schools have become a major focus within the last 20 years. The government push for a more comprehensive school approach to physical activity has was created under President Obama by First Lady Michelle Obama. Comprehensive School Physical Activity Programs (CSPAP) are specific tools designed to help schools implement the comprehensive approach approach to physical fitness. The catchphrase used for the guide for CSPAP even claims: “Active Students = Better Learners”. (see appendix, Image 1). There are five goals in a comprehensive school physical activity program. The components include physical education, physical activity during school, physical activity before and after school, staff involvement, and family and community engagement. (CDC.gov) Two of these components directly relate to classroom physical activity breaks led by general education teachers: physical activity during school and staff involvement. Some research has been done on different types of Comprehensive School Physical Activity Programs.

CATCH

CATCH or Coordinated Approach to Child Health is a program that has become popular in schools across America. As of 2019, CATCH programs are used in more than 10,000 schools across America and more than 50% of schools in Texas, where it was founded. (Catch Global Foundation, 2019) CATCH is designed to promote physical activity, healthy eating and obesity prevention for youth. Texas middle schools participated in a three and a half year trial of CATCH and findings were positive in helping teachers implement weekly classroom activity breaks. Part

of the CATCH program was to promote physical activity in-school. This study tracked thirty middle schools in central Texas and measured progress of classroom activity break implementation over the course of three years (Delk et al., 2014). The schools were separated into three groups. The first group was considered basic and only received training. The second group differed by including facilitator support as well as training and was termed “basic plus”. The third group included both of the elements of the “basic plus” in addition to a social marketing campaign.

As part of this study, an activity break guide was given to all participating schools. This guide was developed by several sources then reviewed by Physical Education teachers to make it easier for teachers to implement physical activity and reinforce academic content (Delk et al., 2014). All activity breaks included in the guide ranged from five to 10 minutes and typically included instructions on how to include and modify instructional content for any subject area.

The data from Delk et al. (2014) was collected by survey in all 30 schools within two measurement periods. The first period occurred in the spring of 2011, during the second year of CATCH implementation, and the second period was in the spring of 2012, during the third year of implementation. The results from the survey indicated that during the first collection period, just over half of teachers in the Basic and Basic Plus receive training on activity breaks. The Basic Plus Social Marketing indicated that over 80% of teachers received training on activity breaks, which was significantly higher than the other two groups. Of the trainings received, roughly 90% were during a faculty meeting, rather than a CATCH district training or other venue. The survey also asked if teachers had access to the CATCH activity break guide and if so, where was it located. In the Basic group, only 56% of teachers indicated they had access to the

activity breaks in the first measurement period and that number increased to 57.8% in the second measurement period. The Basic Plus was significantly higher with 67.6% of teachers indicating they had access to the CATCH activity breaks in the first measurement period. This number for Basic Plus increased to 80% in the second measurement period. The Basic Plus Social Marketing group teachers indicated the highest access to CATCH activity breaks with 79%, then nearly 93% in the first and second measurement periods, respectively.

Teacher self-efficacy was measured using a five point scale. A “5” meant that a teacher felt very confident and a “1” meant a teacher was not very confident. All of the groups averaged somewhere between a “3” and “4” with the numbers increasing from the first measurement period to the second.

The frequency of activity break implementation was also measured in this survey (Delk et al., 2014). Teachers in the Basic group reported 56.3% had conducted at least one activity break during the current school year. That number fell the second year to 53.9% in the basic group. The Basic Plus teachers reported 65.5% had conducted at least one activity break in the last school year and that number increased significantly to 85.2% of teachers conducting at least one activity break in the school year. The Basic Plus Social Marketing group of teachers indicated that 79.5% had conducted at least one activity break in the first measurement period, increasing to 85.8% in the second measurement period. At the end of the second measurement period, 34.3% of teachers in the Basic group, 53.7% of teachers in the Basic Plus group, and 57.7% of teachers in the Basic Plus Social Marketing group reported conducting an activity break in the last week (Delk et al., 2014).

These CATCH middle school results from Delk et al. (2014) are indicative of successful program which gets teachers to conduct more activity breaks in the classroom. The two groups with facilitator support were statistically more likely to conduct activity breaks on a regular basis. This study also indicated that the use of social marketing directed at students may have an impact on teachers' willingness to implement activity breaks. This study concludes that even the training-only approach (Basic) was successful in getting more teachers to include activity breaks. With additional support of facilitators, teachers may be even more likely to adopt activity breaks.

Active Schools

Let's Move! Active Schools is a national initiative of the United States with the goal of engaging schools to increase physical activity, falling under the CSPAP model. This was the original program that is credited to Michelle Obama, former First Lady to get our schools focused on physical activity. The program name has been shortened over the years and is now called "Active Schools".

Research done by Miller et al. (2017) included an evaluation of the Active Schools grants. Active Schools partner with several like-minded organizations to provide grant money to schools to improve physical education and physical activity. This study (Miller et al., 2017) evaluates grants programs of two partner organizations ChildObesity180 and GENYOUth. The purpose of the study was to understand the reported changes in physical education and physical activity within the schools participating in these grant programs.

ChildObesity180 awarded grants to schools to incorporate one of three programs to increase physical activity. These three programs included a before-school physical activity

program, a classroom physical activity break program or a school-based walking and running program. The grants were awarded to the schools in the amount of $1,000 to implement these programs.

