

The Effect of Physical Activity and Exercise on the  
Academic Achievement of Elementary School Students

By Meghan M. Bellarin

Submitted in Partial Fulfillment of the Requirements for the  
Degree of Master of Education

May 2016

Graduate Programs in Education

Goucher College

## Table of Contents

List of Tables	i
Abstract	ii
I. Introduction	1
Overview	1
Statement of the Problem	2
Hypothesis	2
Operational Definitions	2
II. Review of the Literature	4
Importance of Physical Activity and Exercise on Brain and Body Functions	4
Benefits of Physical Activity and Exercise on Academic Success	5
Strategies to Incorporate Physical Activity into the Elementary School Day	7
Summary	10
III. Methods	11
Design	11
Participants	11
Instruments	12
Procedure	12
IV. Results	13
V. Discussion	15
Implementations	15
Threats to Validity	15
Relationships to Literature	16

Implications for Future Research	17
Summary	18
References	19

## List of Tables

1. Dependent t-test for Gain in Benchmark Scores	13
2. Analysis of Variance	14

## **Abstract**

The purpose of this study was to examine the effects of physical activity in elementary school students on academic achievement. This study took place over the course of five weeks and used a pre-test and post-test design. Students in the study participated in a physical activity session during “Morning Meeting” each day for a total of twenty minutes each day. The students were rated each day on their participation level and attendance during the sessions. The tools used to measure academic achievement were the math benchmarks 2 and 3. Results did not show positive effects of the physical activity interventions on the math benchmark scores. Future studies are recommended involving more accurate activity level measurements and requirements in order to determine the effects of physical activity on academic achievement.

# CHAPTER I

## INTRODUCTION

### Overview

A current trend amongst young children is a sedentary lifestyle that leads to a lack of motivation, focus, and behavioral issues in school. Physical activity is often lacking in the school day, and studies have shown that increasing the amount of activity can improve many aspects of a person's well-being. The curriculum and schedules in schools are often full of academics, and there is little time for activity, but it is important that teachers understand the variety of ways it can be integrated for academic success. Desai, Kurpad, Chomitz, and Thomas (2015) state that aerobic exercise and activity positively support mental health, influence health behaviors, and is associated with academic achievement. A child's cognitive performance in school has the potential to be enhanced through the integration of physical activity and exercise into the school day, with or without adding in programs. There are several ways that educators can get the students moving with mathematics problems, taking brain breaks, providing after school exercise programs, and much more.

The researcher is interested in the many positive effects that physical activity and exercise have on students and their academic success. As a physical educator, the researcher can see first-hand accounts of students who are exercising regularly and displaying success in different aspects of their school day, including focus and attention, scores on assessments and benchmarks, and positive behaviors. Teachers are capable of providing students with many life lessons as well as academic lessons, and being physically fit is one lesson where students will be able to see success. There have been numerous studies to determine the effects of exercise on

children and their academic success, and with more positive results, students can become more academically fit as well as physically fit, which will lead to more success.

### **Statement of the problem**

The purpose of this study was to examine the effects of physical activity in elementary school students on academic achievement.

### **Hypothesis**

Physical activity and exercise for twenty minutes in the morning for fifth grade students will have no impact on their math benchmark scores.

### **Operational Definitions**

The independent variable for this study was the number of minutes each day the students spent engaged in physical activity. The type of physical activity that the students participated in each day varied. The types of physical activity included exercise videos from the website “Go Noodle,” coordination and balance activities, and sets of fitness skills that the students would perform. The fitness skills included jumping jacks, push-ups, curl ups, windmills, jogging in place, and arm circles.

The dependent variable in this study was the student scores for the math benchmark 2 and 3. The two benchmarks were state-wide and required for all fifth grade students. A second dependent variable in the study was each student’s participation level during the physical activity. The students were observed by the researcher and the classroom teacher during the physical activity time each morning and were scored on a scale of 0-3. The zero represents students who chose not to participate in the activity, a one for those who participated minimally, a two for those students who participated in most but not all, and a three for those who had full

participation. If the students were absent or not in the room at the time, they were not scored for that particular day and “ABS” was recorded.



## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

This literature review examines the effects of physical activity and exercise on elementary school students and their academic achievement. The first section will discuss the importance of physical activity and exercise on the brain and body functions with more specific scientific references. The second section examines the benefits of physical activity and exercise on academic success specifically. The third section provides strategies to incorporate movement and physical activity into the school day for elementary level classes.

