

FREQUENCY OF PHYSICAL EDUCATION AND THE BENEFITS ON COGNITIVE  
DEVELOPMENT IN ELEMENTARY STUDENTS

By

Michael Cochran

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Professional Education Faculty

Northwest Missouri State University Missouri

Department of Professional Education

College of Education and Human Services

Maryville, MO 64468

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Abstract

This research paper discusses the correlation on the frequency of physical education and cognitive development in elementary students in urban school districts in the state of Missouri. Cognitive data was collected using the Missouri Assessment Program (MAP) standardized test scores in both English/Language Arts (ELA) and Math. A statistical analysis was conducted to compare the (ELA) and Math Proficient scores of 3<sup>rd</sup> grade students with the frequency of PE in each elementary school. After completing a t-test analysis and comparing the literature, findings, and statistical data from the Department of Elementary and Secondary Education (DESE), it is found that there is a significant difference between elementary students who receive Physical Education once per week and elementary students who receive Physical Education more than once per week. Elementary students receiving PE more than once per week have significantly higher standardized test scores in English/Language Arts (ELA) and Math.

## INTRODUCTION

### *Background, issues and concerns.*

Physical education for elementary students in one particular urban school district is limited to 50 minutes one day per week. This amount of physical activity does not correlate with the government recommended amount of 60 minutes per day. In addition to the lack of moderate to vigorous physical activity (MVPA) for elementary students in this district, the structured time for PE as it currently exists, hinders the progression of cognitive development for these students as well.

There have been numerous studies conducted which highlight the benefits of physical activity on cognitive development. Preschool and Kindergarten students who grasp locomotor movements such as skipping, galloping, and hopping show improvement in classroom subjects as well. PE classes which involve team activities have the ability to improve social behaviors such as dealing with frustration, appreciating individual differences, and cooperating with others.

Virtually all of the school districts in the state of Missouri require a minimum of 2 days per week for physical education with the exception of this this district. Elementary students in this district are limited in cognitive development and social behavior advances due to the lack of moderate to vigorous physical activity (MVPA) they receive each week. This district has been making exponential strides in regaining accreditation. Most of the accreditation requirements revolve around standardized test scores and student achievement. Incorporating more PE at the elementary level, could assist in this districts test scores, overall student achievement, and regaining full accreditation ahead of schedule.

There have been many research studies which link childhood obesity to the lack of physical activity. When children reach the age of 5, a majority of them spend a significant amount of time sitting at a desk receiving educational instruction. Due to the rapid demand of efficient test scores by the U.S. Government, attempts to maximize core subject instruction such as English/Language Arts (ELA) and Math have been implemented nationwide. With this emphasis on core subject instruction some districts, particularly urban districts have scaled back exploratory subjects such as PE, Music, and Art.

Studies show, however do not outright prove that an increase in physical movement can in turn increase the cognitive development especially in young people such as elementary students. The Obama administration began an initiative recommending that children should participate in a minimum of 60 minutes of moderate to vigorous physical activity daily. Public schools however, must adhere to a different set of standards which are based solely on academic output. The United States is a nation that works diligently on providing students with the tools necessary to succeed in higher education and the job force. Where the nation is lacking is in the decline of standardized test scores in urban districts. Although initiatives have been and will continue to be implemented to supplement this decline, we have yet to put a solid focus on the benefits physical activity has on the big picture of education. Students who receive only one day of PE per week need to have their frequency increased in order to see a boost in standardized test scores.

*Practice under investigation.*

The practice under investigation will compare standardized test scores of this urban Missouri School district with other similar school districts in the state of Missouri which require a minimum 2 days of physical education per week for elementary students. After comparing the

data with KCMSD and other districts, a data analysis will be conducted to see if there is a significant difference in cognitive development among said districts.

*School policy to be informed by study.*

If a significant difference is discovered between the district with one day of PE per week and other districts which require a minimum of 2 days per week in the state of Missouri. A proposal must be taken to the board of education and the Superintendent explaining the educational value of incorporating more PE time into the curriculum.

*Conceptual underpinning.*

There is a correlation among physical activity and cognitive development. In most districts, a minimum of 2 days of physical education per week is required. In this particular urban district, there is a requirement of one day per week. This district has been working towards regaining full accreditation for several years. One of the main focuses of these efforts is standardized test scores. This district is also near the bottom in virtually every educational category. Many factors contribute to the low numbers, which is why every effort must be made to ensure everything is being done to raise these scores. The Board of Education and the Superintendent need to understand the value of incorporating more PE time into the curriculum.

