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EFFECTS OF PHYSICAL EDUCATION AND ATHLETICS
ENROLLMENT ON STUDENT ACHIEVEMENT

by

Eric Saunders

Dissertation

Submitted to the Faculty of

Harding University

Cannon-Clary College of Education

In Partial Fulfillment of the Requirements for

The Degree of

Doctor of Education

in

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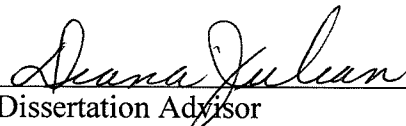
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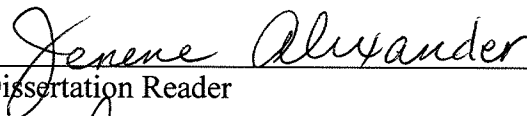
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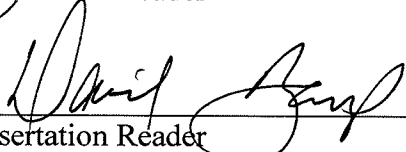
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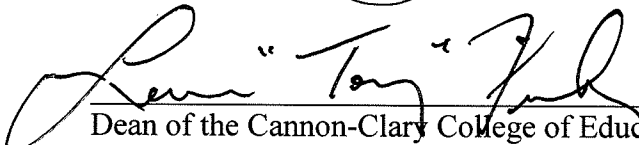
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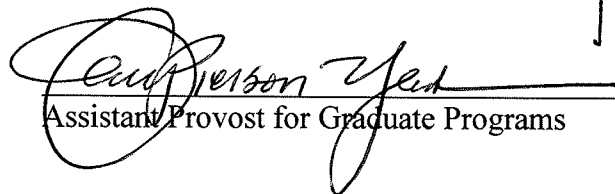
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The staff at Harding University has been irreplaceable. The guidance provided by Dr. Michael Brooks and Dr. Usenime Akpanudo has been the foundation of my work, and without them, it would never have been possible. My Advisor, Dr. Diana Julian, has kept me on task to complete the assignments within the timelines and has coordinated with the rest of the Harding staff to ensure completion. My readers, Dr. David Bangs and Dr. Jenene Alexander, have been beneficial in their suggestions for improvement. Dr. Lewis Finley has emphasized the importance of relationships in an education, and until the end of this process, I did not realize how true his words were and the value of the relationships I have built with the staff at Harding and other Harding students.

DEDICATION

Without God, none of this project would have been possible. Because He is the creator of all things, all the resources were available to make this project a reality. I hope that the results from this project will aid educators in the future as they try to provide the best future possible for children. This service to the children and the future is done to glorify God and fulfill his will for us.

ABSTRACT

by
Eric Saunders, Ed. D.
Harding University
May 2012

Title: Effects of Physical Education and Athletics Enrollment on Student Achievement
(Under the direction of Dr. Diana Julian)

The purpose of this dissertation was to add to the existing research concerning the effects of physical activity on academic achievement. The effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the overall composite, English, Math, Reading and Science scores on the ACT for eleventh-grade students were analyzed.

This quantitative, causal comparative study was performed in a rural high school in Arkansas. The high school had an approximate 800 student population of which 20% were categorized as free and/or reduced lunch. The Universal ACT, given to all eleventh graders, was used as the instrument to measure academic achievement. All categories (Composite, English, Math, Reading, and Science) were used for evaluation.

Included in the sample were all eleventh grade students over a two-year period. Approximately 460 students comprised the sample. The students were classified according to their gender and the number of physical activity classes they had taken during their ninth-twelfth grade years. The two categories of the number of physical activity classes were those with fewer than 2 semesters of physical education classes and

those with two or more. Since the requirement for physical education courses was one semester, the split divided the students into groups of those who went above the minimum requirement and those who did not.

Five 2 x 2 factorial ANOVAs were used to analyze the data for all hypotheses. No significant interaction effects were observed between students enrolling in two or more physical activity classes and those who did not by gender except in the area of Science. Further, simple effects analysis showed among the students with fewer than two semesters of physical activity, males scored significantly higher on the ACT Science than did females. No significant main effects were observed of number of physical activity courses enrolled through the hypotheses.

TABLE OF CONTENTS

LIST OF TABLES	x
LIST OF FIGURES	xi
CHAPTER I—INTRODUCTION.....	1
Statement of the Problem.....	4
Background.....	5
Hypotheses.....	9
Description of Terms	10
Significance.....	11
Process to Accomplish.....	11
CHAPTER II—REVIEW OF RELATED LITERATURE	14
Physical Activity and Possible Effects on Factors Related to Academic Achievement..	15
Fitness, Physical Activity, and Academic Achievement	20
Gender.....	31
Increasing Time in PE Classes.....	35
Conclusion	46
CHAPTER III—METHODOLOGY	49
Research Design.....	52
Sample.....	52
Instrumentation	53

Data Collection Procedures.....	59
Analytical Methods.....	60
Limitations	62
CHAPTER IV—RESULTS.....	64
Hypothesis 1.....	65
Hypothesis 2.....	67
Hypothesis 3.....	70
Hypothesis 4.....	73
Hypothesis 5.....	76
CHAPTER V—DISCUSSION.....	81
Conclusions.....	82
Recommendations.....	86
Implications.....	89
REFERENCES	92
APPENDICES	99

LIST OF TABLES

1. Percentage of Schools Reporting the Requirement of PE in Each Grade.....	37
2. Scale Score Summary Statistics for the ACT test for 1995 Nationally Representative Sample for Twelfth-Grade Students.....	57
3. ACT College Readiness Scores	58
4. ACT Reliability Scores.....	59
5. Student Population Distribution and Enrollment in AP.....	61
6. Student Assignment Distribution.....	62
7. ACT Composite ANOVA Results.....	67
8. ACT English ANOVA Results.....	70
9. ACT Math ANOVA Results.....	73
10. ACT Reading ANOVA Results.....	76
11. ACT Science ANOVA Results.....	79
12. ACT Science Simple Effect Analysis.....	80

LIST OF FIGURES

1. Group Means and Standard Deviations for the ACT Composite Scores	66
2. Group Means and Standard Deviations for the ACT English Scores	69
3. Group Means and Standard Deviations for the ACT Math Scores	72
4. Group Means and Standard Deviations for the ACT Reading Scores	75
5. Group Means and Standard Deviations for the ACT Science Scores	78

CHAPTER 1

INTRODUCTION

The Surgeon General's Office through the United States Department of Health and Human Services (USDHHS, 2007) suggests that children should receive 60 minutes of physical activity every day. Lee, Burgeson, Fulton, and Spain (2007) found in 2006 only 2.1% of high schools in the United States provided daily physical education (PE) for all students. Lee et al. also discovered that during the same year, 55.1% of states provided funding or offered professional development for ways to increase the amount of time students participate in physical activity.

Educators are constantly looking at new ways to improve academic achievement. The No Child Left Behind (NCLB) Act of 2001 (2002) holds schools accountable for academic achievement and is the driving force in the decision making process for many schools today. NCLB requires standards in Mathematics, Reading and/or Language Arts, and Science. While addressing PE, this bill did not require PE but rather made grants available to improve PE in schools and community groups. With the strict academic mandates of NCLB, schools have cut non-academic times and programs to allocate more resources to those academic areas being tested (Castelli, Hillman, Buck, & Erwin, 2007; National Association for Sport & Physical Education, 2004).

Luepker (1999) warned that a decrease in physical education could result in overall problems of health, missed schools days, and school performance. Through multiple facets

such as the Whole Child initiative, Coordinated School Health, Act 1220 of the Arkansas General Assembly, and Michelle Obama's *Let's Move* campaign, student health is addressed at the school level in hopes of producing students who are more successful in the classroom. Sallis et al. (1999) contended that students not only receive physical benefits from physical education, but mental benefits as well.

Lohrmann (2005) argued that a comprehensive education does not limit itself to the core academic area but also contributes to the emotional, social, and physical health of the students. In explaining the assessment tool created for the Association and Supervision of Curriculum Development (ASCD), Lohrmann contended that "A variety of health-related behaviors and conditions impede a student's ability to learn" (p. 9). Many of these obstacles can be overcome through physical activity. The assessment tool, in measuring the education of the whole child, includes PE and physical activity as two areas that need to be assessed in a school.

The Center for Disease Control (CDC) stated, promoting academic achievement is one of the four fundamental outcomes of modern school health programs. Scientific reviews have documented that school health programs can have positive impacts on educational outcomes, as well as health-risk behaviors and health outcomes. Programs that are primarily designed to improve academic performance are increasingly being recognized as important public health interventions. (USDHHS, 2010a, para. 2)

The coordinated school health program, as promoted by the CDC, is an eight-component program including one component that is K-12 physical education. In Texas, legislation

required all elementary, middle, and junior high schools to implement a coordinated school health program that includes PE and physical activity (Texas Education Code, 2007).

Other states, such as Arkansas, have been very active in pursuing physical activity for the students in their public schools. Act 1220 of the 2003 Arkansas State Legislature (Act 1220) included physical activity standards for schools to adopt and provide for their students. Although Act 1220 mandated PE in grades K-8, it did not mandate more than one semester of credit for students in grades 9-12.

On the national stage, Michelle Obama has become the spokesperson for the *Let's Move* campaign targeted at decreasing childhood obesity through nutrition and exercise (USDHHS, 2010b). In conjunction with the *Let's Move* campaign, a White House memorandum dated February 9, 2010, commissioned a task force to fight childhood obesity (Establishing a Task Force on Childhood Obesity, 2010). Like the Surgeon General's Office (USDHHS, 2007), the *Let's Move* campaign suggested that children need a minimum of 60 minutes of physical activity a day (USDHHS, 2010b). In trying to incorporate the time recommendation of 60 minutes of physical activity per day, schools must look carefully at whether this will have an effect on academic achievement.

Ratey (2008), in *Spark*, implied that schools in Naperville, Illinois and Titusville, Pennsylvania have unusually high academic achievement due to their expansive PE programs. In the incorporation of a new PE program, Titusville added time to the school day and took time away from academic courses. Since the change, Titusville has witnessed an increase in test scores as well as beneficial psychosocial changes in student behavior.

With the accountability standards in NCLB (2002), schools are trying to find effective ways to increase student achievement. In meeting NCLB mandates, schools are

reluctant to cut any academic time in favor of a non-academic activity. Outside forces from the CDC to the state legislatures are offering programs and funding to support child health. Schools must look at these initiatives carefully and see if the investment of time during the school day will help them to achieve their academic goals through NCLB.

Statement of the Problem

The purposes of this study were five-fold. First, the purpose of this study was to determine the effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the overall composite score on the ACT for eleventh grade students in a rural school in Arkansas. Second, the purpose of this study was to determine the effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the English score on the ACT for eleventh grade students in a rural school in Arkansas. Third, the purpose of this study was to determine the effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the Math score on the ACT for eleventh grade students in a rural school in Arkansas. Fourth, the purpose of this study was to determine the effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the Reading score on the ACT for eleventh grade students in a rural school in Arkansas. Fifth, the purpose of this study was to determine the effects by gender of students enrolled in two or more physical activity classes in grades 9-11 versus less than two on academic achievement as measured by the Science score on the ACT for eleventh grade students in a rural school in Arkansas.

Background

In Book VII of *Laws*, Plato (1994) described the importance of exercise in the development of a child. Of the two branches of education, Plato describes one as being *gymnasium* which is “concerned with the body” (p. 172). Plato believed the physical body must be trained as well as the mind. The USDHHS (1996) emphasized that ancient cultures, such as the Greeks, have stressed the importance and possible relationship between physical activity and health.

The connection between the mind and the body has strong historical roots and continues in education today. Alongside schools striving to meet their originally intended purpose of academic achievement, many initiatives to increase physical activity among students have been pushed and required of schools. Although physical activity in students can occur in many ways in and out of the regular school day, high schools typically rely upon PE classes and athletics to provide physical activity to their students. Jensen (1998) claimed numerous links between the mind and body have been made, and one should believe that physical activity could aid learning.

Physical Activity

Chomitz et al. (2009) concluded that the physical fitness ability of students greatly enhanced their academic achievement. The sample included 1,103 fourth, sixth, seventh, and eighth graders. Chomitz et al. found that the students’ chances of passing the state Math and English test increased with their ability to pass fitness tests. Castelli et al. (2007) support similar results in third and fifth grade students. In their study, Castelli et al. studied 259 public school students and found aerobic capacity was positively associated with academic achievement when using total, math, and reading achievement. In one of the largest studies

on the topic, Grissom (2005) concluded that there is a consistent positive relationship between physical fitness and academic achievement. In Grissom's study, there were 884,715 participants composed of all fifth, seventh, and ninth grade students in 2002 from California. Grissom (2005), Chomitz et al. (2009), and Castelli et al. (2007) all focused on the fitness level or ability of the students and not on the amount of time the students spent in physical activity.

Singh and McMahan (2006) found in their comparison study of 10 high-ranking academic elementary schools and 10 low-ranking academic elementary schools that schools with a dedicated physical education teacher and a greater commitment to the physical education program, including time, were more successful academically. Furthermore, there was a positive linear relationship between academic scores and physical fitness scores.

In studying the results of self-reported behavior among high school students on the Youth Risk Behavior Survey (YRBS), the CDC reported that "students with higher grades are less likely to engage in physical inactivity and unhealthy weight control behaviors than their classmates with lower grades" (USDHHS, 2003). Field, Diego, and Sanders (2001) observed similar results in their study of 89 high school seniors.

Research supports the link between physical fitness and academic achievement. In trying to address physical fitness, schools rely upon enrolling their students in PE and athletic classes. Although enrollment in PE and athletics does not automatically relate to a higher fitness level, which has been linked to higher academic achievement (Castelli et al., 2007; Chomitz et al., 2009; Grissom, 2005), it does provide the child with the opportunity for physical activity.

Gender

Pate, Wang, Dowda, Farrell, and O'Neill, (2006) found males to be more fit than females. Similarly, Lowery et al. (2004) observed that females have a higher risk of not reaching health objectives. Although the potential for health differences between genders is observable, some studies did not show a difference in the effects of gender on physical activity and academic achievement (Ahamed et al., 2007; Chomitz et al., 2009; Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Tremblay, Inman, & Willms, 2000). However, other studies (California Department of Education, 2005; Carlson et al., 2008; Grissom, 2005; Shephard et al., 1984) did find gender to be a contributing factor in the effects of physical activity and academic achievement.

With an intervention of up to 300 minutes per week of PE, Shephard et al. (1984) observed girls to have a greater effect on their academics as compared to boys. Although Shephard's study was limited to elementary students, this finding was also noted by Grissom (2005) with fifth, seventh, and ninth graders. In a study similar to Grissom's, the California Department of Education (2005) found that the effects were greater for girls in regard to Reading and Mathematics scores. Carlson et al. replicated these findings with SAT/9 scores in Reading and Mathematics.

As previously mentioned, some studies have concluded girls to have a lower fitness level than boys (Lowery et al., 2004; Pate et al., 2006). Sallis et al. (1999) and Vandongen et al. (1995) argued that any observed difference in academic achievement among the genders is attributable to girls having a lower baseline fitness level prior to the physical activity.

Increasing Physical Education Time and Decreasing Academic Time

With schools having a limited amount of time during any given school day, each must appropriate the time available to get the largest possible benefit. With academic achievement being the measure of a school's success through NCLB (2002), it is important that a school look carefully before cutting academic instruction time in favor of non-academic programs to see if academic achievement will be affected.

Trudeau and Shephard (2008) asserted that adding physical activity time in lieu of academic time does not affect the students' academic achievement. In addition, they concluded that taking time from PE and adding it into the academic programs does not enhance academic achievement.

Sallis et al. (1999) concluded in a study of 1,538 fourth grade students that no positive academic benefits were observed as a result of participation in PE. In addition, the authors found no effects on academic achievement from increasing time on physical education.

Coe, Pivarnik, Womack, Reeves, and Malina (2006) found that there were no academic improvements among 214 sixth grade students when comparing enrollment versus non-enrollment in a PE course. They also found no decline in academic achievement among students who decreased their academic instruction time to participate in PE.