Similarly, GENYOUth's program called Fuel Up to Play 60 awarded schools grant money to implement a physical activity "play" from the Fuel Up to Play 60 Playbook. These "Plays" were strategies designed to increase physical activity opportunities before, during and after school. The grant money was awarded in amounts ranging from $300 to $2,000 to support the implementation of the "Plays" (Miller et al., 2017).

Both programs collected data from surveys during periods pre-implementation and post-implementation of the programs. There were 972 schools included in the sample, of these schools roughly 70% received grants from ChildObesity180 and 30% received grants from Fuel Up to Play 60. More elementary schools were awarded grants than secondary schools, roughly 85% to 15%. These grants were also issued nationwide, including 49 states in the sample.

Results from this study (Miller et al., 2017) show that between both the ChildObesity180 and Fuel Up to Play 60 the most significant increases in physical activity practice was due to providing active classrooms (physical activity breaks, subject-based movement activities, walk and shares, etc) and promoting physical activity benefits with messaging in the school (banners and posters in stairways, hallways, etc.). The next most significant increase was due to offering before- and after-school physical activity opportunities. There were significant increases in all of the practices evaluated on the survey. The only practice that didn't increase was for ChildObesity180 offering daily recess, which remained the same and was already high in the

pre-implementation survey at 95%. The findings of the data in this research suggest that small partnership grants may be a potential way to increase physical activity during the school day.

In St. Paul, Minnesota an Active School pilot program based on the Presidential Active Lifestyle Award was presented to sixth graders (Barr-Anderson et al., 2012). This intervention program was six weeks long and consisted of six- 45 minute teacher and peer led physical activity in the classroom, six- 25 minute fitness DVD's, and six physical activity and healthy eating worksheets. The control group received only the weekly activity recording sheets. Both control and intervention groups of students had the incentive of receiving a bookmark and certificate with the presidential seal. Two sixth grade schools participated in this intervention and over the course of the six weeks students were encouraged to log their physical activity. The goal was to complete 60 minutes a day. The results show that the intervention group increased their moderate physical activity on average by 14 minutes a day vs. the control group who actually averaged a decrease of 29 minutes a day. The number of physical activities recorded averaged about two more activities per week in the intervention group than the control group. Eighty-percent or more of intervention group also reported using the DVD's five out of the six weeks with an average viewing of more than three times a week for five of the six weeks (Barr-Anderson et al., 2012). These findings suggest the inclusion of using peers to lead classroom activities and using DVD's may lead to more significant increases in physical activity in middle school students.

Let's Move It

In Finland, a somewhat different trial model called Let's Move It, has been used to increase the amount of physical activity and reduce the amount of sedentary behavior in

students attending vocational school. These students are adolescents, 15-17 years of age, during vocational schools which specialize in a specific career track. The schools involved in this study are located in lower socioeconomic areas because students with lower socioeconomic backgrounds tend to have less active lifestyles. The research done on this trial program is one of the few studies done to identify methods which increase physical activity and reduce sedentary behaviors in students of this age.

Research performed by Hankonen et al. (2016), focused on intervention elements at the personal and environmental level (see Appendix, Image 2). The primary goal of the trial was to determine the effectiveness of the Let's Move It intervention on the change in amount of physical activity and sedentary behavior in adolescent students. Less sedentary behavior and increased physical activity would benefit the vocational students with improved work capacity and mental well-being (Hankonen et al., 2016. p 13). Measurements were taken two-months post-intervention and 14 months post-intervention to determine long-term effects. Physical activity was measured by accelerometers and self-reporting methods. Sedentary behavior was measured by sedentary time and breaks in sedentary time (as measured by accelerometers).

As part of a holistic approach, the design (Hankonen et al., 2016) to educate students about physical activity, the focus was on overall well-being rather than weight loss. The intervention included three steps. The first step was the physical activity group intervention that lasted 45-60 minutes and included motivational messages and self-regulation skills as part of the regular school health curriculum. Trained facilitators taught these courses and to support the curriculum, posters and other marketing material were used in the schools to reiterate the messages. The second step of the intervention was teacher-led classroom activity breaks and

other methods to reduce sedentary behavior while in class. Other methods included using exercise balls as chairs or replacing tables with standing desks. Teachers were also trained in three 90-minute workshops and given written material which demonstrated ideas to reduce student sitting. The third step of this intervention called for improved access to physical activity, increasing access to on-site fitness, creating partnerships in the community for sports practice or facilities use, and providing students with online exercise videos to use at home.

Specific research results for this trial are given in other studies as Hankonen et al. 2016 strictly evaluates the model of the trial rather than the outcome. Heino et al. (2017) reported that there were no statistically significant differences between the control group and the intervention group in regards to the change in physical activity due to the intervention. The data from each of the vocational areas of the control and intervention group showed only a significant difference in the reduction of sedentary time for the Information and Communication Technologies vocational track. No change appeared with Nursing or Business Administration tracks, whereas the Hotel and Catering track actually increased in sedentary behavior with the intervention (Heino et al., 2017).

The Let's Move It trial was also researched from the perspective of teacher intervention (Koykka et al., 2018). It states that teacher behavior is key to changing student health behaviors, as teachers have influence over the amount of activity or sedentary behavior in the classroom. Let's Move It, Finland's intervention trial was more focused on the behavioral aspects of the students and the teachers, specifically using psychological theory and research about forming habits and routines. The teacher training intervention was found to be successful

in increasing teachers' intentions to reduce sedentary time in the classroom (Koykka et al., 2018).