Since physical education has been proven to improve cognitive aspects of learning, a change must be made in this district to include more PE time for elementary students. In addition to the cognitive benefits of more PE time, it would also address the obesity crisis in the United States by giving students a structured environment to receive the required 60 minutes of moderate to vigorous physical activity per day.

*Statement of the problem.*

If more physical education classes benefit cognitive development, the board of education and the Superintendent need to be made aware so they can incorporate more PE time in the curriculum.

*Purpose of the study.*

To find if there is a significant difference in standardized test scores between elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week.

*Research questions.*

Is there a difference in standardized test scores in elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week?

*Null hypothesis.*

There is no difference in standardized test scores in elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week.

*Anticipated benefits of the study.*

Is there a difference in standardized test scores between elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week? School Districts which require 1 day of Physical Education for elementary students must restructure their curriculum to include at least 2 days of Physical Education to improve standardized test scores.

*Definition of terms.*

MVPA-moderate to vigorous physical activity

MAP-Missouri Assessment Program-an annual set of mandatory standardized tests taken by students in the U.S. state of Missouri.

Cognitive Development- a field of study in neuroscience and psychology focusing on a child's development in terms of information processing, conceptual resources, perceptual skill, language learning, and other aspects of brain development.

DESE- Department of Elementary and Secondary Education.

*Summary.*

A study was conducted to see if there is a significant difference in cognitive development between the Kansas City Missouri School district who requires elementary students to have one day of PE per week, and districts who require a minimum of 2 days of PE per week. A t-test will be conducted to compare data between KCMSD and other districts in the state of Missouri.

Once the study is completed and a significant difference is proven. Results of this study will be taken to the Board of Education and the Superintendent to propose more PE time for elementary students in KCMSD.

## REVIEW OF LITERATURE

There have been many research studies over the past several decades that prove a strong correlation between physical activity and cognitive development. The amount of physical activity a child receives affects their cognitive, emotional, social, and behavioral development. Schools and school districts are becoming more aware of these connections and adjusting their schedule and curriculum accordingly.

With increased physical activity, schools have the potential to raise test scores, increase attendance, and decrease behavioral issues. Academics, even at the elementary level are becoming more rigorous due to national, state, and preparatory reasons. An effective way to incorporate more physical activity in the midst of an already full schedule is to collaborate between classroom teachers and physical educators. This supports the idea that movement should be recognized and utilized for its full potential benefits in both the classroom and gymnasium. (Fede, 2012, p. 16).

Early research suggested that physical activity enriches the learning environment. More recent research illustrates the positive benefits physical activity and exercise has on cognition. In 2008, NASPE released a position statement titled Physical Education is Critical to Educating the Whole Child, which states: "Research confirms that students perform better in school when they are emotionally and physically healthy. They miss fewer classes, are less likely to engage in risky or antisocial behavior, concentrate more and attain higher test scores" (NASPE, 2011, p. 1).

Despite the research on physical activity and academics, the amount of physical activity students receive during the school week continues to decline. This decline is attributed to a stronger focus on the core subject academics. The No Child Left Behind legislation raised the bar for academic success, thus forcing administrators to maximize academic instruction which led to a decline in physical activity during the school day. Although research studies have



become stronger over the past decade, there is still a significant disconnect between the research and school practices (Gonzalez, 2010, p. 888).

Ahn and Fedewa (2011), conducted a thorough meta-analysis of 59 studies that examined the effects of physical activity on academic achievement or cognitive functions. They found the greatest effects in math, intelligence quotient (IQ), and reading achievement. The Centers for Disease Control and Prevention (CDC) acknowledges such research, however states that physical activity has either a positive effect or no effect on academic achievement (p. 18). The CDC also reviewed many research studies regarding physical activity and academic achievement, and found less than half to have positive benefits, over half to be insignificant, and approximately 1.5% to be negative. Thus stating that over 50 years of research neither proves nor disproves the positive correlation between physical activity and academic achievement (p. 20).

Due in large part to research studies and medical advances, the United States has a greater awareness on the positive effects of daily physical activity. Physical activity has been documented to increase brain-derived neurotrophic factor (BDNF), which supports learning capacity and cognition and is regulated by physical activity). Regular physical activity stimulates structural changes in the hippocampus region of the brain, an important area for memory, along with increasing neurons, dendrites, and synapse. All of these are essential structural elements located throughout the central and peripheral nervous systems (Hughey, Long, Maslow, & Reed, 2013, p. 185).