Sports Participation

Participation in athletics and sports programs has been studied with its possible association with academic achievement. In their study of sports involvement among 838 urban New York City high school students, Fisher, Juszczak, and Friedman (1996) did not report an association between sports involvement and academic achievement. When

comparing pre-season and post-season grades of student athletes, Din (2006) found no difference in academic achievement while a student participated in a season of athletics. Fredricks and Eccles (2006) found participation in sports predicted higher eleventh grade GPAs and higher education expectations among eleventh grade students.

Coe et al. (2006) stated that there were academic gains among students who participated in vigorous activity outside of the school day as compared to those who did not. There was not a difference noted by Coe et al. in their study about students who participated in PE classes and those who did not. Thus, a possible relationship between athletics participation and academic achievement may exist.

Hypotheses

Multiple sources (Castelli et al., 2007; Chomitz et al., 2009; Grissom, 2005), show a relationship between physical activity and academic achievement. Academic achievement did not show any effects from having time reduced and replaced with physical activity programs (Coe et al. 2006; Sallis et al., 1999; Trudeau & Shephard 2008). The effect of gender in regards to physical activity and academic achievement has received mixed results (Ahamed et al., 2007; California Department of Education, 2005; Carlson et al., 2008; Chomitz et al., 2009; Dwyer et al., 2001; Grissom, 2005; Shephard et al., 1984; Tremblay et al., 2000).

The following null hypotheses guided the rest of this study.

1. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the overall composite score on the ACT.

2. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the English score on the ACT.
3. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Mathematics score on the ACT.
4. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Reading score on the ACT.
5. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Science score on the ACT.

Description of Terms

Academic achievement. Academic achievement is measured by a student's performance on the ACT. The ACT measures knowledge and skills that have been acquired over a period of many years for the student in the areas of English, Mathematics, Reading, and Science (American College Testing, ACT, 2009).

Athletics. The term *athletics* is defined as school sports taught during the school day that include football, basketball, track, volleyball, and other sports. (Arkansas Department of Education, 2010).

Physical activity class. Trudeau and Shephard (2008) include exercise, physical education classes, and sports as areas that include physical activity; thus, physical education and athletics are classified as physical activity classes.

Physical education. Physical education is a class taught during the school day with a planned curriculum. Various topics in the curriculum include basic motor skills, fitness, games, lifelong sports, team and individual sports (Arkansas Department of Education, 2007).

Significance

Research Gaps

As schools struggle to meet adequate yearly progress (AYP) for NCLB (2002), they are also being asked to serve in a multitude of roles for their students. Being a caregiver and supplier of basic health and nutritional needs is but one of the areas that schools are required to help children. With the large number of programs and grant funding available in school health, it is important for schools to ensure the programs and activities being provided for their students are effective. It is also important for schools to look at every possible variable to provide the best educational opportunity for their students.

Possible Implications for Practice

Schools can use the results from this study to determine the best implementation of physical education and athletic classes in regards to academic achievement. State agencies

and other funding entities can also use the results to determine where they should appropriate funds to get the largest return on their investment of educational funds.

Process to Accomplish

Design

A quantitative, causal-comparative strategy was used in this factorial design study. The independent variables for statements one through five of the problem were gender (male versus female) and the number of semesters of previous enrollment in physical activity classes (two or more physical activity classes in grades 9-11 versus less than two). The dependent variable in hypothesis one was academic achievement measured by the ACT composite score. In hypotheses two through five, the dependent variables were academic achievement measured by the ACT English score, the ACT Math score, the ACT Reading score, and the ACT Science score, respectively.

Due to mixed results in previous research, gender was employed as an independent variable to explore if any possible effects in this type of study design existed. Classification of students by those having two or more semesters of physical activity classes and those who do not was done because students are only required to take one semester of these classes for graduation in the state of Arkansas. This factorial design divided the study participants into four groups: males with two or more physical activity classes in grades 9-11, males with less than two, females with two or more physical activity classes in grades 9-11, and females with less than two.

Sample

This study utilized eleventh grade students in a rural school in Arkansas. The study used the results from two years of data. Each year consisted of approximately 230 students.

All students in grade 11 were required to take the ACT Universal Test. Only students in special education functioning in the severe range and not tested were excluded from the study. The students come from a school with approximately 85% of students classified as whites. The free and reduced lunch population of the school is approximately 20% of 800 students.

Instrumentation

Student enrollment in physical education and athletic classes was collected and recorded using APSCAN. Transcripts of the students were used to collect the data concerning their enrollment in the specified courses.

With the onset of national standards, schools must look to measure academic achievement on national tests. The ACT (2009) Program was founded in 1959. The ACT is a widely accepted measure of academic achievement taken by nearly 1.5 million students in 2009 and includes a composite, English, Math, Reading and Science component. Nine states have adopted the ACT into their state testing programs. Administered during the school day to most eleventh grade students, the Universal ACT test was utilized. By using the Universal ACT as opposed to the traditional Saturday test, it eliminates the bias of only assessing those students who chose to take the ACT.

To measure academic achievement, the eleventh grade spring semester Universal ACT test was utilized. In some cases of missing data, equivalent ACT test data from the same semester was used. The scores on the ACT range from 1-36. The scale score reliability of the ACT composite score is .96 for Composite, English .91, Math .91, Reading .85, and Science .80 (ACT, 2007).

Data Analysis

A quantitative, causal-comparative strategy was used in this study. To address all five hypotheses, five factorial between-subject ANOVAs were used. The independent variables for hypotheses one through five were gender and the number of semesters of previous enrollment in physical activity classes. The dependent variable in hypothesis one was academic achievement measured by the ACT composite score. In hypotheses two through five, the dependent variables were academic achievement measured by the ACT English score, the ACT Math score, the ACT Reading score, and the ACT Science score, respectively. To test the null hypotheses, the significance level was set at .05.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

This chapter provides a discussion over existing research that has been conducted concerning the possible relationship between physical activity and academic achievement. This chapter addresses research on physical activity and possible effects on factors that may contribute to academic achievement, physical activity and academic achievement, increasing the amount of time in physical education (PE) classes, and gender differences concerning physical activity and academic achievement. Although this study does not attempt to measure any of the possible physiological or academic behavior benefits of physical activity, the research on these topics serves as a possible explanation for the association between physical activity and academic achievement. Descriptions of studies along with differences and commonalities will be discussed. The contribution each study makes to the body of existing literature in this topic will be addressed as well. Research studies that appeared frequently in the existing body of literature were given priority for inclusion. Priority was also given to those studies involving school-aged children.

The importance of physical activity has been noted through history. In 65 BC, Marcus Tullius Cicero is quoted as saying, “It is exercise alone that supports the spirits, and keeps the mind in vigor” (Torrey, 1973, p. 202). In a more modern view, Founding Father John Adams stated, “Exercise invigorates, and enlivens all the faculties of body and mind....It spreads a gladness and satisfaction over our minds and qualifies us for every sort

of business, and every sort of pleasure” (De Mooy, 2003, p. 46). There has been a belief for many years that there is a link between physical activity and the mind.

Since the passing of NCLB, states have adopted assessments in the areas of Mathematics, English, and Science to evaluate the effectiveness of schools and enforce the accountability movement. Although schools across the nation have responded with an increased focus on core subjects, non-core classes, such as physical activity classes, have been pushed aside and not given the same priority as core academic classes.

Chomitz et al. (2009) summarized the response to NCLB by saying “simultaneous pressures to meet academic achievement testing thresholds legislated by the federal ‘No Child Left Behind Act of 2001’ has required some school administrators to shift resources away from PE toward time on academics” (p. 31). Further, Rentner et al. (2006) found that 14% of school districts report decreasing PE time to accommodate more Math and English.

Physical Activity and Possible Effects on Factors

Related to Academic Achievement

Because academic achievement is reflective of physiological and cognitive processes, one must examine the association between physical activity and physiological responses linked to academic achievement. The physiological responses and cognitive effects of physical activity may help explain a possible link between physical activity and academic achievement.

Physiological Responses

Many studies have been conducted regarding physiological responses to physical activity. The generation of new brain cells because of physical activity has been studied by many (Fabel et al., 2003; Gomez-Pinnilla, So, & Kesslak, 2001; Griesbach, Hovda, Gomez-

Pinnilla, & Sutton, 2008; Praag, Shubert, Zhao, & Gage, 2005). All of these researchers employed rodents, either mice or rats, to determine the possible association between physical activity and the formation of brain cells.

Using MRI on adults over 55, Colcombe et al. (2002) initiated cardiovascular fitness as the independent variable in their study. In examining the effects on humans, Colcombe et al. noted that losses in the frontal, parietal, and temporal cortices sections of the brain were reduced due to exercise.

Additional studies by Herholz et al. (1987) concluded that because of workload levels in exercise, blood flow in the brain increased. This study employed 12 male subjects aged 22 to 36 years of age. Using a bicycle ergometer, Herholz et al. had subjects perform at either 25W or 100W of workload and measured the arterial blood system, pulse frequency, and expiratory CO₂ levels. Using meta-analysis, Sibley and Etnier (2003) additionally observed that aerobic exercise increased the amount of oxygen in the brain as well as increased the blood flow to the brain.

All of these studies measured physiological responses to physical activity. Although not showing a direct effect with academic achievement, they do show an association with factors that accommodate healthy brain activity. In addition to these physiological responses, academic behaviors commonly tied to academic achievement have been shown to be associated with physical activity.

Academic Behaviors

Although not directly measuring academic achievement, many studies have investigated the association of physical activity with behaviors that may be related to academic achievement. In a meta-analysis of the literature for evidence-based physical

activity in school-aged youth, Strong et al. (2005) found that physical activity had a positive influence on concentration, memory, and classroom behavior. Another meta-analysis by Sibley and Etnier (2003) surmised that across multiple studies, physical activity has been shown to have positive effects on concentration, planning, abstract thinking, and self-control. Keays and Allison (1995) derived that upon review of the literature, there were significant improvements in student attitudes, behaviors, and creativity following the initiation of physical activity programs.

A 1973 study by Davey (1973) deduced a positive relationship between physical exertion and attention. The relationship actually followed an inverted “U” shape. Attention continued to increase along with physical exertion until physical exertion began to cross over in to the fatigue category. At this point, attention dropped. Gupta, Sharma, and Jaspal (1974) noted similar results.

Caterino and Polak (1999) reported higher concentration scores among fourth grade students following a physical activity period. Gruber’s (1986) meta-analysis reported a strong relationship between participation in physical activity and self-esteem. Schmalz, Birch, and Krahnstoever (2007) confirmed this relationship in a study limited to non-Hispanic females. Ekeland, Heian, Hagen, Abbott, and Nordheim (2004), along with Shephard (1984), concurred that physical activity increased self-esteem. Tremblay, Inman, and Willms (2000) argued that self-esteem is related to academic achievement. Flook, Repetti, and Ullman (2005) observed similar results on self-esteem and academic achievement.

Although research supports a link between physical activity and academic behaviors, one must carefully examine the link between physical activity and the actual demonstration of increased mental activity. Mental activity can be measured through various cognitive

tasks and assessments including intelligence quotient (IQ). Various studies have been completed exploring the relationship between physical activity and cognitive effects.

Cognitive Effects

Corder (1966), Brown (1977), and Ismail (1967) conducted some early studies that laid the foundation for modern research in the effect of physical activity on children's mental functioning. All three of these studies used IQ tests to measure mental functioning, and Brown (1977) was the only author of the three who reported higher IQ scores in relation to physical activity.

Few, if any, measures of academic achievement are limited to or based upon IQ scores. For this reason, one must explore other cognitive effects associated with academic achievement. Some examples of cognitive effects that may contribute or be attributed to academic achievement include reaction time, memory, and subject specific abilities such as Math. Multiple studies have been performed to examine the possible relationship between physical activity and these cognitive effects.

In a study of 24 children with an average age of 9.6 years, Hillman, Castelli, and Buck (2005) concluded that greater aerobic fitness was associated with positive changes in neurocognitive functioning. Kramer, Erickson, and Colcombe (2006) support these findings even though they predominately focused on adult subjects in their review of literature.

Narrowing the focus to school-aged children, Sibley and Etnier (2003) conducted a meta-analysis of 44 studies relating physical activity and cognition. The authors described an Cohen's effect size of 0.32 concerning physical activity and cognition thus suggesting a small effect size. Although small this conclusion is affirmed by the authors as being

statistically significant thus proclaiming that physical activity has a positive effect on cognition.

Another review of the literature consisting of over 100 studies was undertaken by Thomas, Landers, Salazar, and Etnier (1994). They indicated a positive association with physical activity and cognitive functions. The authors reported that specifically, there were advantages observed in Math, acuity, and reaction time in response to physical activity.

Harada, Okagawa, and Kubota (2004) reiterated the before-mentioned findings of a positive association with physical activity and cognitive functions in their 2001 study. The conclusions from this study showed that those subjects who were involved in a jogging treatment had a clear improvement in learning and memory over those who did not. Interestingly, the improvements declined once the treatment (jogging) had stopped, which indicates that ongoing physical activity is required to maintain the cognitive benefits.

Addressing subject specific cognitive effects, performance on mathematical tasks increased when physical activity lasted two to five minutes as reported by Gupta et al. (1974). When the physical activity lasted 10 to 15 minutes, mathematical performance decreased. This is consistent with Davey's (1973) findings concerning physical activity and attention thus modeling the inverted "U" pattern.

Although physiological factors, academic behaviors, and cognitive effects have been shown to be related to physical activity, none of these fully addressed academic achievement. Schools must be concerned with the actual academic achievement performance of students and specific variables that may contribute to that performance. Whatever the cause for an increase in academic achievement, a consistent positive or non-negative relationship between fitness and academic achievement has been observed by many researchers.

Fitness, Physical Activity, and Academic Achievement

Fitness and Academic Achievement

Multiple studies have evaluated the association between fitness and academic achievement. Although fitness is not physical activity, fitness is the objective and result of physical activity (Casperson, Powell, & Christenson, 1985). Additionally, physical activity is a means by which one improves or maintains fitness. With the link between physical activity and fitness, it is understandable that one explore the possible link between fitness and academic achievement.

Dwyer et al. (2001) conducted one of the first studies to investigate the possible relationship between fitness and academic achievement. They collected the following health information on 9,000 school-aged children from 7 to 15 years of age: height, body mass, standing long-jump, sit-ups, push-ups, sit and reach, dynametry, skin folds, lung function, 50 meter sprint times, 1.6 kilometer run, and heart rates under work capacity. In addition to collecting the fitness level in each of these categories, the “scholastic ability” of each child was recorded. A school representative, usually the principal, assigned these scholastic classifications to each student. In their results, the researchers found various areas of fitness showed a positive relationship to academic achievement.

It must be noted that the instrument used to evaluate the academic achievement of the student was very subjective (opinion from an unnamed school official). Because of the subjectivity of academic achievement in this study, Grissom (2005) questioned the validity of this study. In addition he states, “the reported correlations, although statistically significant (i.e., at 0.001, 0.01, & 0.05 levels of significance) were not impressive” (p. 12).

Other studies measuring fitness and academic achievement employed the FITNESSGRAM as the instrument to measure fitness. Becoming a fitness test battery in 1986 and created by the Cooper institute (Ernst, Corbin, Beighle, & Pangrazi, 2006), the FITNESSGRAM is a test battery widely utilized in schools. Areas measured by the FITNESSGRAM include Aerobic Capacity, Body Composition, Muscular Strength and Endurance, BMI, and Flexibility (Grissom, 2005). According to a study by Welk, Morrow, and Falls (2002), the FITNESSGRAM is both reliable and valid.

In similar studies, Grissom (2005), The California Department of Education (2005), and Sing and McMahan (2006), all used the FITNESSGRAM as their instrument to evaluate fitness in their studies of the possible association between fitness and academic achievement. Although the dependent variable differed, a standardized test was implemented in each study. Furthermore, all three studies took place in California and followed similar methodologies.

In 2002, Grissom (2005) studied 884,715 students in the fifth, seventh, and ninth grades from across the state of California. In each category of the FITNESSGRAM, standards allowed a student to be classified as *healthy* or *needs improvement*. FITNESSGRAM scores reflected the number of categories the students were classified as *healthy*, from zero to six. Grissom applied the FITNESSGRAM results and conducted a simple linear correlation with the SAT/9 test scores in Reading and Mathematics. An ANOVA was then used to analyze the results based upon gender and results of the fitness test. His findings reported a consistent positive relationship between fitness level and academic achievement on both the Reading and Mathematics scores of the SAT/9. Grissom found that each category of *healthy* on the FITNESSGRAM scored statistically higher than

the lower categories in Reading and Mathematics. When exploring subgroups, he further found this relationship to be stronger for students with a higher socio-economic status (SES).