The Let's Move It intervention is interesting because it focuses on an older group of students than the other two studies reviewed with CATCH and Active Schools. CATCH was specifically a middle school intervention and Active Schools looked at both elementary and middle schools. The effectiveness of the activity breaks could be best for younger students, prior to the age of 16. The Let's Move It intervention, based in vocational schools, had participants who were in their later teen years. The intervention was successful in reducing sedentary time, however it didn't change the physical activity levels of the students. Perhaps Doolittle (2016) is correct in that the middle years are when the healthy physical activity habits start to form and school-based interventions may not be as successful in the later years.

Do Movement Breaks Improve Attention and Cognition in Adolescents?

Research has shown mixed results when it comes to understanding if movement breaks actually improve the attention and cognition in adolescents. Research has clearly shown that physical fitness positively impacts many facets of our lives, including cognition. However, as teachers, we are not able to control the physical fitness level of our students. Teachers can, nonetheless, impact the amount of movement in our classrooms. I will be investigating research specifically to find evidence of correlations between attention and cognition and movement breaks.

Soga, Shishido and Nagatomi (2013) performed experiments to investigate the relationship between acute moderate-intensity aerobic exercise and executive function in adolescents. These experiments used tasks to assess inhibitory control, the ability to maintain

focus and behavior, and working memory before, during and after walking on a treadmill at moderate intensity. They also performed the same testing sequence while participants sat in chairs. The test group consisted of 55 Japanese adolescent students ages 15-16. The findings of the study indicated that during the moderate intensity exercise, the inhibitory control was maintained and working memory reaction time and accuracy declined. This study (Soga et al., 2013), did not find a positive effect of exercise on executive function after the exercise. The assessment of participants occurred at five minutes post-exercise. It is possible that the assessment was conducted too soon after the exercise to effect results.

Soga's study did not find positive effects during or five minutes post-exercise. These findings contrast with earlier research (Budde et al., 2008) that acute bouts of coordinative exercise improve attentional performance in adolescents. In this study, the participants were aged 13-16 years of age and were from an elite German performance school. Participants were to perform 10 minutes of sport drills and other coordinative exercises or a regular physical education lesson. 10 minutes post-exercise, they were given tests to evaluate concentration and attention performance. In both instances, the heart rate of the participants were similar, however the results showed that both groups improved attention and concentration performance. Interestingly, the coordinative exercise group results improved attention and concentration performance were significantly higher. Like Budde et al. (2008) several other studies have shown that there is, in fact, a positive correlation between movement breaks and improved attention or cognitive benefits for students (Cooper, Bandelow, Nute, Morris & Nevill, 2012; Fedewa, Fettrow, Erwin, Ahn & Farook, 2018; Hillman et al. 2009; Ludyga, Gerber, Kamijo, Brand & Pühse, 2018; Owen, Parker, Astell-Burt & Lonsdale, 2017; Schmidt, Benzing &

Kramer, 2016). Another recent study, (Ludyga et al., 2018), found that a 20-min break of combined coordinative and aerobic exercise right after lunch is beneficial to both working memory and task preparation processes in adolescents. Participants were 12-15-year-old students from a private school in Finland. The assessment for working memory maintenance was assessed using a Sternberg task which required participants to encode a memory set containing an array of five letters. Electric activity within the brain was recorded using a 64-channel HydroCel Geodesic Sensor Net. This is a device to measure brain waves and electric activity using conductors placed on the body. The Stenberg task indicated faster working memory and task processing after the exercise program. The brain scans also support these findings. The exercise group results of this experiment indicate that a combined aerobic and coordinative exercise program improves the working memory of adolescents (Ludyga et al., 2018).

Owen et al. (2017) found that moderate intensity activity before a mathematics lesson was beneficial specifically for cognitive mathematics engagement in the following mathematics lesson. To find the relationship between physical activity and school engagement, researchers tested for linear and quadratic relationships. Wearable devices which measures movement were used to determine the level of activity in the hour preceding mathematics. Participants also filled out a survey after class to assess levels of behavioral, emotional and cognitive mathematics engagement. The research found a relationship between moderate intensity physical activity and cognitive mathematics engagement. It did not find a significant relationship with behavioral mathematics engagement. There was no relationship found with light or moderate-to-vigorous physical activity. Moderate intensity activities appear the be the

most beneficial intensity prior to mathematics for engagement. Owen et al. (2017) states that "This suggests that moderate-intensity activity is positively associated with investment in learning and strategic learning skills, such as problem solving, but not with active participation in classroom activities and enjoyment of classroom lessons" (p. 65-66).

Physical Fitness

Other research has shown that overall, consistent physical fitness and regular aerobic exercise promotes effective cognitive functions (Stroth, Kubesch, Dieterle, Ruchsow, Heim & Kiefer, 2009). Stroth et al. (2009) says "physical fitness, but not an acute bout of exercise enhances cognitive processing by increasing attentional allocation to stimulus encoding during task preparation" (p.114). This study of adolescents, ages 13-14 of higher and lower fitness levels was performed to measure task preparation, action monitoring and stimulus evaluation (attention and working memory) processes. A modified flanker task was used to measure cognitive functions while wearing electrodes to provide brainwaves during the process. The acute bout of fitness used to compare with overall fitness level was a 20-min moderate intensity stationary bike ride. Event-related potentials were used because they are able to provide brain activity in high resolution waves. Event-related potentials (ERP's) are very small voltages generated in the brain structures in response to specific events or stimuli. (Sur, S. & Sinha, V. K., 2009). These electronic images were able to show how the brain of a physically fit individual performs a task. Findings confirmed benefit from overall physical fitness as was hypothesized. The event-related potential measurements indicated a much stronger task preparation process and also more efficient response monitoring in fit individuals. To conclude, this study showed that contrary to physical fitness, acute bouts of exercise were not related to

electrophysiological brain waves that indicate executive control. It can be deduced that cognitive processing is not significantly influenced by acute bouts of exercise according to Stroth et al. (2009).

