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ACADEMIC AND BEHAVIORAL EFFECTS OF AEROBIC EXERCISE ON
MIDDLE SCHOOL STUDENTS

BY

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ABSTRACT

In light of the many health and fitness advantages of taking part in physical activity, school physical education (PE) programs may not be capitalizing on the impact they can have on various student outcomes. PE programs need to look beyond the health and fitness connections that we have become familiar reading about and seeing first-hand. The view of modern PE programs should be expanded upon to incorporate possible benefits they may have on student achievement and behaviors. The purpose of this study was to examine the short-term impact of an intensive PE program, utilizing Wii aerobics, on middle school students' achievement and classroom behavior. Within the context of Neptune Middle School, this study investigated the effects of a moderate-to-vigorous physical activity (MVPA) PE program on academic achievement of students in their classes that immediately follow PE. This study also investigated the effects of this PE program on student behaviors in the classes that immediately followed PE. Additionally, this study examined the interaction of grade, gender, ethnicity, and education classification (regular or special education) with the effects on student achievement and behavior of participating in the MVPA PE program.

This study utilized a pretest-posttest experimental design with randomization to an intensive Wii PE program or the traditional PE program. Participants were 256 seventh and eighth graders at Neptune Middle School. Surveys were administered prior to participation in the study to assess the students' attitudes about the Wii PE program. Multiple linear regression was used to analyze the results.

Statistically significant positive effects were found for classroom behavior, but not academic achievement. The MVPA PE program reduced discipline related classroom

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removals in those classes that immediately followed PE. Findings from this study can provide the school administrators with an evidence-based strategy for modifying school curriculum and schedules that take into account the impact PE has on student success. Furthermore, urban middle schools struggling with student discipline issues that result in loss of instructional time may benefit from an intensive PE program as they look beyond the traditional methods of student support services for addressing student behaviors within the school day.

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I dedicate this to those that supported my efforts and provided me the encouragement and motivation to not give up: Lara, Drenna, Brandon, Gabby, Collin, Steve, Sharon, and Alisa

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Chapter I: Introduction

Fitness and Health Concerns

Today's youth appear to have become less physically active and fit due to various reasons, including over engagement in technology. As a result, we may be fostering a generation of less fit, unhealthy children. According to the White House Task Force on Childhood Obesity (2013), which has been a focus of the media through First Lady Michelle Obama's Let's Move campaign, we currently face an epidemic of childhood obesity due to a lack of physical activity and unhealthy lifestyles of today's children. The task force found that adolescents average 7.5 hours a day using entertainment media (i.e. technology). Consequently, adolescents are getting far less than the recommended 60 minutes of daily aerobic activity (Centers for Disease Control and Prevention, 2011b). The task force suggests that in order to reverse this trend and increase physical activity, various opportunities to be active must be provided. These include, offering children places to exercise and providing them with specific activities such as "sports, dance or fitness programs that are exciting and challenging enough to keep them engaged (White House Task Force on Childhood Obesity, 2013, para. 2)." Because one out of every three children in the United States classified as obese or overweight before the age of five (Centers for Disease Control and Prevention, 2011a), dramatic, immediate steps must be taken by all stakeholders.

In addition to the effects of physical activity on children's health, various research studies have found connections between being physically active and fit, and student achievement, self-esteem, mental health and behavior (Bass, Brown, Laurson, & Coleman, 2013; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Diamond, & Lee,

2011; Jarrett et al., 1998; Kirkcaldy, Shephard, & Siefen, 2002; Wittberg, Northrup, & Cottrell, 2012). Much of the research has looked at the long-term effects of physical activity on lifestyle changes and health, with limited studies focusing on the short-term effects it has on achievement and behavior. Additionally, there is limited research that looks at the relationship between students' participation in physical activity and its effect on reducing disruptive behavior. The effects of physical activity are suggested to impact students from various backgrounds and with varying characteristics. There is however evidence suggesting that low-income minority populations are more negatively affected by sedentary behavior and decreased fitness levels, and have continued to struggle to meet academic achievement levels comparable to their White, more affluent counterparts (Losen, & Skiba, 2010; Ogden & Carroll, 2010; Taras, 2005).

Adolescents spend much of their day at school. Therefore, schools clearly have the potential to influence not only children's learning, but also their wellbeing. School programs can affect children by providing psychosocial support for physical activity, and improve their health through school policies and administrative commitment that address today's increasingly high sedentary environments (Wechsler, Devereaux, Davis, & Collins, 2000), particularly for middle school aged children. Schools have their greatest ability to influence a child's physical activity during the time the student is at school, particularly during PE. Therefore, it is important for schools to address what is most directly under their control and ability to change, and to do so in an appropriate manner. Thus, a primary area of focus for Neptune Middle School (NMS) must be the physical education programs.