A 2004 study from the California Department of Education (CDE) almost mirrored the Grissom (2005) study. Although no author is stated in the report, Grissom is listed as an employee of the CDE and the contact if there were any questions regarding the study.

Grissom (personal communication, January 4, 2011) confirmed in a phone call that he was the author of the 2004 study for the CDE.

In the CDE (2005) study, the standardized SAT/9 tests implemented in the 2002 Grissom (2005) study had been replaced with the standardized criterion-referenced California Standards Tests (CST). The CST is used to meet the guidelines of NCLB and reports scores for Reading, Mathematics, and Science. The age of the sample remained the same at fifth, seventh, and ninth grade students. Similar statistical methods to Grissom's (2005) 2002 study were utilized, and the results were almost identical without any great differences being noted. Unlike the SAT/9, the CST included a score for Science, but the CDE (2005) study did not mention any analysis with the Science scores.

Singh and McMahan (2006) continued with a similar study in 2005. Their study contained a sample limited to Orange County, California. Aside from the smaller population and different school year being assessed, this study differed from the Grissom (2005) and CDE (2005) studies because Singh and McMahan (2005) engaged school-level data as opposed to individual student data. The researchers also limited their sample to fifth grade students in one California County as opposed to statewide fifth, seventh, and ninth graders.

Singh and McMahan (2006) pointed out that as fitness level averages went up from school to school, so did academic achievement. This finding was observed after using

similar methodology as Grissom (2005) and the CDE (2005), linear correlation and ANOVA, to evaluate the data. One other unique aspect that sets the Singh and McMahan (2006) study apart is that they proceeded with a follow-up qualitative study by interviewing and collecting data on the PE programs of the 10 highest performing schools and the 10 lowest performing schools.

During the 2004-2005 school year, Chomitz et al. (2009) studied fourth, sixth, seventh, and eighth graders in the Cambridge, Massachusetts School District who took the Massachusetts Comprehensive Assessment System (MCAS). Fourth and seventh graders for which there were English scores on the MCAS were observed as well as fourth, sixth, and eighth graders with Math scores. Similar to the CST tests used in the CDE (2005) and Singh and McMahon (2006) studies, all students in the district were required to take the MCAS assessments in response to NCLB.

To measure fitness level, Chomitz et al. (2009) also utilized the FITNESSGRAM instrument. Bivariate and multivariate regressions were performed to evaluate the data. This allowed the researchers to identify explanatory variables and assess the potential of any confounding effects among variables. From the results, the authors contended that ethnicity, higher SES, and higher fitness level were all associated with higher achievement on the Mathematics test. On the English test, gender, ethnicity, higher SES, and higher fitness level were associated with higher achievement levels as well. As reflected in other studies (CDE, 2005; Chomitz et al., 2009; Grissom, 2005), Math scores were more closely associated with fitness levels than English scores.

Castelli et al. (2007) sampled 259 public school students in the third and fifth grades in one Illinois school district. All of the participants had fitness levels recorded by the

FITNESSGRAM as well as standardized test scores of academic achievement. To gauge academic achievement, the standardized Illinois Standards Achievement Test (ISAT) served as the dependent variable. As part of NCLB, the ISAT is given to all students in grades 3 through 8. The ISAT has three scores: Reading, Math, and composite (Reading + Math). Regression analysis was employed to analyze the data and later a hierarchal step regression isolated variables. Results from the analysis included a relationship between fitness and academic achievement. Specifically, performance in Reading and Mathematics were both related to aerobic fitness. Muscle strength and flexibility appeared to be unrelated to academic achievement. These findings were present even after the variables such as age, gender, school characteristic, and poverty index were controlled.

One of the most common findings among the research of a possible covariate, included SES. In the studies that measured SES (CDE, 2005; Castelli et al., 2007; Chomitz et al., 2009; Grissom, 2005; Singh and McMahon, 2006), there was a positive relationship found between SES and academic achievement. Although a factor such as SES can contribute to academic achievement, when SES is controlled, fitness and academic achievement still show a strong association (Castelli et al., 2007, Chomitz et al., 2009). Grissom (2005) suggests that it may be possible that overall better health conditions of the student and/or living conditions were responsible not only for a higher fitness level but for higher academic achievement as well.

Shephard (1997) suggested that alternative explanations for the positive relationships between fitness and academic achievement may exist. These possible explanations include teacher attitudes via the *halo effect*, students attitudes, learning disabilities, and public

policies. Although a cause and effect relationship is not established, there does appear to be a consistently positive relationship between fitness and academic achievement.

Although Chomitz et al. (2009), Castelli et al. (2007), CDE (2005), and Grissom (2005) all studied the relationship between fitness level and academic achievement, none of these studies explored the amount of physical activity these students may be receiving. Sibley and Etnier (2003) concluded from their meta-analysis that there is evidence to argue, “physical activity should be part of the school day for both its physical health and cognitive benefits” (p. 253). Because school leaders cannot control fitness levels of students but can control the opportunities for physical activity which may lead to fitness (Casperson et al., 1985), it is important to look at the possible association between physical activity and academic achievement.

Physical Activity and Academic Achievement

Numerous studies have been conducted with students of various ages regarding the possible connection of physical activity with academic achievement. Shephard (1997) found intense physical activity not only increased concentration and reduced disruptive behavior but also increased Math, Reading, and Writing scores. Research spanning the ages of most schoolchildren (5 to 18) has been conducted by Dwyer et al., (2001), Strong et al., (2005), and Sibley and Etnier (2003).

Using a step-test, Sparrow and Wright (1993), as well as Sjoberg (1980), studied the relationship between physical activity and mathematical ability. Both studies had similar results and concluded that there was no association between physical activity and Math ability when using a step-test.

Dwyer's et al. (2001) concluded, based on students aged 7 to 15, that a school's rating of a student's academic ability was associated with the child's activity level, although the correlations were low. As mentioned before, problems with Dwyer's et al. study included the highly subjective nature of the measurement for academic achievement, which was measured by an opinion from a school official. Significant associations were found between the two measures (lunchtime activity and weekly activity) of physical activity and the rating of academic achievement. All correlations were low, thus the researchers concluded that physical activity and fitness might make a modest contribution to academic achievement.

Strong et al. (2005) and Sibley and Etnier (2003) both conducted a meta-analysis on physical activity and academic achievement. Strong's et al. (2005) review covered school aged children from 6 to 18 years of age, and Sibley and Etnier (2003) included literature of children aged 4 to 18. The Sibley and Etnier's analysis categorized the studies by age. The age groups included early elementary (4 to 7 years of age), late elementary (8 to 10 years of age), middle school (11 to 13 years of age), and high school (14 to 18 years of age). The conclusion from Strong's et al. (2005) analysis of 850 articles included a positive association between academic achievement and physical activity in the cross-sectional studies.

Furthermore, they observed benefits from physical activity enough to state, "School-age children should participate in 60 minutes or more of moderate to vigorous activity" (p. 732).

Sibley and Etnier (2003) were highly selective in their review of 44 studies. They calculated the Cohen's effect size that physical activity had on academic achievement to be 0.3, thus suggesting a small effect. As stated by Cohen (1988), the term small is relative to many factors which include the area of behavioral science, specific content, and research method being used. Although all age groups showed significant effect sizes (ES), the largest

effects were observed in the middle school (11 to 13 years). The smallest, but still significant, ES were noticed in the high school population (ages 14 to 18). The authors further concluded that across multiple studies, verbal skills, and mathematical competencies increased because of physical activity.

Tremblay et al. (2000) studied 6,923 sixth grade students using results from the Elementary School Climate Study questionnaire in New Brunswick, Canada. The measurement of academic achievement in Tremblay's et al. study was standardized test scores in Reading, Mathematics, Science, and Writing administered by the New Brunswick Department of Education. Multiple regression analysis was administered to identify explanatory variables and covariates. In their results, the authors implied that "increased levels of physical activity had a very weak relationship with academic achievement in both Mathematics and Reading" (p. 318).

Another study of sixth grade students performed by Coe et al. (2006), questioned 214 students on the amount of physical activity they receive outside of the school day. The instrument serving as the independent variable was the 3-d physical activity recall test (3DPAR) which required students to recall the physical activity they had participated in during the previous three days.

Coe et al. (2006) used core (Mathematics, Science, English, and Social Studies) grade point averages (GPA) to measure academic achievement as well as Terra Nova standardized test scores. The Terra Nova scores included Reading or Language Arts, Mathematics, Science, and Social Studies. From the results, the authors concluded that students who participated in vigorous physical activity had higher GPAs than those who did not.

In another study implementing students' self-reported physical activity and standardized test scores, Hanson, Austin and Lee-Bayha (2004) assessed seventh, ninth, and eleventh graders in 628 schools. School-level averages were calculated for schools in California. To measure physical activity, Hanson et al. employed the California Healthy Kids Survey. This instrument evaluated a student's responses in areas such as physical activity, physical health, substance abuse, and school safety. The national percentile rank (NPR) on the SAT/9 was recorded for each school to serve as the dependent variable representing academic achievement. After applying autoregressive regression, the authors concluded there were significant effects on performance in Reading and Math for schools with higher averages of reported physical activity. Although not significant, there was an increase in Language scores corresponding to the average physical activity level for the schools.

Din's (2006) study of 225 rural high school students focused on participation in extra-curricular sports and the potential effects on core GPA. This study included five high schools in the Kentucky area of the Appalachian Mountains. Din evaluated the pre-season core GPAs and post-season core GPAs of those participating in extra-curricular sport programs. Relying upon school records, Din compiled the GPAs of students who participated in extra-curricular sports prior to the semester of participation and then after the participation had taken place. Din concluded that there was no difference in core GPAs. Although this may lead one to conclude that sports participation had no effect on academic achievement, Din explained this absence of significant differences as demonstrating the avoidance of a negative effect on core GPA. Furthermore, benefits from physical activity on academic achievement may have occurred during this time but were not noticeable as the

participants may have already been receiving these benefits during the pre-season and maintained the benefits throughout the semester, as implied by Harada et al. (2004).

The Centers for Disease Control (CDC) conducts a nation-wide survey of high school students in grades 9 through 12 every other year (USDHHS, 2011). The results from the survey are published during odd years, and the 2009 results are from data collected from September 2008 through December 2009. A total of 16,460 surveys were collected in the 2009 survey of students in grades 9 through 12. Using logistic regression and $p \leq .0001$, after controlling for gender, race/ethnicity, and grade level, the CDC found that students with higher grades are significantly less likely to have engaged in the following behaviors:

- “Being physically active at least 60 minutes per day on fewer than five days.
- Watching television three or more hours per day
- Using computers three or more hours per day” (USDHHS, 2010a)

Fredericks and Eccles (2006) studied the possible association between eleventh grade students’ involvement in extra-curricular participation and academic achievement. Physical activity participation in the form of sports was evaluated as well as membership in non-sports clubs and activities. A total of 912 eleventh graders were given surveys regarding their participation in these organizations, and the results were analyzed alongside their reported GPAs. Students were also asked about academic achievement in the form of their grades. The GPA was calculated by the researchers using these responses. The authors utilized an analysis of covariance (ANCOVA) to assess the data and concluded that after controlling for covariates, participation in sports was associated with a higher GPA. Positive psychological benefits such as lower rates of depression and higher self-esteem were also reported for those who participated in sports. The researcher’s control of covariates was very well done.

Specifically the eighth grade GPA was a covariate that was controlled with the ANCOVA. Unfortunately, GPA could have been recorded through school records as opposed to student surveys to produce data that were more valid.

In a small sample of 89 high school seniors, Field et al. (2001) administered a 181 questionnaire to participants. Physical activity was recorded by student responses to the frequency of their participation in physical activity. GPA was reported using a 4-point scale from A to D. The authors did not report how the GPA data were collected, whether it came from the survey or the school. With the results from the questionnaire, a median split divided students into either a high exercise group or a low exercise group. Applying a multivariate analysis of variance (MANOVA) and ANOVA to the variables, Field et al. concluded that participants who reported having a higher level of physical activity also had higher GPAs and a higher quality relationship with their parents. The relationship with their parents could serve as a covariate as reported by Garber and Little (1999).

Physical activity and academic achievement were shown to have a positive relationship (Coe et al., 2006; Dwyer et al., 2001; Field et al., 2001; Hanson et al., 2004; Sibley & Etnier, 2003; Strong et al., 2005; USDHHS, 2010a). Tremblay et al. (2000) did not support this relationship. Many studies on physical activity and academic achievement employed self-reported behavior (Coe et al., 2006; Dwyer et al., 2001; Field et al. 2001; Fredericks & Eccles, 2006; Hanson et al. 2004; Tremblay, 2000; USDHHS, 2010a). The two studies that focused on students in grades 9 through 12 and used self-reported behavior found a positive relationship with physical activity and academic achievement (Field et al., 2001; USDHHS, 2010a). Tremblay et al. (2000) used sixth graders, which bring into question the validity of the results on the self-reported behavior for either the sixth grade or the ninth

grade through twelfth grade students. However, with the Tremblay et al. (2000) sample being a different age group from the USDHHS (2010a) and Field et al. (2001) studies, it may indicate that the relationship is not apparent at that particular age. This would correspond with Coe's et al. (2006) mixed results of a positive association with physical activity and self-reported GPA but no association with physical activity and standardized test scores among sixth graders.

Although it is important to consider the validity of any study that relies upon self-reported behavior of children, they should not be discredited entirely. To look at the overall physical activity behavior of students, one must rely on self-reported behavior or direct observation to validate the actual participation. Directly observing the physical activity participation of a large number of students would be impractical for many research studies due to the amount of time and effort required.

Gender

A possible effect that physical activity may have on academic achievement concerning gender has mixed results from various studies. Many, including the CDC who claimed that school-aged females have a higher risk of not reaching health objectives (Lowery, 2004), have documented differences between the genders about health and fitness. Pate et al. (2006) found other health-related differences in their conclusion that males are generally more fit than females. Grissom (2005) and Vandongen et al. (1995) both agree that the effect physical activity has on females' fitness is higher, when compared to males, because of the lower baseline level of females.

Health differences between males and females must be considered because many studies state possible effects that fitness and/or physical activity have on academic

achievement differs between the genders. Not only are fitness levels different between females and males, but the amount of time they spend in physical activity is also different. In a study of the activity levels of females and males ages 13 through 19, Allison and AdlaF(1997) found 44% of the females to be classified as inactive and only 27% of the males were classified as such.

Some studies found no difference in academic achievement among genders concerning physical activity and fitness (Ahamed et al., 2007; Chomitz et al., 2009; Dwyer et al., 2001; Tremblay et al., 2000). However, other studies have reported this difference (Carlson, 2008; CDE, 2005; Grissom, 2005; Shephard, 1997).

Beginning with the Dwyer et al. (2001) study in 1983, there was no difference observed among genders for the effect that physical activity had on academic achievement. The correlations observed were similar for both males and females in this study of 216 fifth grade students. Ahamed et al. (2007) reiterated this idea in their findings. Using a mixed linear model to compare males and females, they noticed that with similar baselines, there were no differences. This was in response to the intervention of an additional 47 minutes of PE per week. Although Sallis et al. (2001) found a difference in genders in only one of eight tested areas; they later controlled for baseline data and contributed this difference in performance among genders to the lower fitness levels of the females at the baseline.

Although differences in gender were not evident in regards to physical activity and the effect on academic achievement, Tremblay et al. (2000) reported that vigorous physical activity resulted in higher self-esteem for both genders. In addition, the authors found there to be higher scores in Reading for the females and Mathematics for the males. Further, the authors note higher scores were not necessarily attributable to physical activity.

Chomitz et al. (2009) indicated a higher score on the English test for females in their 2004-2005 study of 1,103 fourth, sixth, seventh, and eighth graders. However, when gender was controlled, the effects were attributed to physical activity.

One of the earliest studies to report a difference in the genders was from Shephard et al. (1984). This study of 546 primary school students, grades 2 through 6, showed that although males had more vigorous physical activity, the females gained more academically than males after the intervention of up to 300 minutes per week of PE.