#### **Importance of Physical Activity and Exercise on Brain and Body Functions**

There are several proven indicators that have shown physical activity benefits the human brain, its basic functions, and abilities. One of the most critical brain functions that can predict academic success is memory. So (2012) found that physical activity may increase memory functions and in turn create academic success for students who engage in moderate to vigorous physical activity multiple times a week. According to Chaddock-Heyman et al. (2015), students who are at higher fitness levels have superior performance on tasks that challenge working memory and standardized tests of mathematics and reading relative to less fit students.

On a scientific level, there are several effects that occur within the brain as a result of exercise. In specific brain growth and development, Chaddock-Heyman et al. (2015) found that differences in aerobic fitness levels in children play a role in cortical gray matter structure, which is important for academic success. Children who have a higher level of aerobic fitness are shown to have cognitive and brain plasticity, which can correlate with success in academic areas, especially mathematics. Also higher levels of aerobic fitness have been associated with larger brain volumes in two regions of the brain that are critical for memory and learning: the

hippocampus and dorsal striatum (Chaddock-Heyman et al., 2015). Conyers and Wilson (2015) agree, stating that the hippocampus is essential for creating new memories and for learning.

Neurogenesis is the creation of new brain cells within areas of the brain associated with recall, and Conyers and Wilson (2015) believe that exercise enhances this process, while also forming connections between neurons in response to learning and sensory input, known as experience-dependent synaptogenesis. Neurogenesis is important because it activates the higher-order cognitive functions in the brain, which is essential for monitoring, maintaining, and strategizing higher-level cognitive abilities that enhance academic performance. There are many processes in the brain that occur when the body is engaged in physical activity, and the more students are exposed to these activities, the more these functions will continue to increase. There is also evidence that the prefrontal cortex may function at a more efficient level after engaging in physical activity programs.

There are also several health benefits from engaging in physical activity, including increased strength and decreased chance of injuries. Those who are more active experience a reduction in low-density lipoproteins and an increase in high-density lipoproteins (Field, Diego, & Sanders, 2001). Exercise also increases serotonin levels, endorphins, and melatonin, which increase positive emotions (Conyers & Wilson, 2015). These neurochemicals help to make individuals increase their attention and focus as well as boosting moods, which can enhance mastery of skills. The physical and scientific effects of exercise on the brain and body go beyond academic success and are beneficial for a person's well-being. As the health improves, this can begin to create an atmosphere of achievement and success.

### **Benefits of Physical Activity and Exercise on Academic Success**

Due to the many benefits of physical activity on the brain, this in turn results in a higher

correlation of academic success with students as well as an increase in positive behavior. Field et al. (2001) found that among the health benefits of physical activity, exercise has been noted to increase performance on cognitive tasks as well as raise serotonin levels. In students who perform higher rates of exercise, it has been shown that those same students will have higher grade point averages. The number of hours a week a child is physically active can impact their engagement in sports, social settings, and energy levels, causing them to take the initiative to put in the extra efforts in academics. The amount of time spent in physical activities, specifically twenty minutes or more daily, improves performance on perceptual and decisional tasks (Trudeau & Shephard, 2008). Also Trudeau and Shephard noted that when students are involved in physical activities such as music, it has the potential to increase reading skills. Physical activity in general, not specific to physical fitness levels or sports involvement, has positive effects on academic scores through increased focus, decision making skills, and increasing interest levels.

Students who are more physically active in aerobic exercise show higher levels of success in the area of math more so than other academic areas. Aerobic fitness activities have been linked to cognitive functions, response speed, working memory and attention (Desai et al., 2015). When students are able to concentrate and have a healthier mental state after exercising, academic areas such as mathematics, which revolves around memory and concentration, can be more successful. Moses (2011) found that many studies have noted high levels of physical exertion had positive influences on mathematical performance and that increasing the amount of physical activity time did not have a negative effect on academic performance.

Trudeau and Shephard (2008) explored the concept of physical activity having a positive effect on classroom behavior and reduced disruptions in students. Positive classroom behavior

leads to more optimistic attitudes during class in general, which leads to more success with academic lessons. A student's behavior can also determine his or her feeling of school connectedness and school satisfaction, which prevents students from disregarding classwork and allows students to make more positive decisions.