Findings by Vanhelst et al. (2016) also point to overall physical activity influencing attention capacity in adolescents. Attention was measured in this study using the d2 Test of Attention. Participants mean age was 14.2 years with a range of 12 5-16.9 years. Physical activity monitors were worn for seven days measuring physical activity level and quantifying into sedentary, light, moderate, vigorous, and moderate-to-vigorous categories. Findings in this study showed that moderate and moderate-to vigorous activity levels showed a significant positive effect on attention capacity. This study differs from those in the past (Budde et al., 2008; Hillman et al., 2009) which specifically look at acute bouts of physical activity and its impact on attention capacity.

> Differing effects for fit vs. unfit participants were found in yet another study:
>
> The present study revealed an interaction between an acute bout of exercise and long-term physical fitness in adolescence. Although fit adolescents showed better performance in the Eriksen Flanker task than unfit adolescents, unfit adolescents, but not fit adolescents benefited from an acute bout of exercise. (Hogan, Kiefer, Kubesch, Collins, Kilmartin, & Brosnan, 2013. p. 94)

In contrast with the previous study by Stroth et al. (2009), this statement creates an interesting perspective about the idea that a single, acute bout of exercise can benefit cognitive speed and accuracy in unfit adolescents in a similar manner as overall physical fitness can benefit cognitive speed and accuracy in adolescents. Therefore, it can be deduced from these findings that an

unfit student would cognitively benefit from an acute bout of exercise. None of these studies (Stroth et al., 2009; Vanhelst et al., 2016; Hogan et al., 2003) found that an acute bout of exercise produced negative cognitive effects, which would mean that fit individuals would not be negatively impacted by an acute bout of exercise in the classroom. As teachers work to incorporate exercise into the classroom, it is also important to think about individual students or groups of students within the classroom who may cognitively benefit from the exercise more so than others.

ADHD

The effects of acute exercise on students with attention deficit hyperactivity disorder (ADHD) were also studied (Piepmeier et al., 2015). Aproximately 11% of children in the United States are affected by this common disorder, according to Piepmeier et al. 2016. Students with ADHD often present symptoms of inattention, hyperactivity, or impulsiveness or any combination of these symptoms (Mayo Foundation for Medical Education and Research, 1998-2019). If a brief bout of exercise in the classroom could improve attention and cognition, this would be a major win for these students and their teachers.

The study observed participants who had a mean age of 11.22 years for non-ADHD and 10.14 years for ADHD. Piepmeier et al. (2015) asked the non-ADHD and ADHD participants to perform one day with a stationary bike for 30 minutes followed by three types of cognitive testing and then one more day for a non-exercise treatment followed by the same cognitive testing. The treatments were mixed for all participants and those with ADHD on medication continued to take their medication. The cognitive tests used to measure cognitive function were the Stroop Test for inhibition control and general speed of processing, Trail Making Test

(TMT) for set-shifting and speed of processing and the Tower of London test for planning and problem solving.

Findings from this study (Piepmeier et al., 2015) found that exercise benefitted only inhibition control and speed of processing based on results from the Stroop test. The TMT and Tower of London tests didn't show any statistically significant results. What was most interesting is that the hypothesis that children with ADHD would benefit more so than children without ADHD by the acute bout of exercise was found to be false. Where the exercise was found to be beneficial, it was equally beneficial for students with ADHD or without ADHD.

If exercise benefits the speed of processing and inhibition control, then these two cognitive functions are able to be manipulated with an acute bout of exercise. This is consistent with findings from Chang, Liu, Yu, and Lee, (2012), which concluded that 30 minutes of moderate-intensity treadmill exercise positively affected cognitive functions for students with ADHD. Participants were 40 children, ages eight through 13, with a clinical diagnosis of ADHD. These children were split into an exercise group or a control group. were "This present study highlights the positive effect of acute exercise on executive function in children with ADHD." (Chang et al., 2012, p. 234). Results were assessed utilizing the Stroop Test and the Wisconsin Card-Sorting Test and suggested that moderate intense aerobic exercise facilitated inhibition, as well as, set shifting. Both of these functions are responsible for the main executive dysfunctions in ADHD.

One difference in Chang et al.'s finding was that the Wisconsin Card Sorting Test suggested positive results with set-shifting and inhibition control, as well as, speed of processing. In both studies, (Chang et al., 2012; Piepmeier et al., 2015) however there were

cognitive benefits after an acute bout of 30 minutes moderate-intensity exercise for participants with ADHD. Again, neither of these studies suggested any negative effects of exercise, leading to the conclusion that exercise would not negatively impact students with ADHD or students without ADHD.

According to Gapin and Etnier (2014), parents perceive that children and adolescents with ADHD can have reduced symptoms with physical activity. Research based on perception alone shows that parents believe that exercise can be used to control certain symptoms of ADHD. Even if the effects of a brief bout of exercise in a classroom are perceived to positively affect ADHD, it would be a strategy to consider for more focused attention.