Grissom (2005) observed similar findings in regards to gender with fifth, seventh, and ninth graders when he measured the fitness level of students and applied linear correlation with their academic scores on standardized tests. His results included a consistent positive relationship that was stronger among the females than the males.

Similar results as Grissom (2005) were observed by the CDE (2005) with the greatest effect of fitness on academic achievement being seen in the females as opposed to the males. In further calculations, the CDE concluded that there appeared to be an interaction effect with fitness and test scores regarding gender. Females had a greater rate of change in their academic achievement as their fitness level increased. Carlson et al. (2008) found parallel results concerning the Reading and Mathematics scores on the SAT/9.

In a nation-wide longitudinal study by Carlson et al. (2008), 5,316 kindergarteners were examined using teacher logs to measure the amount of time spent in PE and to collect scores from standardized tests given at five different times throughout the kindergarten through fifth grade. Carlson et al. surmised that the females showed a positive gain in Math and Reading scores because of PE enrollment. Further, this effect was noted when the

females, who had 70-300 minutes of PE per week, were compared to the females who had 0-30 minutes per week. Additionally, the authors did not notice any effects among the males.

Although differences among genders have been reported (CDE, 2005; Carlson, 2008; Grissom, 2005; Shephard, 1997), others have not observed this difference (Ahamed et al., 2007; Chomitz et al., 2009; Dwyer et al., 2001; Tremblay et al., 2000). Further examination of a possible discrepancy among genders is warranted.

School leaders who are interested in utilizing positive research benefits from physical activity in regards to academic achievement are limited in their responses. Although legally and morally a school cannot force a child to be physically active, they can enroll them in courses where physical activity takes place, such as PE and athletics. However, providing these opportunities for physical activity decreases the amount of time the student could otherwise spend in tested areas such as Math and English.

With the limited amount of time in a school day, school leaders must take a careful look at how that time is spent. School leaders must determine if there would be harmful effects of enrolling students in PE and/or athletics in lieu of academic classes. As schools have focused their time and efforts in the tested areas of NCLB, many studies have been done to determine the possible effects of the amount of time allocated for each area during the school day.

Increasing Time in PE Classes

As reported by the USDHHS (2004), a majority of students in the United States do not participate in a daily PE class. They further note that the participation rate of American students in regard to PE class has been declining. In response to the NCLB of 2001, many schools are cutting time spent in PE and Art classes to increase the amount of time that

students spend in core academic classes such as Math and English as reported by the Center on Education Policy (CEP, 2007). At the elementary level alone, 44% of districts reported cutting time from other areas to increase time spent in Math and English in an effort to increase test scores and meet AYP requirements (CEP, 2007; Wilkins et al., 2003).

In response to this emphasis on core subjects, either PE classes or other physical activity times such as recess are being eliminated or the time spent in them is being decreased. In 2003, 53.6% of U.S. high school students reported attending a PE class on at least one day during the week (Lowery, 2004). At the same time, Lowery noted that only 30% of the students reported going to PE on a daily basis.

Likewise, in 2006, 4% of elementary, 8% of middle schools, and 2% of high schools required daily PE for all students (Lee, Burgeson, Fulton, & Spain, 2007). Lee et al. also reported that only 4% of high schools were required by their districts to provide regular physical activity breaks.

Over time, participation in high school PE classes has declined. In 1991, 41.6% of high school students reported PE enrollment as compared to 28.4% in 2003 (Lowery, 2004). The CEP (2007) noted that schools have reported a decrease in PE by 25 to 49 minutes per week in response to NCLB.

In a 2006 nation-wide study of 452 school districts and 988 schools, Lee, Burgeson, Fulton, and Spain (2006) concluded that 75.8% of reporting school districts had time requirements for PE at the elementary school level. Roughly, the same percentage, 76%, of these districts reported time requirements in middle school and 81% in high school. This is in contrast with their results of the state educational agencies reporting time requirements of 36% for elementary, 34.1% for middle school, and 86.3% in high school.

Using school-level data, 69.3% of elementary schools reported requiring PE of their students. In middle schools, 83% reported PE as a requirement and 95.2% of high schools reported the requirement. Among other findings, Lee et al. (2007) found that only 2.1% of high schools provided daily PE for all students. Table 1 reports the percentage of all schools that reported the requirement of PE in each grade. As observed in Table 1, the three grades that had the lowest percentage of schools reporting a PE requirement were in grades 10, 11, and 12.

Table 1

Percentage of Schools Reporting the Requirement of PE in Each Grade

Grade	%
K	49.7
1	57.2
2	57.7
3	58.0
4	58.2
5	61.1
6	68.1
7	67.1
8	65.5
9	55.3
10	33.2
11	20.2
12	20.4

In a similar study, Wilkins et al. (2003) stated that 10.4% of principals reported students in their buildings spent more than 60 minutes per week with a specialist in art and music. Also, 40.9% of principals reported spending more than 60 minutes per week in PE taught by a specialist. The sample consisted of 547 elementary schools in Virginia.

As Davey (1973) discussed an inverted “U” shape created by the relationship between physical activity and attention, the amount of time spent in physical activity classes in lieu of academics could produce a similar pattern concerning physical activity and academic achievement. There may be a threshold point where academic achievement declines in regard to cutting time out of the academic day in favor of physical activity time.

Many studies have examined the time spent in PE as opposed to academic classes. The most common finding in these is not of improved academic achievement, but no change in academic achievement when academic time is replaced with physical activity. This suggests that physical activity may increase the efficiency of learning, as argued by Trudeau and Shephard (2008) as well as Din (2006).

In a meta-analysis from Strong et al. (2005), quasi-experimental data suggests that allocating more curricular time to physical activity does not negatively affect academic achievement. This exists even when time for other subjects is reduced.

Singh and McMahan (2006) selected the 10 highest performing schools and 10 lowest performing schools out of the 253 elementary schools in the California Orange County School District during the 2004-2005 school year. In the 10 lowest performing schools: seven did not have a PE teacher and three shared a PE teacher. The seven schools that did not have a PE teacher provided physical activity by either incorporating it in other subjects or

allowing the children to decide their activity on the playground. The 10 highest performing schools showed a contrasting situation that included eight with a designated PE teacher and the other two sharing a teacher with another school. These 10 high performing schools also provided more structured, regular PE classes for their students. In addition, the activities offered at the 10 high performing schools were more sports-like, and they competed in sports competitions. Other group differences between the high performing and low performing schools were observed. In reference to the amount of time spent in PE, the 10 highest performing schools reported 90 minutes of PE per week for their students. In the 10 lowest performing schools, seven reported not having a separate PE program, but rather incorporation of the PE curriculum into other subjects. The remaining three low performing schools reported having no more than 30 minutes per week for PE. Although not definitive, this does express a trend of up to 90 minutes of PE spent per week in elementary schools and the relationship with higher academic achievement. Although this study relied upon school-level data, it does not address other possible situations that may have contributed to a school's performance. The lack of resources for schools was never addressed and could clearly be a strong factor.

Using a sample of elementary students from a single school district described as a relatively affluent suburb in Southern California, Sallis et al. (1999) utilized a stratified technique by minority group to assign participants to one of three treatments. These groups represented student participation in a PE program by either a teacher untrained in the SPARK curriculum, a teacher trained in the SPARK curriculum, or a PE specialist trained in the SPARK curriculum. According to the SPARK website "SPARK is a research-based, public health organization dedicated to creating, implementing, and evaluating programs that

promote lifelong wellness. The SPARK curriculum is comprehensive with professional development and is designed to promote physical activity in and out of the regular school day for students. Data from these three groups were recorded, and the time spent in PE between these three groups varied. The group assigned to PE with an untrained teacher received on average 38 minutes of PE instruction per week. Those with a trained teacher received 130 minutes per week, and those with a specialist received 147 minutes per week of PE instruction as recorded by direct observation.

To measure academic achievement, Sallis et al. (1999) relied upon the Metropolitan Achievement Tests (MAT6 and MAT7). The MAT6 and MAT7 are norm-referenced and provide scores in the areas of Mathematics, Reading, Language, and a composite score. Second grade scores served as a baseline measure on two cohort groups. The reason for the two cohort groups was due to different versions and timings of the post-tests for different groups. An ANCOVA was used with the baseline second grade achievement data serving as the covariate. This analysis was performed with both cohort groups and one-way ANOVA of baseline to post-test differences. Opening the discussion on this study, Sallis et al. (1999) stated that “spending more time in PE did not have harmful effects on standardized academic achievement test scores in elementary schools” (p. 132). However, the results of the study did not seem to support this assertion because there was a drop in scores in 23 out of the 24 groups analyzed. The only group that showed a rise in test scores was a group that contained the PE specialists, and the increase was only in Reading scores. However, as clarified by Sallis et al. (1999), the drop in scores witnessed in all groups suggested that PE time was not the determinate in the drop in scores. The scores of children who participated in physical activity training declined less than those of children in the control condition did. The

explanation given by the researchers for the decline in test scores was due to high baseline levels and the regression-to-the-mean effect.

In studying the possible academic effects of having up to 180 minutes per week of PE, Wilkins et al. (2003) explored the effects of increasing the time in core academic subjects and decreasing the time spent in art, music, and PE. Their study consisted of 547 elementary schools in Virginia during the 1999-2000 school year. Using results from different schools, Wilkins et al. (2003) observed other factors in academic achievement such as financial resources available that could affect not only the time spent on these non-core subjects but on academic achievement as well, thus producing a covariate. To control these variables, a school's levels of financial, human, cultural, and geographical capital were recorded and controlled when comparing academic achievement. To measure academic achievement, the authors applied the Virginia Standards of Learning (SOL) grade 3 and grade 5 tests as the dependent variables. These are the required accountability high stakes tests from NCLB in Virginia.

After examining grades kindergarten through third grade and using partial correlations with multiple regression, Wilkins et al. (2003) found no evidence of a meaningful relationship between the amount of time spent in art, music, and PE on academic achievement. However, the amount of time specifically spent in PE did show a statistical significance with Math scores, with a correlation coefficient of .09. Due to such a large sample size, the possibility of statistical significance can arise even when the correlation coefficient is low, as in this case. Analyzing the K-5 population, multiple statistically significant coefficients appeared, as before, with the highest being .11. This led the authors to state that there is no relationship between the time spent with a specialist in these three

subjects (art, music, and PE) and academic achievement. It was noted that although no positive relationship could be stated, there is no suggestion of an inverse relationship between time in these learning areas and passing rates on high stakes tests. In every situation studied, although not statistically significant, the statistical trend was positive between the time spent with a specialist in each of these three areas and academic achievement.

Similar to the study performed by Singh and McMahan (2006), Ahamed et al. (2007) employed school-level data to evaluate the possible effects of increasing time for PE in lieu of core academic time on academic achievement. In their study, the intervention group with the largest amount of PE time reported an average of 183 minutes per week as opposed to the control group reporting 140 minutes per week. The amount of time spent in PE was recorded via teacher logs, and academic achievement was measured using the Canadian Achievement Tests (CAT-3). Eight elementary schools were analyzed by Ahamed et al. in British Columbia. Six of these schools receiving the intervention were identified as being in need of an intervention due to parents' views of the PE program. The remaining two control schools received no interventions. In the intervention schools, a program called *Action Schools! BC* (AS! BC) was implemented. This program called for an additional 15 minutes of physical activity in the classroom each day on top of the 80 minutes (two 40 minute sessions) of traditional PE class received by both the control and intervention group. For the dependent variable, achievement was measured by the CAT-3, a standardized test that includes Mathematics, Reading, and Language. The total scores (sum from each section) created a composite score to measure academic achievement.

Independent *t*-tests were employed to compare groups in the intervention and control groups at baseline data (Ahamed et al., 2007). A mixed linear model was used to identify

covariates, and 20% variability in prior academic achievement was found in the control schools, so prior academic achievement was included as a covariate in the model. Results reflected that dedicating 10 extra minutes per day to physical activity did not compromise academic achievement. Furthermore, negative effects of having up to 183 minutes per week on academic achievement were not observed. A variable not addressed in this study was the original assignment of the control and intervention groups. The assignment of these groups was based upon parents' perception of the existing effectiveness of the programs. This assignment created confounding variables that could have possibly contributed to the results. When a program is in dire need for improvement, any change may prove to be beneficial.

In comparing two groups of which one was assigned to PE for 225 minutes per week and the other was not enrolled in PE, Coe et al. (2006) found that concurrent enrollment in PE did not have an effect on academic achievement. All students were enrolled in a PE class either during the first semester or during the second semester. Although not enrolled in a PE class, students were placed in an alternative exploratory class such as arts and computer classes. To determine the amount of time in PE class spent in physical activity, the System for Observing Fitness Instruction Time (SOFIT) was used. The use of a Shapiro-Wilk test revealed that the academic achievement variables were not normally distributed. Because of this, the Kruskal-Wallis analysis was engaged to determine any possible differences in academic achievement. The results revealed that those who were currently enrolled in PE classes did not show any difference in their academic achievement scores than those who were not. In addition, the specific semester of enrollment in PE classes did not have a significant effect on academic achievement. This was reflected in the Terra Nova scores as well as the GPAs. The important finding in Coe's et al. research was that students who

performed vigorous physical activity achieved higher academic scores. In addition, enrollment in PE class as opposed to the arts and computer classes did not have a negative effect on academic achievement.

In one of the earliest studies on the topic, Shephard et al. (1984) relied upon a longitudinal, experimental design to determine the possible effects of students receiving up to 300 minutes per week of PE. Those in the control group experienced 40 minutes per week of physical education. The intervention group that received more time in PE reduced their academic time by the same amount. Those in the intervention group scored higher on report card grades and standardized tests. Mathematics was a specific subject in which the intervention groups scored higher than the control group.

Carlson et al. (2008) categorized participants' level of PE as low (0-35 minutes per week), medium (36-69 minutes per week) and high (70-300 minutes per week) in a study from the 1998-1999 school year to examine the association between time spent in PE and academic achievement. To measure academic achievement, an assessment instrument from the National Center for Educational Statistics was created from multiple copyrighted assessment batteries. Other demographic information serving as possible covariates collected included student's family income, race, and mother's education. In their results, Carlson et al. found there to be a significant benefit in academic achievement for females in Math and Reading in relation to the amount of time they were enrolled in PE. This occurred when the groups labeled high and low, in relation to PE time, were compared. There were no such findings among males.

Up to 300 minutes a week of PE will not affect academic achievement was the conclusion from Trudeau and Shephard (2008). In a review of existing literature, Trudeau

and Shephard concluded that quasi-experimental data indicate that allocating up to one hour per day of physical activity does not affect academic achievement in primary school students negatively. Further in their study, they concluded that time allocated to subjects other than physical activity does have a negative effect on academic achievement. In identifying variables for the study, Trudeau and Shephard agreed that PE, physical activity, and sports programs were restricted to those programs offered within the school context. Academic achievement was identified as actual or self-reported GPAs and determinants of GPA such as learning, classroom behavior, engagement of learning, and self-esteem. The authors examined seven quasi-experimental studies. Combined, these studies examined the results from over 2,500 students in grades kindergarten through twelfth grade with only one of these studies limited to students in grades 9 through 12. The conclusion from these studies was that students achieved equally despite reduced teaching time. This suggested the efficiency of learning was enhanced when students were in physical activity courses in lieu of other courses.

Trudeau and Shephard's (2008) review of 10 cross-sectional studies produced mixed results. Six of these studies indicated a significant association with physical activity and academic achievement, although four reported a negative or null association. With cross-sectional studies, there is a possibility of a potential bias occurring, specifically with the SES serving as a confounding variable. The authors agreed that SES is one of the strongest predictors of academic achievement. In some of the studies reviewed, SES was controlled, and a positive association between physical activity and academic achievement was still observed. Aside from potential academic benefits, Trudeau and Shepherd also emphasized the positive health results from participation in physical activity programs. In their

conclusion of the review of the literature, the authors conclude, “The literature strongly suggests that the academic achievement, fitness, and health of our children will not be improved by limiting the time allocated to PE instruction, school PA (physical activity) and sports programs” (p. 9).