The level of physical activity has shown an effect on the academic success rate when comparing vigorous exercises, moderate exercises, and strengthening exercises to one another. According to So (2012), vigorous activities may include soccer, basketball, aerobics, and swimming; moderate activities include badminton, table tennis, carrying light loads and cycling at a regular pace, and strengthening exercises can include push-ups, weight lifting, sit-up, and weight training. Vigorous exercises will raise heart rate higher than strengthening exercise. So demonstrated that higher levels of physical activity result in a higher correlation of academic success than lower levels of physical activity. Vigorous activities increase brain and memory functions and can have a positive influence on boys and girls. Strengthening exercises have not shown a high correlation with academic achievement when compared to more vigorous activities performed less than four times a week, especially in boys. As elementary schools push for higher academic success through higher standards, the positive effects on academic achievement from movement and physical activity within the school day should be considered. Higher levels of activity have shown to give greater success with concentration, memory functions, behavior, and decision-making skills for students, all of which can enhance a student's academic abilities and achievement and could then transfer over to higher levels of academic success.

### **Strategies to Incorporate Physical Activity into the Elementary School Day**

Most elementary schools around the world have physical activity built into the school week through physical education classes. The amount of time varies between schools, districts,

states, and countries, but most have a set schedule of minutes per week a student is guaranteed to be physically active. Elementary schools also generally have time built into their schedules for recess each day. These are two opportunities that for the most part are scheduled, but can be lost or taken out of schedules for various reasons including testing, instrumental classes, and interventions, so it is important for educators to develop more strategies to incorporate physical activity into the school day.

Brain breaks are a popular strategy and are designed for students to perform in a small space near desks or in the classroom in their own chairs (Caldwell & Ratliffe, 2014). Examples of appropriate breaks would be performing fitness skills such as jumping jacks, jogging in place, or pushups; using exercise videos from DVD's or the internet; or playing games in class that involve physical activity. Videos, short clips, and movement sessions should be quick and to the point and are intended to give the student an opportunity to refocus and reboot their energy. A few goals of brain break videos are to increase students' heart rate, assist teachers with providing physical activity within the day, and release some of the students' energy after sitting during a lesson. Movement breaks are essential to refocusing attention on academics and can be taken advantage of multiple times a day (Koch, 2013).

Integration of physical activity and academic subjects is bridging or merging the content from multiple academic areas to allow students to see the connections and relationship of knowledge (Koch, 2013). Within the classroom setting, there are several ways to integrate physical activity, including stories, historical characters, creating shapes, and using locomotor movements to perform tasks. Koch gives several suggestions, including Math Bo, which is using math equations and functions and "combat" style skills in the air to complete the equations. Integrating the compass and directions within the classroom and using fitness skills for direction

on the map can also allow students in social studies to move more. Within science classes, teachers can use physical experiments and allow students to move throughout the room, as well as acting out content material, like physically acting out the states of water. It is important for classroom teachers to understand basic locomotor movement skills and terminology, and for this to occur, the physical education teacher and classroom teachers would need to collaborate.

Another integration strategy that has proven to be very useful is the use of yoga skills and techniques. Yoga practice improves individuals' physical fitness levels, focus and relaxation, as well as several aspects of cognition and executive functions (Telles, Singh, Kumar, Kumar, & Balkrishna, 2013). It is suggested that yoga should be practiced several times a week and for multiple weeks in a row in order to gain the physical and cognitive benefits. Suggested yoga skills include breathing techniques, loosening exercises, and physical postures. Specific yoga skills can be performed within classroom settings, at recess, or within appropriate places at the school, and consist of different postures such as the butterfly pose, cobra posture, raised leg posture, and tree posture. According to Telles et al., the strategy of incorporating yoga into the school day for elementary students is one that teachers are capable of doing without technical training, can be varied each day to keep enthusiasm and interest, and has shown significant benefits towards cognitive achievement and focus.

Afterschool clubs are a great approach to incorporating physical activity into a school day without taking time from the normal daily schedule. Käll, Nilsson, and Linden (2014) found that enjoyable, non-competitive activities resulted in many benefits for the school, students, and teachers, including fellowship, reduced boredom, and joy. The activities held after or before school should be positive, motivational, and enjoyable for all to participate in and held at least

two times a week. The programs can cater to all types of students and can include the use of equipment, teams, individual games, or no equipment at all.