On-Task Behavior

Classroom teachers often note that students are perceived to be more "on-task" after an activity break. They may be correct in this correlation. Mahar et al. (2006) studied the effects of a classroom physical activity program on on-task behavior. Participants were elementary aged students in a North Carolina public school. The program that was brought into the classroom was termed "Energizers" and was led by the classroom teacher. Teachers received a 45-minute training on how to be effective activity program leaders. Teachers were then asked to provide a 10-minute activity daily to students for 12 weeks. Each classroom was assessed on physical activity using pedometers, a wearable device which measures steps. They were also assessed for on-task behavior with direct visual observations before and after the energizer break. Behavior was observed in ten second intervals. The observer would then circle the corresponding code of: on-task, motor off-task, noise off-task or passive/other off-task.

The intervention group (Mahar et al., 2006) averaged 782 more steps each school day than the control group, which was statistically significant. The mean percentage of the intervention group's on-task behavior measured increased from 70.9% before the Energizer to 79.2% after the energizer. The study concluded that because of the eight-percent increase in on-task behavior, there would also be an impact on the academic performance of students with a ten-minute activity break. They also found that not only did on-task behavior increase overall post activity break, but also that the least on-task students (students who were on-task less than 50% of the time) had an increase of 20% post-activity break (Mahar et al., 2006). on-task behavior was assessed in the 3rd and 4th grade classes specifically, which has a likelihood to translate to adolescents as well as adults.

Brain-Based Movement

Researchers have taken up brain-based science and applied it to classroom education. Spencer Kagan has written several books and includes the research behind why his Silly Sports and Goofy Games actually feed the brain.

> As students play, even if it is only for a two or three-minute game of quick tag, their heart rate and volume increases, pumping more oxygen and glucose to the brain. Their respiratory rate and volume increases as well, oxygenating the blood. With more oxygen and glucose pumped to the brain, students are more alert. (Kagen, 2004, para. 5)

This would be considered an activity break or "brain break". As noted in the introduction, Eric Jensen (Jensen, 2000) agrees that the brain needs breaks to process information. Pairing the additional blood flow from physical movement over the course of a short break, could give the

brain exactly what it needs to become more focused and alert. This is precisely the reason why teachers report students are more focused and why we may see an increase in attention and speed of processing on the cognition tests.

The games that Kagan (2004) refers to in his book are content based games that can be used in the classroom for movement breaks. These games, along with other non-content based methods discussed earlier in this paper, such as GoNoodle and specific exercises, are ways to include brief exercise breaks into the classroom.

Variables to be Considered When Planning Exercise Breaks

Based on this research, how have the specific elements contributed to the results and how might we best identify the type of exercise to perform and for how long to obtain increased attention span and overall cognition? Thirty minutes of moderate-intensity exercise is simply not feasible in the majority of classrooms. There are different recommended exercise methods based on the research found. Once again, the research is quite mixed in its findings.

Intensity and Duration

Examining research that found a positive relationship between exercise breaks and cognitive benefits, there is a wide range of suggestions as to what type of exercise is most helpful. Cooper et al. (2016) found that intermittent, high-intensity and sprint-based exercise provided benefit to speed of executive function for adolescents based on the Stroop test performed both immediately following the exercise and 45 minutes post-exercise. This study's findings are important because "...the exercise model used more closely reflects the high-intensity, intermittent nature of physical activity patterns in young people." (Cooper et al., 2016, p. 159). The exercises performed in this study were 10-second sprints followed by 50

seconds of rest and then the cycle was repeated ten times. The total time of exercise was 10 minutes plus warm-up and stretch. In agreement with the findings from Cooper et al. (2016) and Kujach et al. (2018), this study found that high-intensity intermittent exercise improves executive performance in young adults with a mean age of 21 years.

Cooper, Bandelow, Nute, Morris, and Nevill (2012) also found cognitive benefits in adolescents with moderate-to-high intensity exercise with an acute bout of mid-morning exercise. This research used a seven x 30 meter shuttle run with a 30 second reset. The total time of exercise was 10 minutes. One main difference in this study is that participants were instructed to keep their heart rate below the 190 beats-per-minute threshold. If they did reach the threshold, they walked the remainder of the exercise. The type of cognitive benefit is slightly different than the benefit found in the high-intensity, sprint-based exercise. This amount of time for moderate-to-high intensity exercise could feasibly be conducted in a classroom utilizing a more stationary type of exercise.

Several other studies have supported the claim that short 10-20 minutes of moderate intensity exercise benefits cognition (Budde et al., 2008; Hillman et al., 2009; Owen et al., 2017; Soga et al., 2015). Vanhelst et al. (2016) argues that moderate-intensity exercise made a significant positive effect on attention capacity, followed by a smaller positive impact with moderate-to-high intensity. At the point of high intensity, the positive effect decreased. Vanhelst et al. (2016) studied adolescents over a seven-day period while wearing an accelerometer. This study specifically looked at level of intensity and amount of exercise each day in association with attention capacity.

Vanhelst et al. (2016) found that the amount of time spent daily in moderate exercise that was most beneficial to the participants' attention was at least 41 minutes a day, while the moderate-to-high intensity recommendation was at least 58 minutes a day. This is a comprehensive daily total for exercise. Any amount of exercise in the classroom would contribute to this total. Interestingly, the amount of exercise recommended by the government is 60 minutes, very close to the 58 minutes recommended by Vanhelst et al., 2016, based on their research.