Hughey, Long, Maslow, & Reed (2013), conducted a study which included 2<sup>nd</sup>-8<sup>th</sup> grade African American youths who attended a small Title I charter school. At this charter school, 98% of the students are African American. They used controlled schools which received the traditional amount of physical activity, and experimental schools who reviewed 45 minutes of

daily physical activity. Two cognitive measures of fluid intelligence and perceptual speed were studied. Fluid intelligence is general ability to think abstractly, reason, identify patterns, solve problems, and discern relationships. Perceptual speed is ability to quickly and accurately compare letters, numbers, objects, pictures, or patterns. Physical fitness was also measured using the Fitnessgram testing system (p. 188)

Participant of the study performed the Fitnessgram test such as endurance, abdominal strength, upper body strength, and flexibility. When finished with the fitness testing, students were tested on their fluid intelligence and perceptual speed. The results were split into elementary and middle school subcategories. Females at the elementary level experimental schools did not show a significant improvement on fluid intelligence and perceptual speed. However, males at the elementary level experimental schools did show significant improvement on fluid intelligence and perceptual speed. The same trends proved true at the middle school level as well. The findings of this study proved that 45 minutes of daily physical activity can improve cognitive functions, but the level of improvement does vary between genders (Hughey, Long, Maslow, & Reed, 2013, p. 193).

The benefits of physical activity on cognitive development depend on the vigorousness of that activity. Physical educators model their lesson plans around moderate to vigorous physical activity (MVPA). Increasing the level of MVPA also increased the physical gains one can achieve.

In a study consisting of 48 eighth grade students (36 male, 12 female), participants were given an extra interval aerobic run during physical education class. The aerobic run was designed to increase their MVPA. These additional interval aerobic runs were performed during

the first, third, fifth, and sixth hour of the day. Ten minutes after each exercise, students performed a two minute mathematics task. Increases in numeric speed were found in all class periods tested except for sixth hour, which suggests that students can experience cognitive increases if their MVPA is increased in the beginning and middle part of a school day (Travlos, 2010, p. 304).

Much like studies done in past years, the positive correlation between physical activity and cognitive development exists, but to this point cannot be proven without a doubt. The results of this particular study indicated that intense physical activity affects numerical speed and accuracy of simple addition problems. Furthermore, the results of this study also support previous findings reporting that speed of problem solving was significantly faster after 20 min of moderate intensity exercise (Travlos, 2010, p. 307).

Research studies regarding physical activity and cognitive development cite the No Child Left Behind act as a large contributing factor to the decline, and in some cases elimination of physical education programs in the United States. Some districts who value physical education have found ways to incorporate physical movement in their existing curriculum. As mentioned previously, even in physical education settings the level of engaged time is often times below the level necessary to achieve physical and cognitive gains. Due to the impact video games have on the youth in our society, a digital resource known as Exergames has become popular for physical educators (Calvert, 2011, p. 93).

Exergames can improve youths' health status and provide social and academic benefits. Exergame play increases caloric expenditure, heart rate, and coordination. Psychosocial and cognitive impacts of Exergame play may include increased self-esteem, social interaction, motivation, attention, and visual-spatial skills (Calvert & Staiano, 2011, p. 93). Calvert and

Staiano reviewed literature on Exergames specifically regarding the benefits on student physical, emotional, and academic behavior.

Exergames such as *Dance Dance Revolution* for Nintendo Wii naturally increase the level of MVPA because they are designed around entertainment value rather than education. The 21<sup>st</sup> century learner, who in many cases happens to be a video gamer as well, is the target audience for the idea behind Exergames in physical education. Traditional PE programs tend to isolate the audience to sports players and sports enthusiasts. There are many cognitive outcomes Exergames can increase such as: spatial awareness, attention, and understanding of cause–effect relationships. They also teach players to manipulate a tool, respond to visual feedback, plan actions, understand spatial constraints, and create a cognitive map of their bodily movements in relation to game play (Calvert & Staiano, 2011, p. 95). Research suggests that an increased level of physical activity can only lead to positive outcomes or no outcomes, yet hardly ever negative outcomes. Physical educators must incorporate today’s learner to increase their engaged level of MVPA, which in turn can potentially increase their physical, social, and emotional behavior. In addition to improved academics, Exergames lend themselves to a greater depth physical education when played at home (p. 95).