A more specific afterschool strategy is a running club to offer students assistance with improving their running and walking abilities, as well as developing a sense of community. Some of the options include basic running clubs, like Girls on the Run, H.E.R.O. Boys' Running Club, and Running and Writing clubs. Vanzandt (2011) found that after integrating a writing and running program, there were significant benefits to the students who participated. Many of these groups meet twice a week for about sixty to ninety minutes and work on running technique and endurance, building up to a culminating race such as a 5K. Within the program, Vanzandt also found that many students made more growth after implementing running buddies, which increase accountability, goal setting, and motivation. The program coincides with a writing program to help promote journal writing skills. The use of a running program after school has proven to be successful for many elementary schools in gaining student achievement in academics, social situations, and physical fitness.

### **Summary**

Physical activity and exercise are a critical part of everyone's life, whether the purpose be to maintain current health, become more successful in academic areas, increase aerobic fitness levels, or simply to be happier. It is important to understand the benefits from a scientific viewpoint as well as an academic perspective for students in elementary school so that teachers are able to integrate necessary activities into daily routines to benefit the students. From brain breaks to curriculum driven running programs, there is evidence that shows that exercise in school is critical to the success of students in academics, focus, physical health, and social relationships.

## **CHAPTER III**

### **METHODS**

#### **Design**

The purpose of this study was to examine the effects of physical activity in elementary school students on academic achievement. This is a quasi-experimental study using a single group of the same students that were not randomly selected. The study uses a pre and post assessment based on math benchmark scores. The independent variable is the number of minutes students spent participating in physical activity each morning during “Morning Meeting.” The dependent variable was the students’ scores of math benchmark 2 and math benchmark 3. Another dependent variable was the level of participation that the students performed during the physical activity. The students were observed and scored based on a scale of 0-3, with 0 given to the students who chose not to participate and 3 given to the students who participated at a high level for the full time period. A comparison of the ranking of students on their math benchmark 2 and their ranking for math benchmark 3 was made to determine if the null hypothesis could be supported.

#### **Participants**

The students in this study were fifth graders in a medium sized elementary school. There were ten girls and thirteen boys, and all were physically able to participate. The school was a Title 1 school in Anne Arundel County in Maryland and had an enrollment of 475 students. Within the class of participants, there were several student subgroups represented, including African American, Asian, Caucasian and Hispanic. Approximately 75% of the participants qualified and received free and reduced meals. There were no participants that had an IEP and three participants are Limited English Proficiency. This class was selected because the observer



participates in a school-wide initiative called “Morning Meeting” with the homeroom class and had the ability to integrate movement into the scheduled meetings each day. The observer had already established a positive rapport with the classroom teacher and the students and the change in routine did not affect student learning or behaviors. The observer was able to obtain the pre-assessment and post-assessment benchmark scores from the data program Performance Matters.

### **Instruments**

This study used four measures, including attendance, physical activity participation, and math benchmark ranking scores as pre and post assessments. Attendance was taken based on the student being present or absent (ABS) for the activity period. The physical activity was measured on a scale of 0-3 based on the amount of time and effort the students participated. The observer would facilitate the physical activity and record the students’ participation level at the end of the time period. The pre-assessment was the participants’ ranking of scores with their classmates on the math benchmark 2 that the participants took in January of 2016. The post-assessment was the participants’ ranking of scores with their classmates on the math benchmark 3 that the participants took in March of 2016.

### **Procedure**

Each day for a period of six weeks, amounting to twenty seven total school days, physical activities were built into a 20-minute block from 8:55 a.m. to 9:15 a.m. The activities included exercise videos from [www.gonoodle.com](http://www.gonoodle.com), fitness based workouts, sessions of yoga or stretching, and walking in the halls. The “GoNoodle” website included activity categories of guided dancing, free movement, stretching, sport and exercise, kinesthetic learning, coordination, and calming. The activities were selected because of participant interest, variation of styles of physical activities, and variation of level of physical activity.