Up to 300 minutes per week of PE is reinforced by Dwyer et al. (2001). Also known as “The South Australian Project,” Dwyer et al. concluded that increasing curricular time for PE did not negatively affect academic achievement. This study was conducted in two phases. The first phase began in 1978 and evaluated the impact of a 14-week exercise training programs. The control group met for 90 minutes a week in a PE type class. The intervention group met for 300 minutes per week in a physically active PE class. At the end of the 14-week period, the participants did not show any difference in academic achievement regarding the amount of time they spent in PE type classes. In 1980, seven of the original schools participating in the 1978 Dwyer et al. study continued the intervention. The health and academic achievement of these 216 fifth graders who participated in the original study were evaluated for the second phase. Although the intervention students received 45 minutes less academic time each day, there was no decrease in their academic achievement.

In an updated review of literature, Trudeau and Shephard (2010) concluded that the introduction of sport or PE has no effect on GPA. In addition, putting 60 to 90 minutes a day of PE into the school day will not jeopardize academic achievement in primary schools. They further concluded that active students compensated for the lack of learning time by greater efficiency of the learning process. The authors suggest that a possible 450 minutes per week of PE would still not have negative effects on academic achievement.

Conclusion

Although the inverted “U” theory Davey (1973) has been shown in some experimental cases, it has yet to show a definitive vertex point at which the amount of time spent in PE would negatively affect academic achievement. To this point, research has only been conducted with up to 450 minutes per week of PE. In addition, many of these studies have been performed at the elementary level because education is more streamlined at the elementary level, and other variables are therefore easier to control. At the high school level, it is normal for students to have independent schedules of one another, thus producing variables that would be outside the control of a researcher. Although this may be true, it is still important to look at those students who have opted to take more physical activity classes in their high school career and see if there is a relationship in the amount of time spent in those classes and academic achievement.

One factor to consider is that course selection is a matter of preference by the student and/or a matter of necessity by the school. With this being the case, one must also take into account that students in high school who have more time in physical activity classes (PE and/or Athletics) have less time than their peers do in academic classes. This is in relation to the research on decreasing academic time and increasing PE time.

In an evaluation of the existing literature for *Active Living Research*, Trost (2007) has the following observation.

According to five studies involving elementary students, regular physical activity breaks during the school day may enhance academic achievement. Introducing physical activity has been shown to improve cognitive performance and promote on-task classroom behavior. It is important to note that the cognitive and behavioral

responses to physical activity breaks during the school day have not been systematically investigated among middle or high school students. (p. 3)

As mentioned before, physical activity leads to fitness (Casperson, Powell, & Christenson, 1985). Because they are not synonymous, there are studies that address each one differently and their possible effect on academic achievement. However, as mentioned before, the school leader does not have the option of adjusting the fitness level of any child. This being the case, the focus of this study was to explore possible variables school leaders can control, which include opportunities for physical activity that may lead to increased academic achievement. Specifically, this includes enrollment in physical activity classes such as physical education and athletics.

CHAPTER III

METHODOLOGY

Although schools are striving to meet accountability requirements of NCLB, they must be cognizant of variables that may affect academic achievement. Emphasis in the areas of Mathematics, Reading and/or Language Arts, and Science have pushed many schools to increase the amount of time spent in core subjects and decrease time in others (CEP, 2007). As a result, the time spent in PE has been on the decline (Retner et al., 2006).

Research has noted a possible association between physical activity and physiological effects (Fabel et al., 2003; Gomez-Pinnilla et al., 2001; Griesbach et al., 2008; Praag et al., 2005) as well as academic behaviors (Caterino & Polak, 1999; Davey, 1973; Ekeland et al., 2004; Flook et al., 2005; Gruber, 1986; Gupta et al., 1974; Keays & Allison, 1995; Schmalz et al., 2007; Shephard, 1984; Sibley & Etnier, 2003; Strong, 2005; Tremblay et al., 2000). Research has also witnessed a link between physical activity and cognitive behaviors being observed by many (Arcelin et al., 1995; Brown, 1977; Corder, 1966; Gupta et al., 1974; Harada et al., 2004; Hillman et al., 2005; Hogervost et al., 1996; Ismail, 1966; Kirkendall, 1986; Kramer, 2006; Krausman, Crowell, & Wilson 2002; Sibley & Etnier, 2003; Thomas et al., 1994; Tomporowski, Davis, Miller, & Naglieri, 2008). Grissom (2005) and other researchers (CDE, 2005; Castelli et al., 2007; Chomitz et al., 2009; Dwyer et al., 2001; Singh & McMahan, 2006) have noticed a positive relationship between students' fitness level and academic achievement. The link between physical activity and academic achievement has

been observed by the Coe et al. (2006), Din (2006), Dwyer et al. (2001), Field et al. (2001), Fredericks and Eccles (2006), Hanson et al. (2004), Shephard (1997), Sibley and Etnier (2003), Strong et al. (2005), Tremblay (2000), and USDHHS (2010a).

The amount of time spent in PE and possible effects on academic achievement have been noted by Ahamed et al. (2007), Carlson et al. (2008), Coe et al. (2006), Dwyer (2001), Sallis et al. (1999), Shephard et al. (1984), Singh and McMahan (2006), Strong (2005), Trost (2007), Trudeau and Shephard (2008), and Wilkins et al. (2003). Overall, there does not appear to be a harmful or negative effect on academic achievement when time in core subjects is decreased to accommodate more time in PE. Research supports this idea when up to 450 minutes per week are spent in PE (Trudeau & Shephard, 2010).

With a whole child emphasis in education, multiple health initiatives and grants have been made available to schools. School leaders must make decisions concerning the best allocation of time during the school day. Academic achievement and accountability from NCLB are driving forces that guide many, if not most, of the decisions made by a school leader. With this in mind, a school leader must always consider the possible ramifications their decisions may have on academic achievement.

The purpose of this study was to determine the possible effects that a student's enrollment in physical activity classes in grades 9-11 had on academic achievement. The following five hypotheses served as the guide for this study:

1. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the overall composite score on the ACT.

2. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the English score on the ACT.
3. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Mathematics score on the ACT.
4. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the overall composite score on the ACT.
5. No significant difference will exist by gender for eleventh grade students in a rural school in Arkansas enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Science score on the ACT.

This chapter will describe the research design, sample used, and instrumentation in this study. Furthermore, data collection procedures, analytical methods, and limitations will be discussed.

Research Design

A quantitative, causal-comparative strategy was used in this factorial design study. The independent variables for statements one through five of the problem were gender and the number of semesters of previous enrollment in physical activity classes (two or more

physical activity classes in grades 9-11 versus less than two). The dependent variable in hypothesis one was academic achievement measured by the ACT composite score. In hypotheses two through five, the dependent variables were academic achievement measured by the ACT English score, the ACT Math score, the ACT Reading score, and the ACT Science score, respectively. Gay (1996) supported the use of a causal-comparative strategy because the causes for the existing status of a variable were explored.

Sample

The population in this study consisted of students from a rural high school in Arkansas. Two years of data were used, which included the students graduating in 2010 and those enrolled as juniors during the 2009-2010 school year. Each year, there were approximately 230 students in each class. All students in grade 11 were required to take the Universal ACT test during the spring semester. Students identified as severe special education were not tested. The high school reports approximately 85% white students and a free and reduced lunch utilization of approximately 20%.

Of the 461 students in the study, 346 had complete data that consisted of gender, physical activity classes, and ACT test data. Those without complete data did not display a noticeable pattern except for 56 students who were juniors in the spring of 2010 and were enrolled in the Advanced Placement (AP) English Language and Composition during the same semester. There was not a test make-up for the ACT Universal test, and those students in the AP English Language and Composition course opted to take the AP test, which was given the same day as the ACT Universal test. As described later, 29 of these students were still included in the study. Other students who were excluded due to incomplete data had

various reasons such as being absent on test day, moving into the district after the test date, or moving out of the district before the test date.

Instrumentation

Student transcripts were the sole source of information in this study. Each student's enrolled courses as well as earned grades are entered in the Arkansas Public School Computer Network (APSCN). Gender is recorded on transcripts as well. From this database, the transcripts were printed. Results from all ACT tests are affixed to each student's transcript. In addition, the number of semesters in Grades 9-11 that a student was enrolled in either an athletic class or a PE class was recorded. The possible range for these data was 0-12.

The American College Testing, Inc. publishes the ACT assessment, and it was used as the measure of academic achievement. Each category (English, Mathematics, Reading, Science, and Composite) of the assessment was recorded for all students. The Universal ACT test given during the spring semester of the junior year to all students was used as the primary measure. In the event the student did not take the Universal ACT due to attendance or conflicting tests, other national ACT test data were utilized. All other test dates were from either April or June (National test prior to CPEP) of the junior year.

Trudeau and Shephard (2008) warned against using classroom assessment to measure academic achievement due to possible bias from the instructor's perception of student athletes. Further, they define academic achievement to "encompass academic success, school performance, and all combinations of these terms" (pp. 2). This is contrary to Strong et al. (2005) who claimed, "Indicators of academic performance include grade point average, scores on standardized tests, and grades in specific courses" (p. 733).

Each year over 2 million students take the ACT (ACT, 2007). The 2007 technical report claims that nearly 3,000 post-secondary institutions either require or recommend that the applicants take the ACT. ACT has historically advised students to take the test after a substantial portion of their coursework has been completed. In alignment with the curriculum of most schools and the coursework taken by most students, this time frame occurs during the spring semester of their junior year.

According to the ACT technical report, the ACT is an assessment of four multiple-choice sections with an optional Writing Test. The four sections include English, Mathematics, Reading, and Science. Colleges for admissions and course placement use the results from the ACT, and college remediation is many times decided upon by the results of the ACT. States use the results as part of their statewide assessment programs, and the results are also used for scholarship purposes.

The ACT is a curriculum-based test that measures the student's mastery of college readiness standards. The purpose of the ACT is to assess a student's preparation for college. This test is focused on the academic skills that mirror the complexity of college-level work. Opposed to an aptitude test, the ACT measures the educational achievement of the test taker. Typically, the test is taken in the tenth, eleventh, or 12th grade. The majority of test takers are between the ages of 16 and 20. The highest achievable score is 36, and the results are norm referenced.

In constructing the ACT, all published curriculum frameworks for grades 7 through 12 were obtained from all the states in the United States. Textbooks for these grades were reviewed, and lastly, educators in the secondary and postsecondary level were consulted in determining the importance of the skills and knowledge from the frameworks and textbooks.

In order to assess students with widely different achievement levels, a level of correct proportion range of .20 to .89 is used for item inclusion. Furthermore, the target mean item difficulty is .58.

The English portion of the ACT is a 75 item, multiple-choice assessment. The students have 45 minutes to complete this section. Punctuation, grammar and usage, as well as sentence structure are measured. There are five prose passages followed by questions concerning each passage. Usage and Mechanics comprise 40 of the items, and Rhetorical Skills are assessed in 35 items.

There are 60 questions comprising the Mathematics portion of the ACT. Students have a total of 60 minutes to complete this section. Basic formulas and computational skills are required for the problems. There are six content areas covered by the test that include pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry. Calculators are allowed although not required. The Math score is comprised of sub scores in Pre-Algebra/Elementary Algebra for 24 of the items, Intermediate Algebra/Coordinate Geometry for 18 items, and Plane/Geometry/Trigonometry for 18 items.

The Reading portion of the ACT is 35 minutes long, and has 40 multiple-choice items. In measuring Reading comprehension, the students are required to derive meaning from several texts, explicitly and implicitly. Four prose passages comprise the Reading test and mimic the level and type of text one may encounter during the first year of college. The score on the Reading portion is based on all 40 items with a sub score in Social Studies/Sciences from 20 of the questions and the remaining 20 in Arts/Literature.

Measuring the interpretation, analysis, evaluation, and problem-solving skills for the Natural Sciences is evaluated in the Science portion of the ACT. This section consists of 40

items and is 35 minutes long. It is assumed that students have at least two years of introductory Science courses prior to taking the test. Understanding, analysis, and generalization represent the three cognitive levels assessed in this section. The Science score is derived from all 40 items.

Continuing, the Technical Report explains the possible scores on each section of the test range from 1 to 36. A Composite score is calculated using the average of the scores from the four sections with any fraction of 0.5 or higher being rounded up. The score distribution of the ACT is listed in Table 2.

Table 2

Scale Score Summary Statistics for the ACT test for 1995 Nationally Representative Sample for Twelfth-Grade Students (Mathematics Test administered with calculators allowed)

Statistic	English	Mathematics	Reading	Science	Composite
National (N = 2,981)					
Mean	17.17	17.93	17.59	17.08	17.58
SD	5.96	4.54	6.44	4.72	4.83
Skewness	0.42	0.82	0.68	0.58	0.69
Kurtosis	2.47	3.30	2.81	3.27	2.90
SEM	1.65	1.41	2.23	1.84	0.90
Reliability	.92	0.90	.88	.85	.97
College-Bound (N = 2,356)					
Mean	18.05	18.54	18.39	17.69	18.30
SD	5.95	4.60	6.54	4.76	4.87
Skewness	0.30	0.72	0.55	0.54	0.57
Kurtosis	2.38	2.99	2.60	3.14	2.71
SEM	1.65	1.43	2.24	1.84	0.91
Reliability	.92	.90	.088	.85	.97

Because the ACT is used to address college readiness, ACT has recommend cut-off scores to suggest college readiness. These scores are found in the following Table 3.

Table 3

ACT College Readiness Scores

Subject	College Course	ACT test score
English	English Composition	18
Mathematics	College Algebra	22
Reading	College Social Sciences	21
Science	College Biology	24

Addressing reliability, the six national ACT administrations in 2005-2006 were analyzed.

Table 4 lists the scale score reliability and calculated standard error of measurement results for these data sets.

Table 4

ACT Reliability Scores

Subject	Scale Score Reliability			Average SEM		
	Median	Minimum	Maximum	Median	Minimum	Maximum
English	.91	.89	.91	1.71	1.65	1.79
Math	.91	.89	.92	1.47	1.43	1.56
Reading	.85	.85	.87	2.18	2.11	2.26
Science	.80	.74	.83	2.00	1.90	2.12
Composite	.96	.95	.96	0.94	0.91	0.96

The validity of the ACT is addressed by many different criteria. Although the test is used for college admissions and course placement, the validity as a measure of academic achievement is the concern for this study.

The technical manual addresses academic achievement under the term “educational achievement.” In measuring the reliability of the ACT, the technical manual expresses caution about using GPA as a measure of educational achievement because curriculum and grading policies are different among schools, and one must account for these differences.

Using the courses taken by a student as well as their GPA and high school attended, multiple regression was used and produced a strong association with most ACT scores. The greatest predictive accuracy in the review of 1996 test scores showed Math and Composite scores to have the largest R^2 values. The Mathematics R^2 value was .65 and Composite was .63. The English R^2 value was .52.

In the technical manual, ACT went further, involving 403,381 students from 10,792 high schools, and compared coursework taken to ACT scores. All regression coefficients were statistically significant at $p < .01$. The regression coefficients ranged from .28 to .63, thus allowing the authors to make the claim that an increase in the level of the coursework relates to increased ACT scores. This allows the ACT to be a valid measure of academic achievement.

Data Collection Procedures

Student transcripts were copied by the main office of the cooperating school. All identifiable information was removed from the transcripts. The data were collected during the spring semester of 2011 in agreement with the IRB approval. Upon receiving the data,

SSPS was used to analyze the data and sum the physical activity classes. After the data were entered into SPSS, the transcripts were placed in a locked file cabinet.

Analytical Methods

All students were classified according to gender and number of physical activity classes they had been enrolled in during grades 9 through 11. The cut-off value of *one* was used in the number of physical activity classes because students were only required to take one semester of PE or athletics (for which they receive a PE graduation credit).

The test scores from 2009 and 2010 were compared using an independent samples *t*-test for all four categories of the ACT and the Composite score to see if they were statistically significantly different to exclude combining them into one population. The Paired samples *t*-tests were run not only for the April 2010 and the Universal 2010 test of those students who took both, but also for the June 2010 and the Universal 2010 test. The June testing was prior to the College Preparatory and Enrichment Program (CPEP) and both the April and June testing were compared with the Universal test to use as a possible replacement for those in the spring of 2010 who took the AP English Language and Composition test.

The AP students with scores were compared to the rest of the population using an independent samples *t*-test to see if there was a disparity in their scores. Following this, a stratified random sample was used to assign the subjects to each block of the factorial ANOVA and ensure the AP population was properly represented by the percentage of AP students in each block. The distribution of students is shown in Table 5.