Regular physical activity in children can support academic performance, on-task behavior, weight control, and cardiovascular and musculoskeletal health, as well as reduce the likelihood of developing chronic disease in adulthood. Despite the research illustrating the benefits of academic achievement through physical activity, approximately 45% of schools in the United States meet the guideline of at least 30 minutes of MVPA per day (Carlson, et al., 2014, p. 47).

A research study was conducted in 2014 consisting of 172 elementary students. The Physical Education teachers and Principals of these students were asked 15 yes or no questions regarding the level of physical activity at their school. Socioeconomic status (SES) was also a factor of this study and was determined by comparing the free and reduced lunch percentages. The lower SES schools were less likely to have a physical education teacher and had fewer opportunities for physical activity than did schools with a high SES. On average, students at high SES schools had 4.4 more minutes of physical activity per day (Carlson, et al., 2014, p. 48).

The results from this study suggested that students from low SES schools are not getting the adequate amount of MVPA can have an effect on academic, emotional, and social outcomes. In these low SES settings, classroom teachers need to incorporate more MVPA within the school day to supplement for the lack of physical education instruction (Carlson, et al., 2014, p. 49).

Many schools throughout the United States are required by state law to incorporate the daily recommended amount of 60 minutes of MVPA. Most of these state laws are governed by the Physical Education–Related State Policy Classification System (PERSPCS). A research study was conducted to determine whether public schools in states with specific and stringent physical education laws were reporting more weekly PE time in the most recent School Health Policies and Programs (Collins, et. al., 2012, p. 1594). When focusing on the correlation between physical activity and academic achievement, schools that do not follow the recommended guidelines of 60 minutes of MVPA per day are hindering the academic success of its students.

In this study, schools were grouped by their state's PERSPCS time requirement scores (none, nonspecific requirement, or specific requirement). Average weekly school-level PE was calculated using the School Health Policies and Programs reported PE minutes (Collins, et. al.,

2012, p. 1595). States with specific requirement laws averaged over 27 and 60 more PE minutes per week at the elementary and middle school levels. Compared with schools within states with nonspecific laws and over 40 and 60 more PE minutes per week with elementary and middle schools in states with no law (p. 1595).

This research study suggests that in order to effectively police the appropriate amount of physical activity in schools, the laws need to be written accordingly. States with no law governed by the (PERSPCS) have zero accountability and only have to adhere to the district curriculum, which may need to be updated to fit the existing physical education guidelines.

Before focusing on the benefits physical activity has on cognitive development, the United States must address the amount of MVPA students receive while in school. Many of the lines between district policies and school practices are blurred in regards to physical activity, particularly at the elementary level. A study was conducted with the purpose of assessing the association of district and school PE policies, the PE environment, and PE and recess time. In this study, 65 schools from 9 states completed instruments assessing district and school PE policies, the school PE environment, and time in PE and recess (Holt, et. al., 2013, p. 132).

There results of this study did not find much significance between PE policies and PE or recess minutes, and no policies were associated with both. However it was concluded that some time policies in certain states needed to be revisited to allow for maximum engaged time in both PE and recess (Holt, et. al., 2013, p. 140).

The literature suggests several factors in regards to physical activity which could increase academic, social, and behavioral outcomes. The research supporting the correlation between physical activity and academic achievement is becoming stronger each year; however it still remains too insignificant for a nationwide overhaul of education policies. Most of the literature

advocates more physical education in schools, yet fails to state specific steps on how to reach this goal and leaves most of the interpretation to each individual school district.

## RESEARCH METHODS

### *Research design.*

A data analysis was conducted using a t-test with data provided from the DESE website to compare ELA and Math Proficient standardized test scores with KCMSD and other districts in the state of Missouri. The independent variable is the frequency of PE offerings, either once per week or at least two times per week. The dependent variable is the Missouri Assessment Program (MAP) scores.

### *Study group description.*

Elementary students from the KCMSD and other districts in the state of Missouri were compared during this study. The school samples were chosen using the stratified sampling method which separates the schools into two different groups; one being the school district which requires PE once per week, and the other group being the school districts which require PE at least two times per week.