## CHAPTER IV

### RESULTS

This study examines the effects of physical activity in elementary school students on academic achievement. The dependent variable was the fifth grade math benchmark 3. Multiple regression was the statistical technique of choice since there were multiple measures that could impact performance on benchmark 3. The independent or co-variables included attendance, and physical activity sessions, and average participation in the activity sessions. The fifth grade math benchmark 2 was the baseline score. Students attended or did not attend physical activity sessions and thus a ratio or percentage of sessions attended was constructed from the total attended divided by the total possible sessions offered. Additionally, the researcher kept track of how attendees participated on a scale of 0 to 3, with 3 being the highest participation and 0 being non-participation. These variables were entered into a dependent t-test, which found that there was a significant gain in student performance from benchmark 2 to benchmark 3 through construction of a simple gain score by subtracting benchmark 2 from benchmark 3. The results are shown in Table 1.

Table 1

*Dependent t-test for Gain in Benchmark Scores*

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
gain	5.759	21	.000	14.59091	9.3223	19.8595

The null hypothesis, that no gain from one Benchmark to the other, could be rejected.

This is depicted in Table 2 and simply repeats the independent t-test finding through Analysis of Variance, which runs as a part of the multiple regression analysis.

Table 2

*Analysis of Variance*

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5088.909	3	1696.303	27.168	.000 <sup>b</sup>
	Residual	1123.864	18	62.437		
	Total	6212.773	21			

a. Dependent Variable: Benchmark 3

b. Predictors: (Constant), attended ratio, Average Participation, Benchmark 2

When the coefficients of the co-variables that were thought to impact the performance on Benchmark 3 were examined, these co-variables all had negative coefficients in the regression equation. Thus, multiple regression is statistically saying that these variables actually are negatively related to performance or detracted from the performance. The attendance ratio was not statistically significant, but the average participation showed a negative relationship. The results and implications are discussed in the subsequent chapter.

## **CHAPTER V**

### **DISCUSSION**

The purpose of this study was to examine the effects of physical activity in elementary school students on academic achievement. The null hypothesis that no gain on the students' benchmark scores could be rejected.

#### **Implications**

The implications of the results of this study show that physical activity and exercise did not have a direct impact on the academic achievement of fifth grade students. The students were able to choose their participation level during each physical activity session, therefore they did not all take advantage of the movement each day. The increase in scores from the two Benchmarks was a positive outcome, but there was no positive correlation with the benchmark scores as a result of the activity. The researcher can conclude that although the physical activity can be positive for the students' physical well-being, in this study it was not a positive influence on their academic achievement.

#### **Threats to Validity**

There are many threats to validity within the study including internal and external validity. External validity refers to the extent to which the results of the study can be generalized. The study group consisted of one of the three fifth grade classes and the results cannot be generalized for all fifth grade students at the school. The students live in suburban neighborhoods and attend a Title 1 school so the results cannot be generalized for all students of a similar demographics. The study was also comprised of only fifth grade students, which indicates the results cannot be comprehensive for all elementary aged students. This intervention

took place in the morning prior to academic lessons, which were later in the school day and may have had a factor in the effects of the physical activity.

Internal validity refers to the extent to which a causal relationship can be made based on the physical activity sessions and the academic achievement of the study group. The data that was used was the scores on the fifth grade math benchmarks. The physical activity sessions were conducted in the morning of each school day during the scheduled “Morning Meeting,” and the students’ attendance for the physical activity sessions may have varied due to students coming late to school, being absent, or being out of the room for various reasons. Another threat to validity was the level of participation of the students during each of the sessions. The student’s motivation, attitudes and external factors within their lives each day could have affected their level of participation. The researcher also could have miss-estimated the participation degree of the students. The notion that the students were familiar with the benchmarks and may have performed better on benchmark 3 due to having already taken benchmark 2 could be a threat to validity as well.

### **Relationships to Literature**

Several other researchers have studied the effects of physical activity and exercise on academics using many different interventions, fitness measurements, and with varying results. Desai et al. (2015) agrees that when studying the effects of exercise and academics, considerations should be made for the adequacy of opportunities of fitness in schools, not just physical activity, in general. There are several health-related fitness components that make up physical activity and aerobic fitness has shown to have a more significant relationship with academic achievement.