Table 5

Student Population Distribution and Enrollment in AP

Physical Activity Classes	Female		Male	
	Enrolled	Not Enrolled	Enrolled	Not Enrolled
0-1	35	103	9	72
2+	13	53	9	89

Fifty students were then selected using a stratified random sample for each cell in all five of the factorial ANOVA designs. Table 6 shows the distribution of these 50 students in accordance with the stratified random sample.

Table 6

Student Assignment Distribution

Physical Activity Classes	Female		Male	
	Enrolled	Not Enrolled	Enrolled	Not Enrolled
0-1	12	38	5	45
2+	10	40	5	45

Prior to factorial ANOVAs being performed, the data were screened for outliers falling outside of four standard deviations as supported by Mertler and Vannatta (2010). The

z-score method was implemented to test for normality using skewness and kurtosis. Mertler and Vannatta further defend an alpha level of .001 being used because the sample size was greater than 100. Further screening included testing the homogeneity of variance using Levene's Test of Equality of Error Variances.

Line plots were created for each dependent variable to determine if there were interaction effects between the variables. Following the construction of these graphs, tests of between-subject effects were conducted with the partial eta squared being calculated simultaneously.

Five 2 x 2 factorial ANOVAs were used in this study. Mertler and Vannatta (2010) support the use of a factorial ANOVA design to simultaneously study the mean differences on the ACT scores with two groups. ANOVAs were performed on the data using SPSS. Gender and number of semesters of physical activity enrollment in grades 9 through 11 served as the independent variables in the ANOVA analysis with the five dependent variables of ACT Composite score, ACT English, ACT Math, ACT Reading, and ACT Science. Factorial ANOVA was employed so the main and interaction effects of gender and physical activity classes could be explored.

The conclusions from the analysis as well as findings, conclusions, and discussions concerning the results were reported in the results and discussions chapters. To test the null hypotheses of no statistically significant effect being found in any of the five cases, a significance level of .05 was used.

Limitations

One of the limitations of this study concerned the exclusion of the students who take an AP English test during their junior year. Although accommodations were made to include

this population (using the April national test first and if not available, the June national test), some did not have this data to include.

Although accepted by many colleges and universities, the ACT is not an instrument used to measure accountability in NCLB. As each state uses their own assessment instrument for NCLB, any results using individual state assessments would be limited to that particular state. Furthermore, with the adoption of common standards and the movement toward common assessments, results from using individual state tests would only be valid for a few more years.

Further, the demographics of the school were limited to a mostly white affluent population. The school has high achievement numbers by not being on school improvement and 95% attendance and graduation rates.

CHAPTER IV

RESULTS

This study explored the effects of physical activity class enrollment on student achievement by gender for students in a rural Arkansas high school by using a quantitative approach. Gender (Female and Male) and the number of physical activity classes (0-1 and 2+) served as the independent variables. The measure of academic achievement utilized was the ACT composite, ACT English, ACT Math, ACT Reading, and ACT Science results representing the dependent variables. Factorial Analysis of Variance (ANOVA) was implemented to examine the five hypotheses. The results of these procedures are contained within this chapter.

Hypothesis 1

The first hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the overall composite score on the ACT. The data were screened for outliers. The z -scores for each subject were then calculated using SPSS. The lowest z -score was found to be -2.06560 and the highest being 2.48168. Thus, no outliers were observed. Consistent with Mertler and Vannatta (2010), any point exceeding four standard deviations from the mean would be considered an outlier with sample sizes larger than 100. Appendix A lists the descriptive statistics for the composite score.

Skewness and kurtosis were calculated to determine normality. The results are in Appendix B. Further, the z -score method results are listed as well. As observed, none of the z -scores exceeded the threshold of 3.29. To test the homogeneity of variance, Levene's Test of Equality of Variances was used. Results are listed in Appendix C. Since the results were not significant, no data transformations were necessary. Figure 1 displays the group means and standard deviations for the ACT Composite scores.

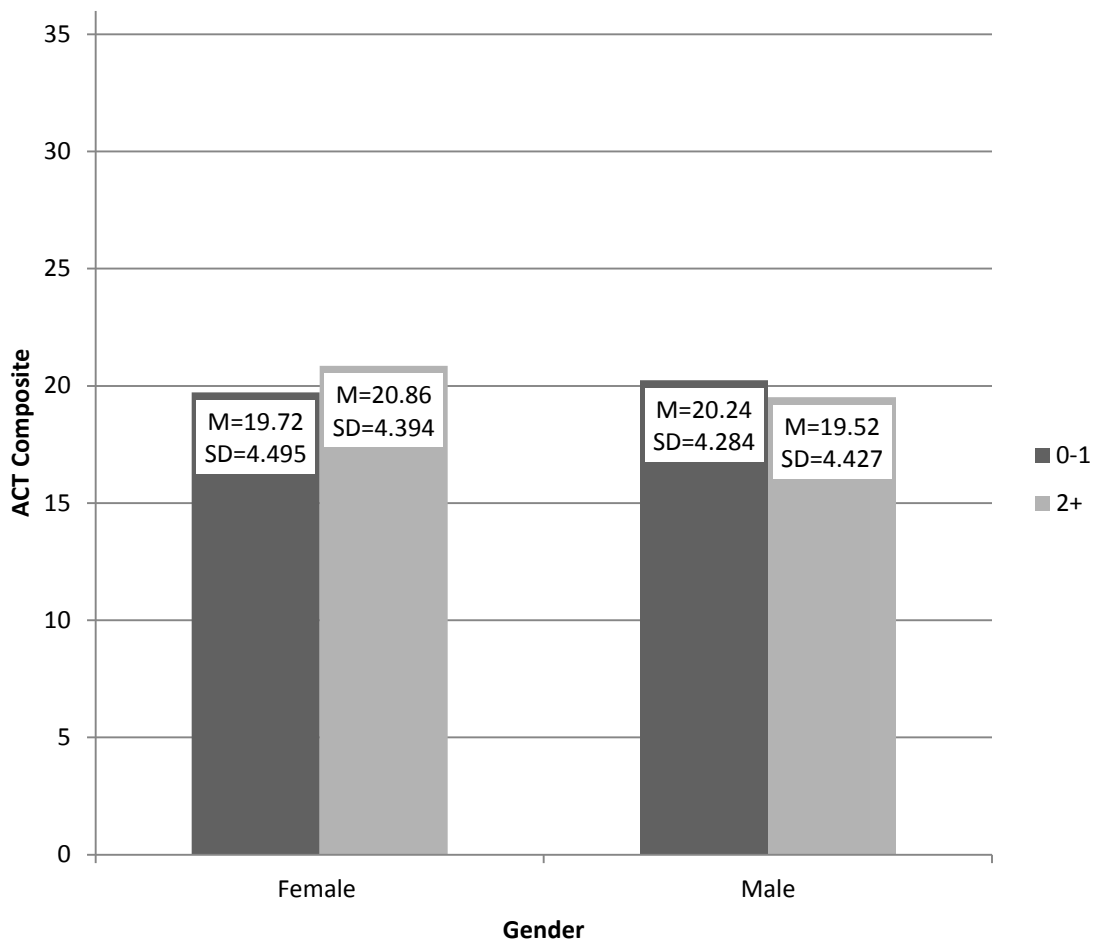


Figure 1. Group means and standard deviations for the ACT Composite scores.

A line plot was then constructed to determine any possible interaction between factors (Appendix D). Results from the univariate ANOVA are in Table 7.

Table 7

ACT Composite ANOVA Results

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P</i>	<i>ES</i>
Gender*Physical Activity	43.25	1	43.25	2.23	.137	.011
Gender	8.41	1	8.41	.43	.511	.002
Physical Activity	2.21	1	2.21	.11	.736	.001
Error	3795.70	196	19.37			

The line plot indicated interaction between gender and physical activity. After ANOVA analysis, the interaction was not found to be statistically significant, $F(1,196) = 2.23, p = .137$, with a partial eta squared value of .011. Statistical significance was not observed for the main effect of gender, $F(1,196) = .43, p = .511$, with a partial eta squared value of .002. Furthermore, no statistical significance for the difference between means of physical activity was observed, $F(1,196) = .11, p = .736$, with a partial eta squared of .001.

Hypothesis 2

The second hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the English score on the ACT. The data were screened for outliers. The *z*-scores for each subject were then calculated using SPSS. The lowest *z*-score was found to be -2.06560 and the highest being 2.48168. Thus, no outliers were observed. Consistent with Mertler and Vannatta (2010), any point

exceeding four standard deviations from the mean would be considered an outlier with sample sizes larger than 100. Appendix A lists the composite score descriptive statistics.

Skewness and kurtosis were calculated to determine normality. The results are in Appendix B. Further, the z -score method results are listed as well. As observed, none of the z -scores exceeded the threshold of 3.29. To test the homogeneity of variance, Levene's Test of Equality of Variances was used. Results are listed in Appendix C. Since the results were not significant, no data transformations were necessary. Figure 2 displays the group means and standard deviations for the ACT English scores.

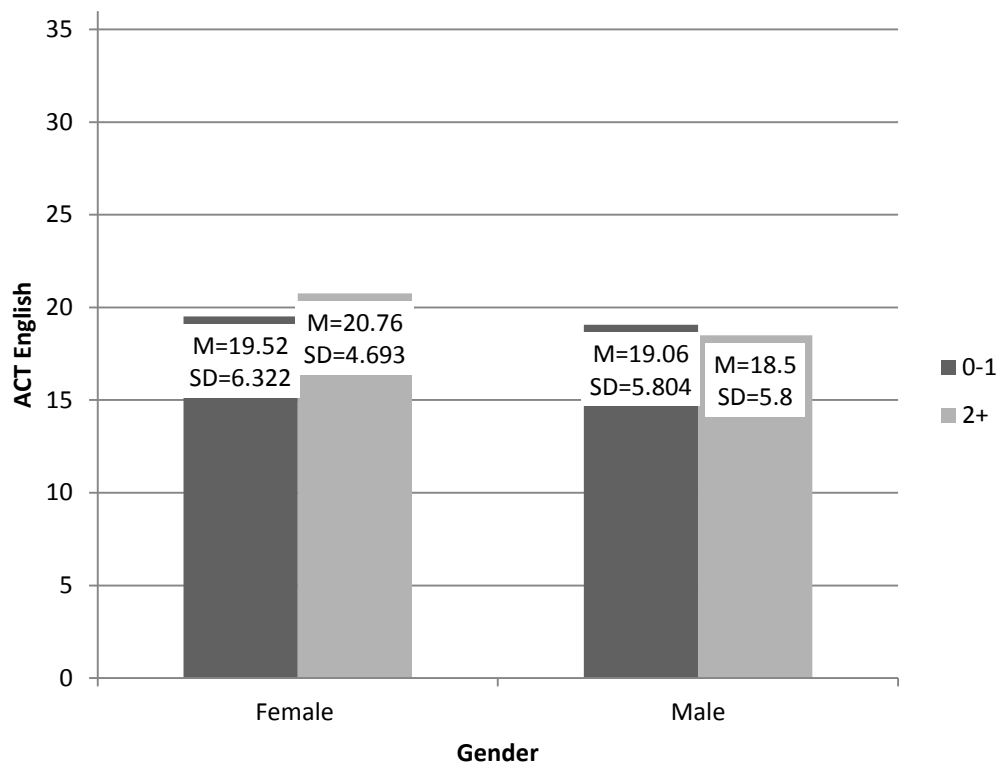


Figure 2. Group means and standard deviations for the ACT English scores.

A line plot was then constructed to determine any possible interaction between factors (Appendix E). Table 8 shows the univariate ANOVA results.

Table 8

ACT English ANOVA Results

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P</i>	<i>ES</i>
Gender*Physical Activity	40.50	1	40.50	1.253	.264	.006
Gender	92.48	1	92.48	2.860	.092	.014
Physical Activity	5.78	1	5.78	.179	.673	.001
Error	6336.92	196	32.33			

The line plot indicated interaction between gender and physical activity. After ANOVA analysis, the interaction was not found to be statistically significant, $F(1,196) = 1.253, p = .264$, with a partial eta squared value of .0006. Statistical significance was not observed for the main effect of gender, $F(1,196) = 2.860, p = .092$, with a partial eta squared value of .014. Furthermore, no statistical significance for the difference between means of physical activity was observed, $F(1,196) = .179, p = .673$, with a partial eta squared of .001.

Hypothesis 3

The third hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Math score on the ACT. The data were screened for outliers. The z -scores for each subject were then calculated using SPSS. The lowest z -score was found to be -2.06560 and the highest being 2.48168. Thus, no outliers were observed. Consistent with Mertler and Vannatta (2010), any point

exceeding four standard deviations from the mean would be considered an outlier with sample sizes larger than 100. Appendix A lists the composite score descriptive statistics.

Skewness and kurtosis were calculated to determine normality. The results are in Appendix B. Further, the z -score method results are listed as well. As observed, none of the z -scores exceeded the threshold of 3.29. To test the homogeneity of variance, Levene's Test of Equality of Variances was used. Results are listed in Appendix C. Since the results were not significant, no data transformations were necessary. Figure 3 displays the group means and standard deviations for the ACT Math scores.

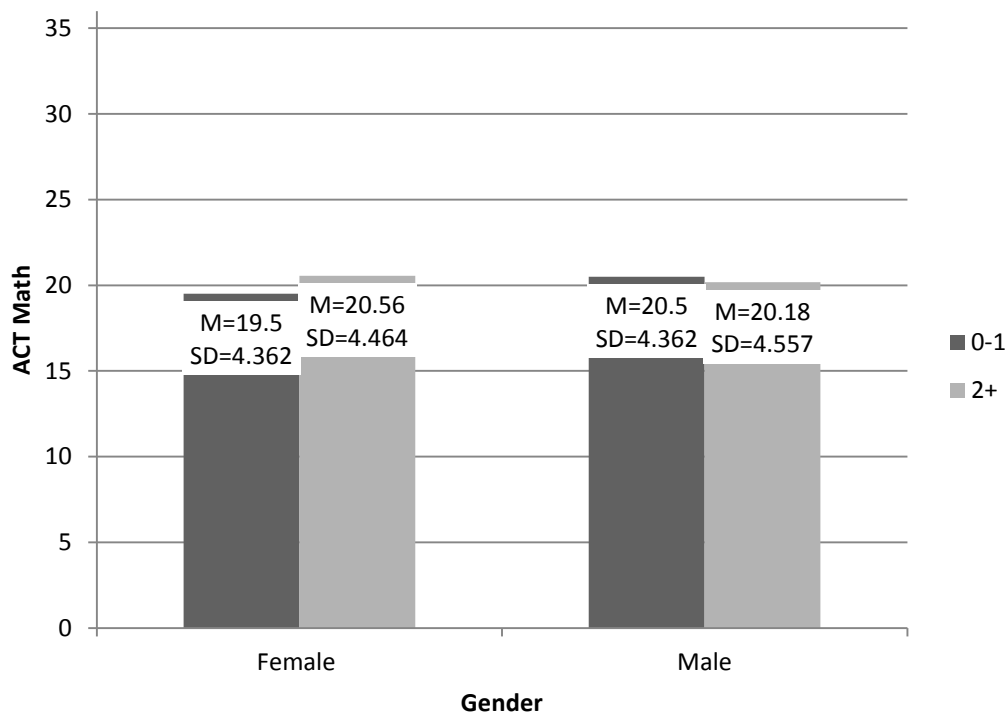


Figure 3. Group means and standard deviations for the ACT Math scores.

A line plot was then constructed to determine any possible interaction between factors (Appendix F). Univariate ANOVA was conducted with the results listed in the Table 9.

Table 9

ACT Math ANOVA Results

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P</i>	<i>ES</i>
Gender*Physical Activity	23.85	1	23.81	1.209	.273	.006
Gender	4.81	1	4.81	.244	.622	.001
Physical Activity	6.85	1	6.85	.348	.556	.002
Error	3858.70	196	19.69			

The line plot indicated interaction between gender and physical activity. After ANOVA analysis, the interaction was not found to be statistically significant, $F(1,196) = 1.209$, $p = .273$, with a partial eta squared value of .006. Statistical significance was not observed for the main effect of gender, $F(1,196) = .244$, $p = .622$, with a partial eta squared value of .001. Furthermore, no statistical significance for the difference between means of physical activity was observed, $F(1,196) = .348$, $p = .556$, with a partial eta squared of .002.