Cognitive Engagement and Physical Engagement

With the understanding that 10-20 minutes of moderate to vigorous intensity exercise breaks having a positive effect on attention, Schmidt et al. (2016) sought to find out if that exercise was best done with cognitive engagement or strictly aerobic exertion. The findings of this study of fifth grade (pre-adolescent) students divided participants into one of four conditions: (1) physical activity with high cognitive demands, (2) sedentary with high cognitive demands, (3) physical activity with low cognitive demands, (4) sedentary with low cognitive demands. Each of these conditions were performed for 10 minutes during language teaching in the morning. Participants wore heart rate monitors and rated themselves with a perceived physical exertion scale as well as a perceived cognitive engagement scale. Interestingly, the findings suggested that the cognitive engagement with low physical exercise condition improved focused attention and processing speed. No significant results were found for the either of the physical exercise conditions. An assumption could be made that cognitively engaging interventions are best for increased attention benefits, however, as we have

previously discussed, other studies have shown positive benefits to attention with just 10-minute exercise breaks (Budde et al., 2008; Owen et al., 2017)

Comparing Coordinative and Aerobic Exercise

When contemplating the type of exercise break to incorporate into the classroom, the previous study examined (Schmidt et al., 2016) showed a positive benefit to attention with cognitive engagement. The next two studies examined differences between coordinative exercises and aerobic exercise. Coordinative exercise is more complex and cognitively demanding with higher motor demands than aerobic exercise. Examples of such exercise would be bouncing a volleyball alternating with left of right hand or dance steps with different directions or speeds. Coordinative exercise could be described as much like cognitively engaging lesson which enhance attention. These two studies argue that coordinative exercises benefit cognition. Ludyga et al. (2017) studied a combination of coordinative and aerobic exercise and found positive benefits for working memory. Budde et al. (2008) designed a study to compare the results of a coordinative exercise bout and an aerobic exercise bout.

Arguing that neither an acute twelve-minute bout of coordinative exercise nor, aerobic exercise improve cognitive performance is van den Berg, et al. (2016). Not only did this study find no effects of low-to-moderate coordinative or aerobic exercise, but also strengthening exercise had no effect on cognitive performance either. This is inconsistent with the findings of Budde et al. (2008) as well as, Ludyga et al. (2017).

Coordinative exercise could also include using stability balls as chairs. It takes coordination of muscles in order to stabilize the body while sitting on a stability ball. Mead, Scibora, Gardner and Dunn (2016) published research on the use of stability balls vs. activity

breaks and a sedentary classroom on standardized math test scores. Three sixth-grade classrooms were used in this study. One math classroom sat on stability balls for the school year. Another classroom used five-minute activity breaks just prior to work time in math class. These five-minute breaks consisted of six, 30-second segments of either strength or cardiovascular exercises. Yet another classroom, remained sedentary for the entire class. The math class was at the exact same time each day for all three classes and used the same curriculum. Test scores were measured in fall for the Measures of Academic Progress (MAP) against the prior year assessment and in the spring with the Minnesota Comprehensive Assessment (MCA) against the prior spring results.

Results of Mead et al. (2016) found that for the MCA test there was a significant difference between the stability balls and activity break class. Test scores for the stability ball class increased an average of four points, whereas the activity break class decreased by about six points. The sedentary class's scores remained within one point of the pre-test. The MAP pre- and post-test results showed a ten-point increase for the stability ball class, a seven-point increase for the activity break class and a five-point increase for the sedentary class. Both of the tests show that the stability ball group was significantly higher than the other two groups. The activity break group only showed an increase in the MAP testing vs. a decrease in the MCA testing, which is contrary to other studies which show activity breaks increase academic performance (Cooper et al., 2012; Fedewa et al., 2018; Hillman et al. 2009; Ludyga et al., 2018; Owen, et al., 2017; Schmidt et al., 2016).

A study which focused on the effects of strength training, aerobic exercise and non-exercise had findings that produced similar positive cognitive effects (Harveson et al.,

2016). Both strength training and aerobic exercise were found to have increased speed of processing based on results from the Stroop test.

CHAPTER III: DISCUSSION AND CONCLUSION

Summary

Performing exercise in the classroom is not a new concept, however there is now more research which indicates that classroom-based activity breaks are beneficial to students' brains and bodies. The recent focus on core-subject testing has typically given students more sedentary time in the classroom. This thesis focuses on research about activity breaks in the secondary classroom, types of exercises to perform to increase attention, how to incorporate these breaks into the classroom and how some schools have integrated more activity into the school day.

There is a variety of research on benefits of exercise on attention and cognition in adolescents. Much of this research has been done by neuroscientists and tests have been performed by analyzing brain waves, as well as, performing tests such as the Eriksen Flanker Task or the Stroop Task for measuring attention. Through some of these tests, effects of short bouts of exercise have been found to improve cognition and attention in adolescents according to some researchers. (Budde et al., 2008; Hillman et al., 2009; Owen et al., 2017; Soga et al., 2015). Other research has maintained that it is overall physical fitness which influences attention capacity in adolescents. (Vanhelst et al., 2016.)

Two separate studies focusing on benefits of exercise and ADHD suggested positive results with speed of processing (Piepmeier et al., 2015; Chang et al., 2012) . Both participants with ADHD and those without ADHD were found to have equivalent benefit from an acute 30-minute bout of exercise (Piepmeier el al., 2015). Chang et al. found that set-shifting and

inhibition control were also benefited by an acute, 30-minute bout of moderate exercise. Speed of processing, shift-setting and inhibition control are all key components of executive function in which are dysfunctional in students with ADHD. On-task behavior was also found to increase after a 10-minute bout of classroom activity. Not only did on-task behavior increase overall post activity break, but interestingly, the students who were on-task the least (less than 50%of the time) had an on-task behavior increase of 20% post- activity break (Mahar et al., 2006).