Neptune Middle School

At NMS, all students are required to take physical education (PE). The average class sizes during the 2011-2012 school year were 25, 22, and 18 for grades 6, 7, and 8 respectively (New Jersey Department of Education, 2011). The student population for all three grades totaled 896. As seen in Table 1, NMS is evenly divided by gender, and has a large minority population. Additionally, greater than one-fifth of the population is classified as special education.

Table 1

NMS Student Population Descriptive Statistics (N = 896)

Descriptor	Number	Percent
Educational Program		
General Education	699	78
Special Education	197	22
Economically Disadvantaged Students	503	56
Gender		
Male	445	50
Female	451	50
Race/Ethnicity		
White	195	22
Black	585	65
Hispanic	89	10
Other	27	3

Note: Updates to the 2011 data on the School Report Card may have changed totals since date of review (New Jersey Department of Education, 2011)

With 6 hours and 10 minutes of instructional time daily, the students of NMS are instructionally engaged 27 minutes more than the state average. The school operates on an A/B block schedule that alternates PE and elective classes every other day. Thus,

within a two-week period every student participates in a 72-minute PE class five times, totaling 360 minutes.

Unfortunately, although NMS provides every student with 72 minutes of math and language arts instruction daily, the school continues to struggle to make adequate yearly progress (AYP). Based on the New Jersey Assessment of Skills and Knowledge (NJASK) results for 2011, collectively a large percentage (i.e. 62%) of NMS students were not proficient in language arts literacy, compared to only 35% for students in its comparable demographic factor group (DFG) statewide (New Jersey Department of Education, 2011). Additionally, 55% of NMS students were not proficient in math, compared to 33% of students in the same DFG statewide. More specifically, the subgroups that failed to make AYP were greatest among the school's minority students and students with disabilities population. According to the AYP status report from the New Jersey Department of Education (2010a), NMS had three subgroups that did not reach the AYP benchmark for math this past school year. These subgroups were: (a) students with disabilities, (b) African-American, and (c) economically disadvantaged. Further review of the data indicates that greater than 50% of the students with disabilities were also economically disadvantaged African-American students (Alfone, 2010b).

As reported by the New Jersey Department of Education (2010a), stark inequities in math and language arts literacy exist between the number of general education students and students with special needs that were proficient on the NJASK. Whereas 52% of general education students in grades six through eight reached the proficiency benchmark in math, only 11% of students in the special education subgroup obtained proficiency. In language arts literacy 65% of the general education students obtained proficiency while

only 19% of the special education students reached that same literacy benchmark. The achievement results we see at NMS unfortunately support the rationale behind one of the main goals of the 2001 No Child Left Behind (NCLB) Act, which was to minimize or eliminate the achievement gap that exist between diverse populations including students with special needs (Rabin, Saenz & MacGillivray, 2008).

Coinciding with low scores on the high-stakes tests, NMS students elicited more than 4,070 behavioral infractions that resulted in student removals from class during the 2011-2012 school year (Alfone, 2012). Greater than 95% of the student removals were for Black students. Because of the loss of instructional time, this is believed to have contributed to the low achievement scores. During the 2009 – 2010 school year, the middle school had 8% more students suspended than the state average (New Jersey Department of Education, 2010a), and even more alarmingly, 27% more students were suspended during the 2010-2011 school year compared to other students throughout the state (New Jersey Department of Education, 2011).

In a study that looked at U.S. Department of Education data from more than 9,000 middle schools, it was found that a significant difference existed in the frequency of suspensions among children when looking at race, ethnicity, and gender (Losen & Skiba, 2010). The study further found that African-American middle school children are suspended much more often than their White counterparts are. More specifically, Black males were found to be suspended three times more than White males. Black females were found to be suspended four times more than White females. These findings would suggest that African-Americans lose more valuable class time than their White counterparts. Discipline for minority students exacerbates the problem at NMS where

approximately two-thirds of the student population is African-American (New Jersey Department of Education, 2013).

The Neptune Township School District has been effective in updating its curricula to align with the new Common Core Standards for most core subjects, and is in the process of doing the same for its electives and PE classes. The school has a multitude of fitness activities that are implemented in the gym classes to address the PE curriculum. There are seven full-time PE/health teachers, all of whom are certificated staff members and have received sustained training on all the traditional and innovative equipment and fitness programs provided for the students. The traditional PE program includes activities such as basketball, volleyball, kickball, and jogging to name a few. Non-traditional gym class equipment and programs include a confidence ropes course, kettle bells weight training, aquatic program with kayaking and swimming, rock wall climbing, cardio fitness room, and Wii aerobics.