Hypothesis 4

The fourth hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Reading score on the ACT. The data were screened for outliers. The z -scores for each subject were then calculated using SPSS. The lowest z -score was found to be -2.06560 and the highest being 2.48168. Thus, no outliers were observed. Consistent with Mertler and Vannatta (2010), any point exceeding four standard deviations from the mean would be considered an outlier with sample sizes larger than 100. Appendix A lists the composite score descriptive statistics.

Skewness and kurtosis were calculated to determine normality. The results are in Appendix B. Further, the z -score method results are listed as well. As observed, none of the z -scores exceeded the threshold of 3.29. To test the homogeneity of variance, Levene's Test of Equality of Variances was used. Results are listed in Appendix C. Since the results were not significant, no data transformations were necessary. Figure 4 displays the group means and standard deviations for the ACT Reading scores.

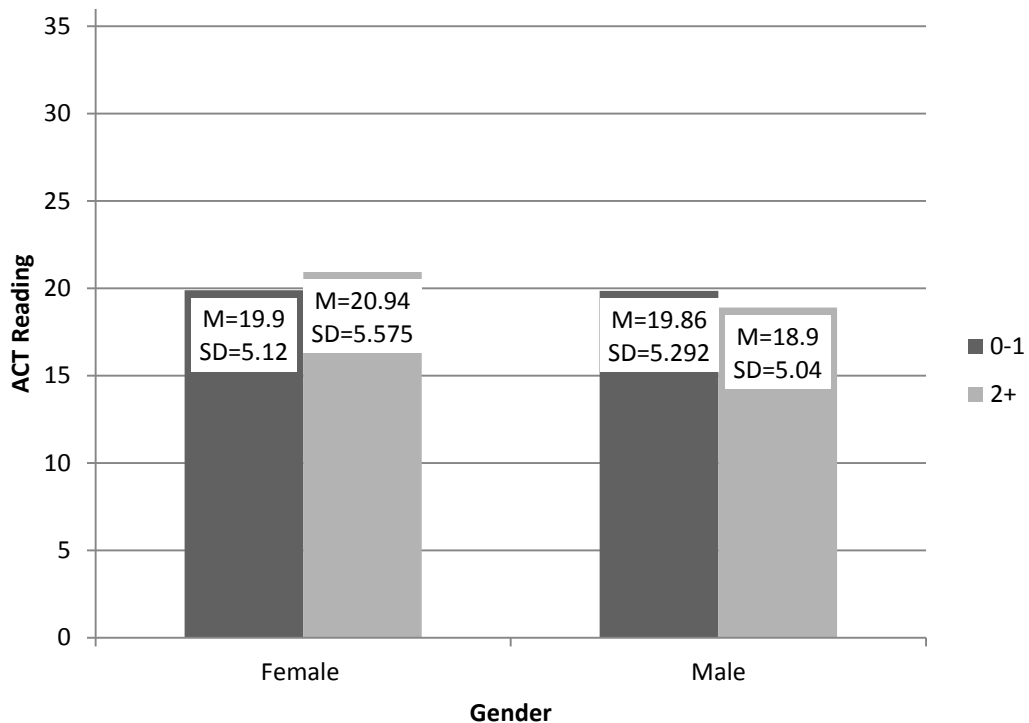


Figure 4. Group means and standard deviations for the ACT Reading scores.

A line plot was then constructed to determine any possible interaction between factors (Appendix G). Table 10 shows the univariate ANOVA results.

Table 10

ACT Reading ANOVA Results

Source	SS	df	MS	F	P	ES
Gender*Physical Activity	50.00	1	50.00	1.807	.180	.009
Gender	54.08	1	54.08	1.954	.164	.010
Physical Activity	.08	1	.08	.003	.957	.000
Error	5423.84	196	27.67			

The line plot indicated interaction between gender and physical activity. After ANOVA analysis, the interaction was not found to be statistically significant, $F(1,196) = 1.807$, $p = .180$, with a partial eta squared value of .009. Statistical significance was not observed for the main effect of gender, $F(1,196) = 1.954$, $p = .164$, with a partial eta squared value of .010. Furthermore, no statistical significance for the difference between means of physical activity was observed, $F(1,196) = .003$, $p = .957$, with a partial eta squared value of .000.

Hypothesis 5

The last hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Science score on the ACT. The data were screened for outliers. The z -scores for each subject were then calculated using SPSS. The lowest z -score was found to be -2.06560 and the highest being 2.48168. Thus, no outliers were observed. Consistent with Mertler and Vannatta (2010), any point

exceeding four standard deviations from the mean would be considered an outlier with sample sizes larger than 100. Appendix A lists the composite score descriptive statistics.

Skewness and kurtosis were calculated to determine normality. The results are in Appendix B. Further, the z -score method results are listed as well. As observed, none of the z -scores exceeded the threshold of 3.29. To test the homogeneity of variance, Levene's Test of Equality of Variances was used. Results are listed in Appendix C. Since the results were not significant, no data transformations were necessary. Figure 5 displays the group means and standard deviations for the ACT Science scores.

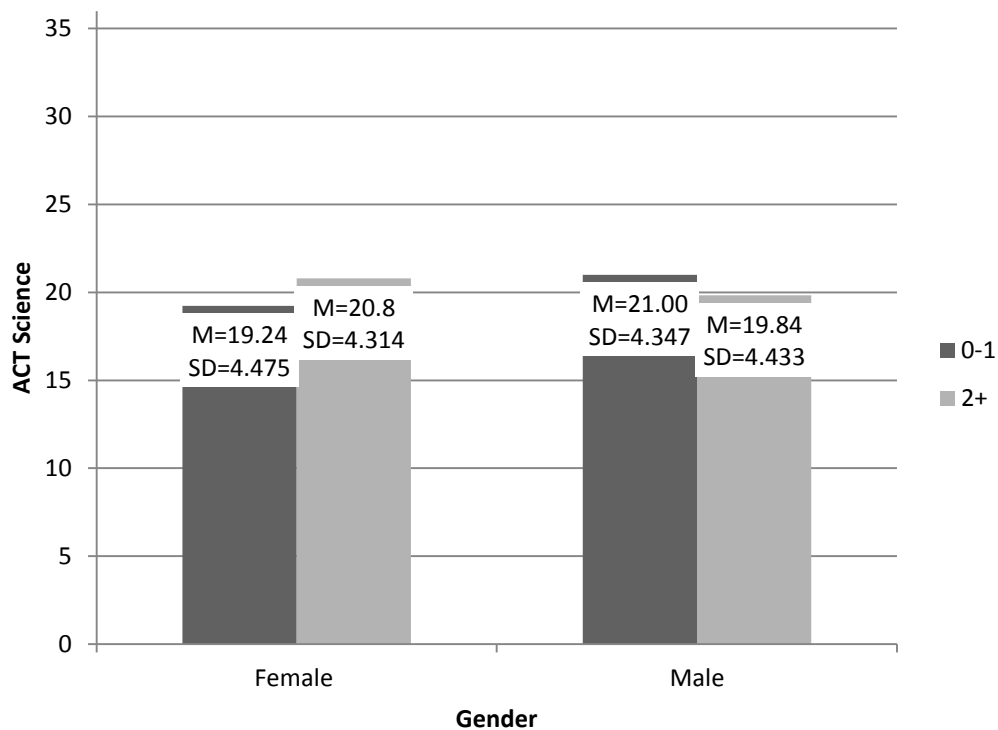


Figure 5. Group means and standard deviations for the ACT Science scores.

A line plot was then constructed to determine any possible interaction between factors (Appendix H). Table 11 shows the univariate ANOVA results.

Table 11

ACT Science ANOVA Results

Source	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P</i>	<i>ES</i>
Gender*Physical Activity	92.48	1	92.48	4.793	.030	.024
Gender	8.00	1	8.00	.415	.520	.002
Physical Activity	2.00	1	2.00	.104	.748	.001
Error	3781.84	196	19.30			

The line plot indicated interaction between gender and physical activity. After ANOVA analysis, the interaction was found to be statistically significant, $F(1,196) = 4.793$, $p = .030$, with a partial eta squared effect size of .024. Simple effects analysis showed among the students with fewer than two semesters of physical activity, males scored significantly higher on the ACT Science than did females ($p = .047$). No difference were observed between genders among the students who had two or more semesters of physical activity ($p = .276$). The results from the simple effects analysis are shown in Table 12.

Table 12

ACT Science Simple Effect Analysis

Physical Activity Group	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p</i>
0-1 Contrast	77.40	1	77.44	4.013	.047
Error	3781.840	196	19.30		
2+ Contrast	23.040	1	23.04	1.194	
Error	3781.840	196	19.30		.276

CHAPTER V

DISCUSSION

The accountability movement in education through NCLB has required many school leaders to make decisions regarding the balance of time in tested subjects and non-tested subjects leading to a decrease of time in non-tested subjects and an increase of time in tested subjects (Chomitz et al., 2009; Retner et al., 2006). School leaders must manage their resources carefully and with time being one of those resources, they must learn how to utilize it to the maximum benefit so as to meet the requirements of NCLB.

The purpose of this study was to explore the possible academic effects of students being enrolled in physical activity courses in grades 9-11 beyond the minimum requirement of one semester for graduation in a rural Arkansas high school. A sample was collected of all students for two consecutive graduating classes. These students took part in the ACT test during the spring semester of their junior year and a causal-comparative study was employed. Students were grouped according to the number of physical activity courses, those taking one or less in one group and those taking more than one in another. The ACT Composite and all four sub-test areas measured academic achievement.

This chapter reflects on the results from the data collected and the analysis performed. Recommendations were then made for school leaders based upon the results of the analysis concerning possible effects of physical activity classes. Lastly, implications as well as the significance of this study are discussed.

Conclusions

Five 2 x 2 factorial analysis of variances (ANOVAs) were implemented to evaluate all five hypothesis. In each hypothesis, the independent variable categories were gender (male and female) and the number of physical activity courses taken (greater than one and one or less). The dependent variables were the ACT composite score and the ACT sub-test scores. Main and interaction effects for each hypothesis were analyzed.

Hypothesis 1

The first hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the overall composite score on the ACT. While line plots indicated interaction effects, ANOVA results exhibited no significant interaction between gender and physical activity. Thus gender and the number of physical activity classes did not interact to influence the ACT composite score. The main effects of gender and physical activity classes did not display statistical significance when determining their effect on the ACT composite score. Therefore, the null hypothesis for the interaction and main effects could not be rejected.

While there was not a statistically significant difference in the ACT composite scores of students with two or more physical activity classes when compared to those with one or less, it does not necessarily indicate the absence of academic benefits from taking a higher number of physical activity classes. As noted by previous research (Din, 2006; Sallis, 1999; Trudeau & Shephard, 2008), the absence of any decline in academic achievement while taking additional physical activity time in lieu of academic time demonstrates the effectiveness of physical activity on learning.

One must note the subject specific areas tested by the ACT did not necessarily receive a decline in time. It is practice at the school where the data were collected to have students in an English, Math, and Science course during the ninth, tenth, and eleventh grades regardless of the number of physical activity classes taken. However, these physical activity classes were taken in lieu of courses such as art, vocational education, social sciences, and other similar elective, non-core classes.

Hypothesis 2

The second hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the English score on the ACT. While line plots indicated interaction effects, ANOVA results showed no statistically significant interaction between gender and physical activity. Due to these results, gender and the number of physical activity classes did not interact to influence the ACT English score. When determining the effect on the ACT English, the main effects of gender and physical activity classes did not show statistical significance. The null hypothesis for interaction and main effects could not be rejected as a result from the analysis.

While not statistically significant, females scored higher than the males in both physical activity categories on the English portion of the ACT. The difference between males and females was greater among the high physical activity group. This is consistent with the research from many studies (CDE, 2005; Carlson, 2008; Grissom, 2005; Shephard, 1998) who found females to have a higher gain in academic achievement from physical activity as opposed to males. Since the differences observed in this study were not statistically significant they were congruent with the findings of Ahamed et al., (2007) , Chomitz et al.,

(2009), Dwyer et al. (2001), and Tremblay et al., (2000) who also reported no differences. Like Composite scores, the results from the English scores were not statistically significant. While this did not show an increase in scores it also did not show a decline.

Hypothesis 3

The third hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Math score on the ACT. ANOVA results demonstrated no significant interaction between gender and physical activity that was statistically significant even though the line plots indicated possible interaction effects. Therefore, gender and the number of physical activity classes did not interact to influence the ACT Math score. The main effects of gender and physical activity classes did not show statistical significance when determining their effect on the ACT Math score. Therefore the null hypothesis for the interaction and main effects could not be rejected.

Differences among genders in regard to math scores and physical activity were observed by Carlson (2008), CDE (2005), and Grissom (2005). In this study, males scored higher than females in the lower physical activity group and females outperformed males in the higher physical activity group, although neither of these differences were statistically significant. Since these differences were not statistically significant, they were consistent with research performed by Sallis (2001) and Vandongen et al. (1995) who found that females may have greater academic gains in response to physical activity due to a lower baseline fitness level at the beginning of a physical activity intervention. The lack of statistical significance is consistent with previous research (Ahamed et al., 2007; Chomitz et al., 2009; Dwyer et al. 2001; Tremblay et al., 2000).

Hypothesis 4

The fourth hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Reading score on the ACT. While line plots indicated interaction effects, ANOVA results did not confirm statistically significant interaction between gender and physical activity. Thus gender and the number of physical activity classes did not interact to influence the ACT Reading score. The main effects of gender and physical activity classes did not show statistical significance when determining their effect on the ACT Reading score. Therefore, the null hypothesis for the interaction and main effects could not be rejected.

Differences in Reading scores by gender in regards to physical activity have been observed by Carlson (2008) and Tremblay (2000). While females did outperform males in both physical activity categories, the differences were greater in the higher physical activity group although not statistically significant which is consistent with the findings from Coe et al. (2006).

Hypothesis 5

The last hypothesis stated that no significant difference will exist by gender for eleventh-grade students enrolled in two or more physical activity classes in grades 9-11 compared to less than two on academic achievement as measured by the Science score on the ACT. Line plots indicated interaction effects between gender and physical activity. This was confirmed through ANOVA with the interaction effects being statistically significant. Thus gender and the number of physical activity classes did interact to influence the ACT Science score. Simple effects analysis showed among the students with fewer than two semesters of

physical activity, males scored significantly higher on the ACT Science than did females. Furthermore, there was enough evidence to support rejecting the null hypothesis case of the interactive effects.

Consistent with previous results from the Composite and other sub-test scores, females scored higher than males in the higher physical activity group, even though the results were not statistically significant. The only statistically significant finding in this study was from the interaction effects of gender and physical activity in regards to the ACT Science scores. These results are contrary to Tremblay (2000) who did not observe any significant differences when looking at Science scores specifically. However, this statistically significant result had an eta squared value of .024.

Recommendations

The results of this study indicate no harmful effects of physical activity class enrollment in grades 9-12 in a rural Arkansas high school on academic achievement as measured by the four subtests and composite score on the ACT. These findings correspond with the results from Ahamed et al., (2007), Chomitz et al., (2009), Dwyer et al. (2001), and Tremblay et al., (2000). This study did not utilize a cause and effect approach to determine if physical activity classes were beneficial or harmful to academic achievement. Rather, this study tried to evaluate the academic achievement of students who took more than the required minimum of physical activity courses in the grades 9-11 and compare them to the academic achievement of students who did not take more than the required amount. Furthermore, this study focused on a possible intervention (enrollment in physical activity classes) for students in grades 9-11 that school leaders could utilize.

School leaders should use these results with caution. It must be understood that for students to take part in athletics (one of the physical activity classes) they must pass four core classes during the previous semester and maintain a 2.0 GPA. While this would initially seem to have a great influence by limiting the population in the two or more physical activity classes group to high academic achievers, this is not necessarily the case. One must understand that these students may take multiple years of athletics and then fall under 2.0 in their GPA thus becoming ineligible. This is an example of how a lower academically performing student would then be in the high physical activity group.