There is a wide range of suggestions of what type of exercise breaks are most helpful to improving attention or cognition. Cooper et al. (2016) found that 10 minutes of intermittent, high-intensity exercise positively affected the speed of executive function. Kujach et al. (2018) found that intermittent, high-intensity exercise also improves executive performance in young adults. Cooper et al. (2012) found that speed of response time was positively affected across several cognitive domains with a moderate- to high-intensity 10-minute exercise bout in adolescents. Several other studies support the moderate to high-intensity findings (Budde et al., 2008; Hillman et al., 2009; Owen et al., 2017; Soga et al., 2015).

Alternatively, some classrooms focus on academic activity breaks rather than on strictly physical exercise without academic content. Research done by Schmidt et al. (2016) found that cognitive engagement breaks with low physical exercise improved the speed of processing and focused attention. This study did not find significant cognitive benefits for strictly physical activity breaks or physical activity breaks with academic content. Another type of exercise break that has been researched is the more complex and cognitively challenging coordinative exercise break. Two studies (Ludyga et al., 2017 & Budde et al., 2008) found that coordinative exercise breaks benefit cognition, possibly due to the higher motor and cognitive demands.

Teachers who integrate physical activity into their classrooms have given reasons for their choices (Cothran et al., 2010 & Dinkel et al., 2017). According to Cothroan et al. (2010) the encouragement to include physical exercise in the classroom has been based on the feeling that it helped meet students' wellness needs and that they, the teachers, were personally interested in wellness. Another main reason that encouraged the use of physical activity in the classroom is that they perceived it would motivate students academically and benefit attention.

Teachers have also reported barriers to implementing activity breaks in the classroom. The most common barrier that teachers gave was lack of time or scheduling (Cothran et al., 2017; Dinkel el al., 2017; Warehime et al., 2019). Also mentioned, was the pressure of standardized testing as well as infrastructural which includes space and technology. Even with the barriers listed, many teachers still felt they could include more exercise breaks in the classroom with support from administration and staff development opportunities.

With the research that exercise is beneficial to the brain and body, there has been an increase of programs which strive to increase the amount of physical activity students obtain throughout the day. One such model is the Comprehensive School Physical Activity Programs (CSPAP), which is designed to increase physical activity throughout the student's day with a main focus of increasing exercise opportunities during the school day. Several types of Comprehensive School Physical Activity Programs have been in use across the United States and other countries.

The Coordinated Approach to Child Health (CATCH) program was successful with increasing the amount of activity breaks in the middle school classroom. These CATCH middle school results from Delk et al. (2014) are indicative of program which gets teachers to conduct

more activity breaks in the classroom. This study concludes that even the training-only approach was successful in getting more teachers to include activity breaks. With additional support of facilitators and social marketing teachers may be even more likely to adopt activity breaks. Active Schools researched grants from two partners, ChildObesity180 and Fuel Up to Play 60. Results from the study (Miller et al., 2017) show that both the ChildObesity180 and Fuel Up to Play 60 had significant increases in physical activity practice due to providing active classrooms (physical activity breaks, subject-based movement activities, walk and shares, etc) and promoting physical activity benefits with messaging in the school (banners and posters in stairways, hallways, etc.). Another Active School program piloted in St. Paul with 6th graders focused on increasing physical activity with peer involvement (Barr-Anderson et al., 2012). Findings suggest the inclusion of using peers to lead classroom activities and using fitness DVDs may lead to more significant increases in physical activity in middle school students.

Let's Move It is a Comprehensive School Physical Activity Program intervention piloted in Finland with vocational track students who were equivalent to the ages of older United States high school students. This program aimed to decrease sedentary behavior through classroom movement. The intervention was successful in reducing sedentary time, however it didn't change the physical activity levels of the students. (Koykka et al., 2018; Hankonen et al., 2016; Heino et al., 2017).

Professional Application

Teachers responded that they are encouraged to perform more exercise breaks because they feel it will benefit the students with focused attention and overall health. Teachers also responded that barriers of implementing more exercise breaks could be overcome if it were a

school-wide focus with the support of the administration and staff development training. Resources could be provided to the school with the application for Active School grants or partners in the community who would like to support the well-being of students. This method is currently being used in the United States, at the local school district level as well as abroad in countries such as Australia and Finland.

Of all research studied in this thesis, almost all moderate exercise of 10 or more minutes had either a positive or neutral impact on attention or cognition according to the test measures. Very few studies found activity breaks to have no improvement in attention or cognitive abilities. Breaks could be taken in-classroom using specific materials provided by a program created at improving activity in the schools, or teachers could use the research of brain-based educators who suggest content-based, cognitively engaging exercise breaks.

Limitations of Research

Research done on exercise and the relationship between academic benefits is increasing. For this thesis, most of the research found was quantitative and neuroscientific and performed in a research facility. Testing in research facilities may not transfer to the classroom. Much of the cognitive testing included brain activity measurements which is not at all like a school content related exam. Sample sizes of the neuroscientific research tended to be smaller in size which can lead to less reliability in results.

Qualitative research used in this thesis reviewing results of implementing activity breaks in the secondary classroom tended to be survey-based. Surveys or other qualitative research can have bias in the responses from staff discussion prior to responding or differences in perceived observations between responders.