There is continued research that suggests that students involved in extracurricular physical activities can have similar academic levels to those not involved in activities, which has led to improved interactions with peers, a stronger sense of belonging, and higher satisfaction (Trudeau & Shephard, 2008). Field et al. (2001) has found that higher levels of exercise have also led students to better relationships with their families and a lower level of depression, which can increase performances on cognitive tasks. Käll et al. (2014) conducted a study that took place over a longer period of time, was directed at the entire school, and the physical activity intervention was scheduled and obligatory, which led to a stronger study and more significant improvements in academic achievements. With the interventions being more strategic and important to the students and staff, there are more opportunities for success.

Although this particular study did not make significant improvements for academic achievement, Conyers and Wilson (2015) believe that it is essential to note that there are no negative consequences for physical activity as a part of the school day, and it should be an integral part of the schedule. If students become more physically active and develop higher levels of fitness, it has been shown to activate important regions in the brain essential for higher-level cognitive control abilities.

### **Implications for Future Research**

The results from this study have shown several implications for future research. One implication is to have a higher degree of control on the participation level of the students and more accurate measures of the participation levels such as heart rate. A future researcher could also consider a two group study to compare the score increases from one class who receives the physical activity intervention and a class who does not. The timing of the intervention in relation to the academic lessons could also be an implication that a future researcher should consider.

Considering that this study was conducted for one grade level in one school, researchers could study several grade groups or the same grade levels across different demographical schools. Finally, a random sample of students being selected instead of a specific class may benefit future research in order provide more accurate results.

### **Summary**

The results of this study show there was no positive relationship between physical activity and academic achievement for fifth grade students after interventions. Although there were gains in student performance, the study had limitations which may have had an impact on the results. Previous research suggests there are positive correlations between exercise and academic success and a lengthier and controlled study may prove differing results. It is proposed that more research is conducted on the effects of physical activity and academic achievement in all students. There are many proven benefits of physical activity and exercise including overall well-being, brain functions, and relationships. The research suggests that implementing exercise into the school day will have positive effects for all students.

## REFERENCES

- Caldwell, T., & Ratliffe, T. (2014). Investigation of intensity levels during video classroom exercise sessions. *Physical Educator*, *71*(3), 473-490.
- Chaddock-Heyman, L., Erickson, K. I., Kienzler, C., King, M., Pontifex, M. B., Raine, L. B., & Kramer, A. F. (2015). The role of aerobic fitness in cortical thickness and mathematics achievement in preadolescent children. *Plos ONE*, *10*(8), 1-11  
doi:10.1371/journal.pone.0134115
- Conyers, M., & Wilson, D. (2015). Smart moves: Powering up the brain with physical activity. *Phi Delta Kappan*, *96*(8), 38.
- Desai, I. K., Kurpad, A.V., Chomitz, V.R., & Thomas, T. (2015). Aerobic fitness, micronutrient status, and academic achievement in Indian school-aged children. *PLoS ONE* *10*(3): e0122487. Doi:10.1371/journal.pone.0122487
- Field, T., Diego, M., & Sanders, C. E. (2001). Exercise is Positively Related to Adolescents' Relationships and Academics. *Adolescence*, *36*(141), 105.
- Käll, L. B., Nilsson, M., & Lindén, T. (2014). The impact of a physical activity intervention program on academic achievement in a Swedish elementary school setting. *Journal of School Health*, *84*(8), 473-480. doi:10.1111/josh.12179
- Koch, J. L. (2013). Linking physical activity with academics: strategies for integration. *Strategies*, *26*(3), 41-43.
- Moses, T. (2011). Does physical activity impact the academic achievement of fifth grade students in two Arizona schools? (Order No. 349042). Available from *ProQuest Education Journals*. (918227237).



- So, W. (2012). Association between physical activity and academic performance in Korean adolescent students. *BMC Public Health*, 12(1), 258-264. Doi:10.1186/1471-2458-12-258.
- Telles, S., Singh, N., Kumar, A., Kumar, A., & Balkrishna, A. (2013). Effect of yoga or physical exercise on physical, cognitive and emotional measures in children: a randomized controlled trial. *Child & Adolescent Psychiatry & Mental Health*, 7(1), 1-28. Doi:10.1186/1753-2000-7-37
- Trudeau, F. & Shephard, R. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioral Nutrition and Physical Activity*, 5:10. Doi:10.1186/1479-5868-5-10.
- Vanzandt, C. (2011). Running to achieve: engaging students in literacy and physical activity through an after-school learning community. (Order No. 3478632). *ProQuest Education Journals*. (903795189).