One recommendation is to allow schools, districts, and state agencies that are pushing a whole child initiative in education to use the results to show there are no harmful effects for students in grades 9-12 in enrolling in physical activity classes. This study does not go so far as to claim that physical activity increases academics or cognition as suggested by Brown (1977), Corder (1966), and Ismail (1967). Results from this study show the avoidance of negative outcomes with the exceptions of Science scores, which showed a statistically significant gain. Further this study gives school leaders the opportunity to respond to outside forces who try to eliminate or limit physical education or athletics within the school day due to a lack of perceived benefits in the elimination of academic time in favor of physical activity time.

School leaders are limited in the responses they can provide. While school leaders typically cannot filter the students coming into the schools, the school leaders must learn to create opportunities to make the most out of incoming students. For this reason, only variables during grades 9-11 were analyzed because a school leader can control them.

This study shows enrollment in excessive physical activity classes does not have negative effects on academic achievement, thus allowing the school leader to enroll students in courses that have been shown to increase the student's self-esteem, fitness level, psychosocial health, and overall wellness (Astrand, 1992; Ekeland et al., 2004; Flook, Repetti, & Ullman, 2005; Ratey, 2008; Sallis, 1994; Schmalz, Birch, & Krahnstoever, 2007;; Shephard, 1984; Tremblay et al., 2000). This could not only have benefits for individual students but also for the school environment and the community as the school could be providing whole child services while not having a harmful effects on academic achievement as demonstrated in this study.

If an educator wants to answer the question "Does physical activity improve academic achievement?" a study much different than this one must be performed that controls a multitude of variables. It is unrealistic to control all the variables in a student's education that may contribute to academic achievement. Baseline data would need to be collected and the intervention of physical activity would then need to be applied with the results then being measured while as many of the possible covariates and confounding variables being controlled during the intervention period. The length of time of the intervention would need to be carefully considered such as a single or multi-year intervention. Further the students' previous fitness levels would have to be analyzed and controlled for as well as SES as these are reported to be confounding variables with academic achievement (CDE, 2005; Castelli et al., 2007; Chomitz et al., 2009; Grissom, 2005; and Singh and McMahon, 2006).

In addition, the impact physical activity may have on the physical and mental health of a student could be explored alongside academic effects. A community-wide interaction

could be undertaken to explore the broader reaching effects of physical activity in high school students. This would include the results of an increase or decrease in physical activity by the students and the effects on the local physical and mental health care systems to determine possible societal and community effects. Other community factors that may be related include crime rates and a satisfaction rating among residents.

Implications

The results from this study first implied that students who take physical activity courses beyond the minimum requirements do not have adverse effects on their academics. This is true when looking at school-wide effects as a whole and not individual cause and effect that would require a baseline measurement of academic achievement, an intervention, and then a post-test.

Students who take extra physical activity classes have a greater likelihood of increasing their fitness levels (Astrand, 1992), benefiting from psychosocial benefits (Ekeland et al., 2004; Flook, Repetti, & Ullman, 2005; Ratey, 2008; Schmalz, Birch, and Krahnstoever, 2007; Shephard, 1984; Tremblay et al., 2000), and from this study, no loss in their academic performance which is reiterated by Sallis (1999), Strong (2005), and Trudeau and Shephard, (2008). This allows the school leader to address the whole child and make changes that will impact the child's quality of life without having a detrimental effect on the child's academic performance.

Some of the strengths of this study included the limitation of the confounding and lurking variables. All students attended the same high school, had the opportunity to be enrolled in the same courses, and took similar ACT tests.

Most education curriculum decisions are handled at the state or local level. Schools need the opportunity to offer or require students to take physical activity courses in all high school years during the school day and allow it to count towards graduation requirements. As reported by Lee, Burgeson, Fulton, and Spain (2007), only 2.1% of high schools in the United States provided daily physical education (PE) for all students. While many students are enrolled in physical activity, many are not (CDC, 2009) and therefore not receiving the proper amount of physical activity as suggested by (USDHHS, 2007, 2010c) of 60 minutes of physical activity per day. Lee et al. (2007) further report that over 30 organizations including the American Heart Association and the National Association for State Boards of Education recommend daily physical activity in all grades through grade 12.

Individual graduation requirements for students to graduate from high school should require physical activity courses for every year of high school. In addition, more grant money needs to be available to fund schools that offer these programs. The benefits as described by Ekeland et al. (2004), Flook et al. (2005), Raley (2008), Sallis (1994), Schmalz, et al. (2007), Shephard (1984), Tremblay, et al. (2000), and Trudeau and Shephard (2008) from physical activity are not limited to the academic realm but also benefit society since students are taught more healthy lifestyles, acquire higher self-esteem, and receive psychosocial benefits. With these benefits, the infusion of more physical activity participation by our youth could decrease the strain on the public and private health care system as well as the mental health system. Garrett, Brasure, Schmitz, Shultz and Huber (2004) report that inactivity costs the United States health care system \$83.6 billion annually. This single intervention into the education system could have far-reaching benefits while not having adverse effects on the academic achievement of the students.

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APPENDICES

APPENDIX A

Descriptive Statistics of ACT Scores

Subject	<i>N</i>	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SE</i>	<i>SD</i>
Composite	200	11	31	20.08	.311	4.398
English	200	8	34	19.46	.403	5.704
Math	200	13	32	20.18	.313	4.424
Science	200	10	32	19.90	.373	4.418
Reading	200	8	31	20.22	.312	4.398

APPENDIX B

Normality Results for ACT Scores

Subject	Skewness			Kurtosis		
	Statistic	<i>SE</i>	Z-score	Statistic	<i>SE</i>	Z-Score
Composite	.159	.172	.92	-.679	.342	1.980
English	.070	.172	.41	-.253	.342	.001
Math	.443	.172	2.57	-.810	.342	2.368
Reading	.199	.172	1.16	-.818	.342	.818
Science	.022	.172	.13	-.127	.342	.371

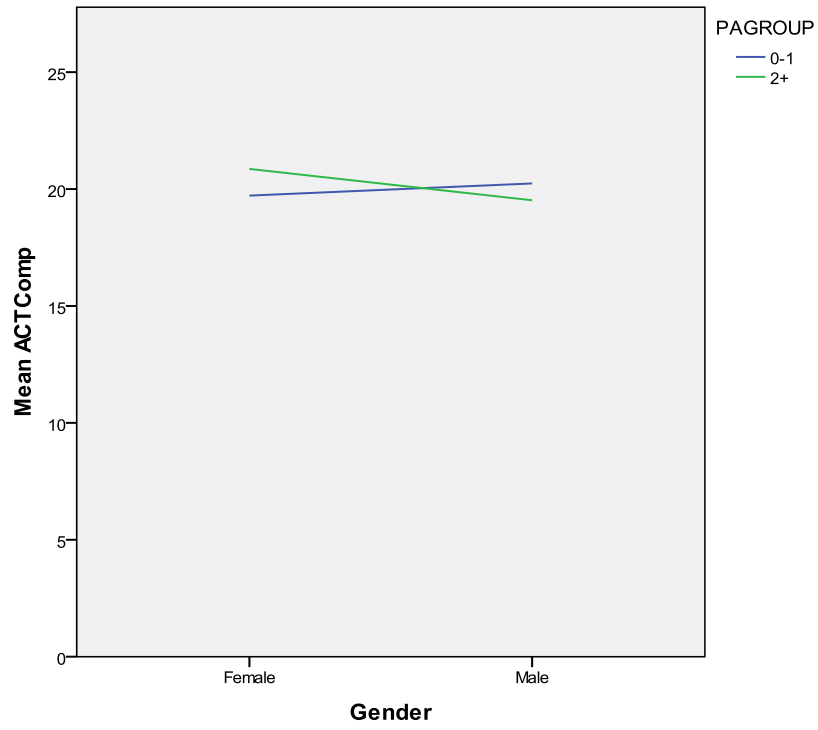
APPENDIX C

Homogeneity of Variance Results for ACT Scores

Subject	<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
Composite	.227	3	196	.877
English	2.494	3	196	.061
Math	.146	3	196	.932
Reading	.088	3	196	.967
Science	.250	3	196	.861

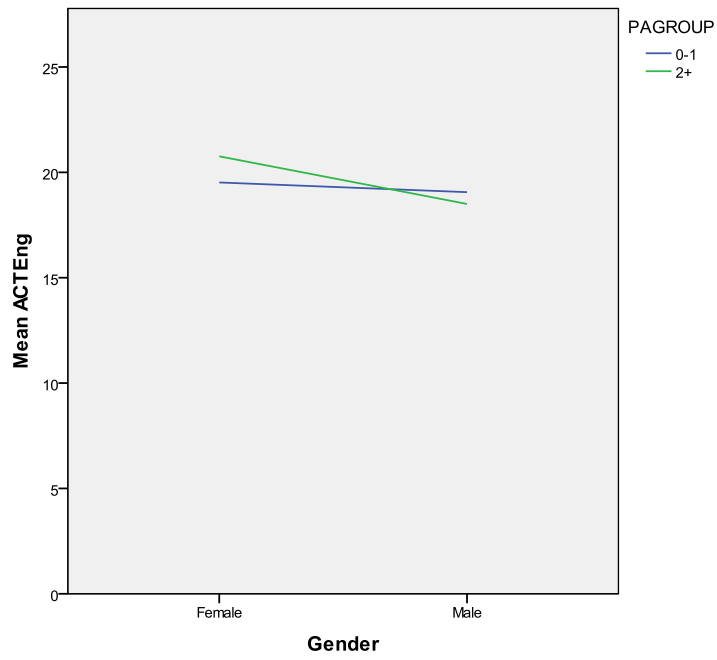
APPENDIX D

Eleventh Grade Estimated Marginal Means of ACT Composite Scores



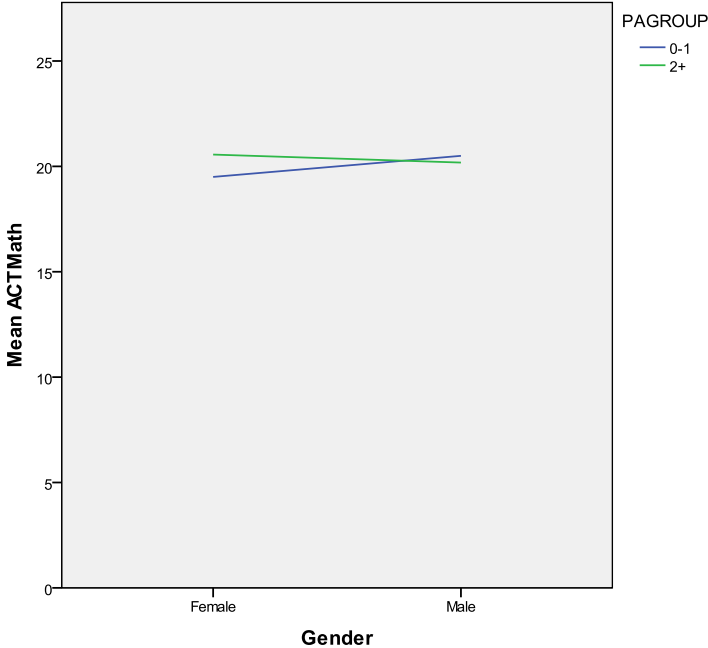
APPENDIX E

Eleventh Grade Estimated Marginal Means of ACT English Scores



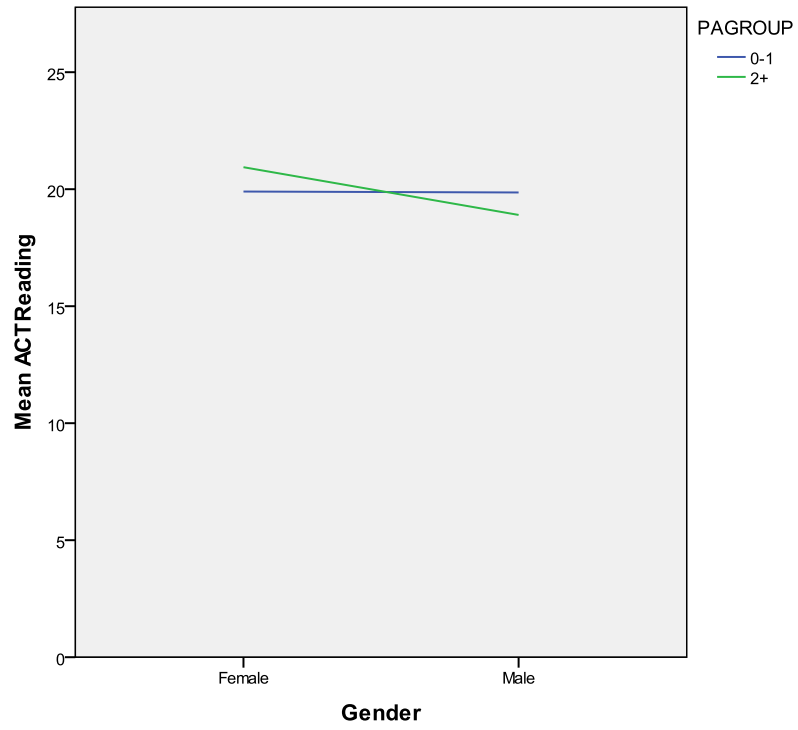
APPENDIX F

Eleventh Grade Estimated Marginal Means of ACT Math Scores



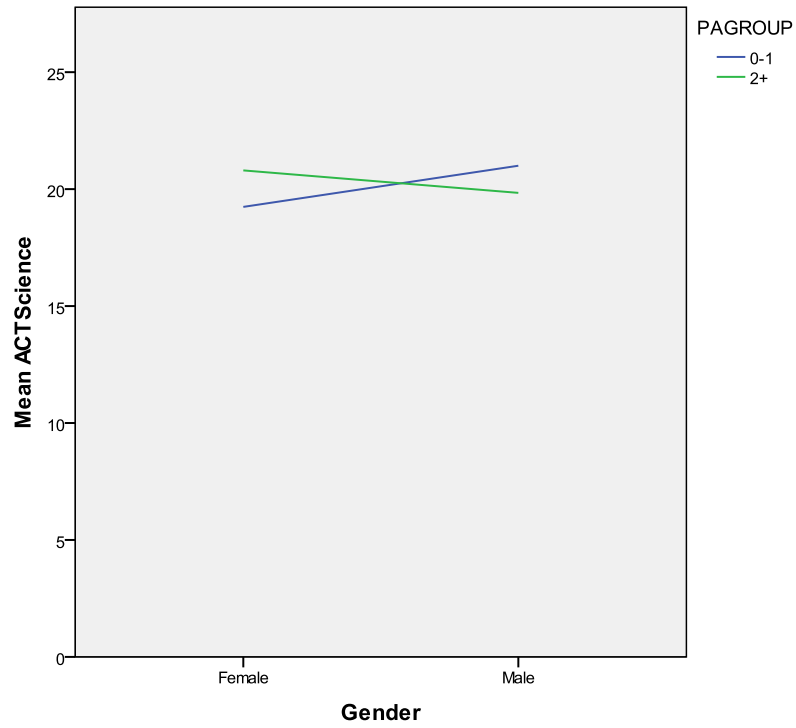
APPENDIX G

Eleventh Grade Estimated Marginal Means of ACT Reading Scores



APPENDIX H

Eleventh Grade Estimated Marginal Means of ACT Science Scores



APPENDIX I

Status of Request for Exemption from IRB Review



Status of Request for Exemption from IRB Review

(For Board Use Only)

Date: April 1, 2011

Proposal Number: 2011-25

Title of Project: Effects of Physical Education and Athletics Enrollment on Student Achievement

Principal Investigator(s): Eric Saunders eric.saunders@lavacaschools.com

- Research exempted from IRB review.
- Research requires IRB review.
- More information is needed before a determination can be made. (See attachment.)

I have reviewed the proposal referenced above and have rendered the decision noted above. This study has been found to fall under the following exemption(s):

1 2 3 4 5 6

In the event that, after this exemption is granted, this research proposal is changed, it may require a review by the full IRB. In such case, a **Request for Amendment to Approved Research** form must be completed and submitted.

This exemption is granted for one year from the date of this letter. Renewals will need to be reviewed and granted before expiration.

The IRB reserves the right to observe, review and evaluate this study and its procedures during the course of the study.

A handwritten signature in cursive script that reads "Chen Pierson York".

Chair, Harding University Institutional Review Board