Exercise break research results were narrowed using a specific age range of pre-adolescent to late teenage years. The range was narrowed again specifically to identify cognitive or attentional variables being tested. Studies set in other countries or world regions that fit these criteria were also included in the literature review. Therefore, this review includes conclusions that may possibly apply to other world regions.

Implications for Future Research

Future research should include more quantitative research on actual in-classroom activity breaks and their impact on academic measures. With the understanding that researchers may be better equipped to measure exercise and testing in labs, the reality is that it may not transfer to the classroom. Further research should be done with ADHD students and should include students who have learning disabilities such as Autism Spectrum Disorder and traumatic brain injury.

More stability ball and other coordinated exercise research should be conducted in the classroom. Also, it would be beneficial to study test scores over the time spent using a comprehensive school physical activity program (CSPAP).

Conclusion

Teachers, administrators and school staff are always looking out for the best ways to improve student learning. The addition of physical activity in the secondary classroom or during the school day could improve attention, cognitive abilities and other health benefits leading to improved academic performance.

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Appendices

Interview prompts on teacher motivation.

Interview prompt	Frequency of teacher responses
Meet students wellness needs	14
Personal interest in wellness	12
Motivate students to engage academically	8
Sounds like fun	7
New professional challenge	5
My friend(s) talked me into it	4
Teacher pay	4
My principal encouraged me	1
Free equipment	0
Other	0

Table 1. Interview prompts on teacher motivation. (Cothran et al., 2010)

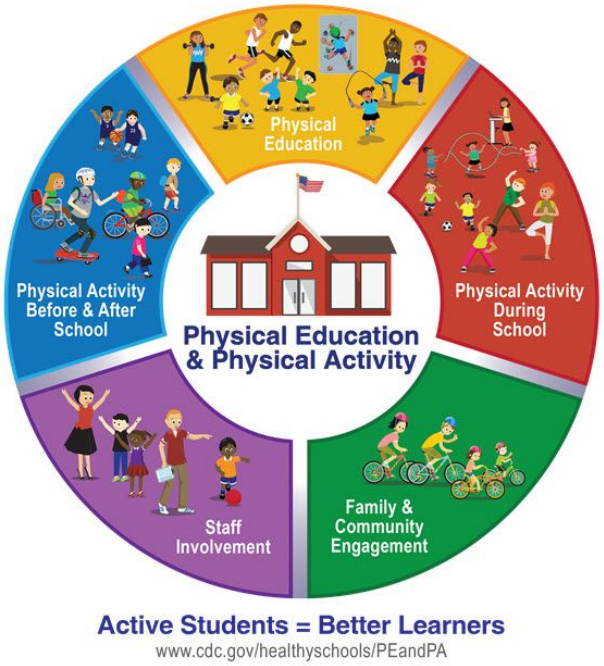

Image 1. Comprehensive School Physical Activity Program graphic. (CDC.gov., 2018.)

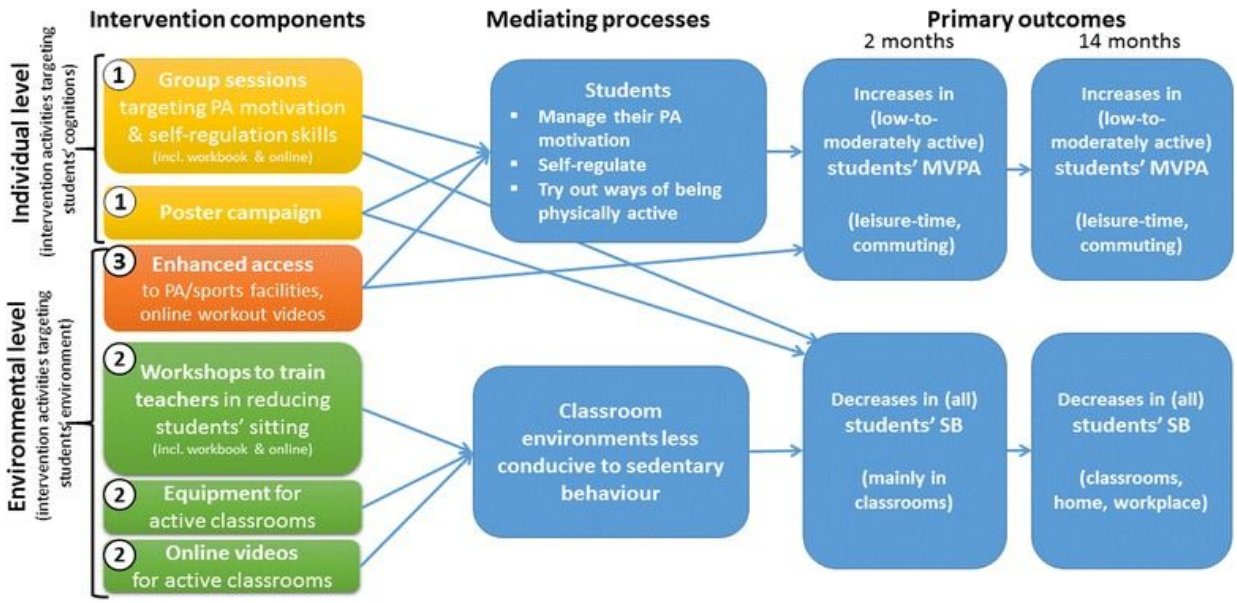

Image 2. Let's Move It Intervention Logic. (Hankonen et al., 2016)