### *Data collection and instrumentation.*

Data for this study was provided by the DESE website. ELA and Math Proficient Missouri Assessment Program (MAP) standardized test scores will be compared between PE once per week district and other districts in the state of Missouri from 2010-2014.

### *Statistical analysis methods*

A t-test was conducted to see if there is a significant difference in cognitive development with the district that requires one day of PE per week, and other districts in the state of Missouri who require a minimum of 2 days of PE per week.



## FINDINGS

A t-test was conducted to determine whether there was a difference in ELA MAP scores between elementary students who have PE once per week and elementary students who have PE more than once per week from 2010-2014. This table illustrates the organized findings based using statistical data on the Missouri DESE website in 2015.

**t-Test Analysis Results on the Frequency of PE and ELA MAP Scores from 2010-2014**

Source	Mean	Mean D	<i>t</i> -test	df	<i>p</i> -value
PE Once/Week (n=1)	14.68				
PE More than Once/Week (n=4)	23.05	-8.375	-2.204	23	0.038

Note: Significant when  $p \leq 0.25$

Five comparative urban school districts were chosen for this study to determine if there is a significant difference in ELA Map scores between elementary students who receive PE once per week and elementary students who receive PE more than once per week. The data was collected from the DESE website and includes ELA Proficient MAP scores. The mean of PE once per week was 14.68, and the mean of PE more than once per week was 23.05. The Mean D, or difference between the two groups, was -8.375. The t-test result was -2.204 and the df was 23. The null hypothesis states that there is no difference in standardized test scores in elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week. This null hypothesis was rejected because the p-value 0.038 is lower than the alpha level, 0.25. This shows that there is a significant difference between elementary students who receive PE once per week and elementary students who receive PE more than once per week.

**t-Test Analysis Results on the Frequency of PE and Math MAP Scores from 2010-2014**

Source	Mean	Mean D	<i>t</i> -test	df	<i>p</i> -value
PE Once/Week (n=1)	13.7				
PE More than Once Per/Week (n=4)	35.64	-21.94	-4.31	23	0.0002

Note: Significant when  $p \leq 0.25$

Five comparative urban school districts were chosen for this study to determine if there is a significant difference in Math Map scores between elementary students who receive PE once per week and elementary students who receive PE more than once per week. The data was collected from the DESE website and includes Math Proficient MAP scores. The mean of PE once per week was 13.7, and the mean of PE more than once per week was 35.64. The Mean D, or difference between the two groups, was -21.94. The *t*-test result was -4.31 and the *df* was 23. The null hypothesis states that there is no difference in standardized test scores in elementary students who have Physical Education multiple days per week, and elementary students who have Physical Education 1 day per week. This null hypothesis was rejected because the *p*-value 0.0002 is lower than the alpha level, 0.25. This shows that there is a significant difference between elementary students who receive PE once per week and elementary students who receive PE more than once per week.

## CONCLUSIONS AND RECOMMENDATIONS

The data from the t-Test analysis in both the ELA and Math comparisons suggest that there is a significant difference between elementary students who receive PE once per week and elementary students who receive PE more than once per week. The p-value in the ELA analysis was 0.038 and the p-value in the Math analysis was 0.0002. Both of these numbers are significantly lower than the alpha level of 0.25 which completely rejects the null hypothesis in both comparisons. There is a significant difference between elementary students who receive PE once per week and elementary students who receive PE more than once per week.

The data revealed in this study proves the conceptual underpinning of this particular urban district being on the low end of MAP standardized test scores in both ELA and Math. The data in this study also suggests that this district needs to restructure its schedule and curriculum to incorporate more opportunities for moderate to vigorous physical activity (MVPA) throughout the school year. Each elementary school in this study is comparable in size and socioeconomic status. The value of physical education is evident in each district minus this district, and the significant difference in the test scores cannot be overlooked by the Board of Education.

The suggestion to the Board of Education for this district is two-fold. Option one, would be to revamp the curriculum to allow more time for moderate to vigorous physical activity (MVPA) for elementary students. This option might prove difficult due to the already rigorous demand on core education and the effect that standardized test scores have on school funding. Option two, would be to implement an elementary sports extracurricular program to provide these students an opportunity to compete in organized athletics to supplement for the lack of physical activity they receive during normal school hours. Obesity numbers continue to rise and

test scores in urban districts continue to fall. The most effective way to address both crises is to add more PE to the schedule and more physical activity in general to the existing curriculum.

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