As many schools offer students resources beyond that of the classroom, NMS also offers a multitude of social and academic services to its students (see Figures 1). Despite the many programs offered to its struggling students, NMS continues to have difficulty achieving school-wide academic improvement. Thus, alternative solutions need to be sought. An intensive PE program such as Wii aerobics may be a unique strategy for addressing the many needs of NMS students. The Wii home video game console was released by the Nintendo Corporation on November 19, 2006 (Wii, n.d.). Its claim to fame is that the Wii games are physically interactive and encourage active participation with two or more people. In December 2009, the console was recognized for breaking the

record of most sold consoles in a single month. Thus, the Wii game console is extremely popular among the young and old.

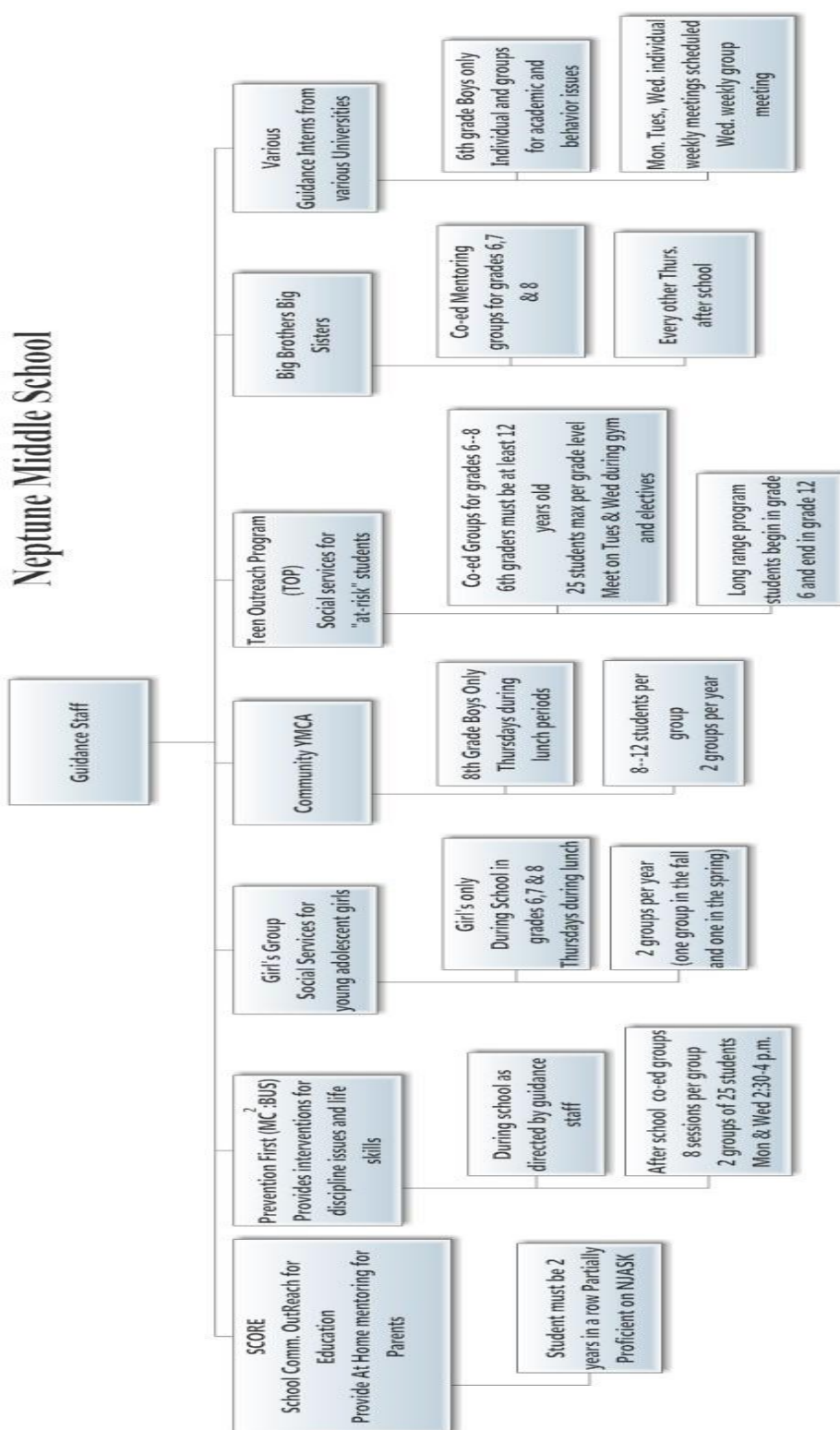


Figure 1. Descriptions of each service group including name of program, person(s) in charge, selection criteria, and the time when the students meet as a group or individually.

Capitalizing on the Wii's popularity, an aerobics PE program that utilizes this technology may increase student engagement, and thus help students improve their physical conditioning beyond that achieved from participation in a school's traditional PE program. The purpose of this experimental study is to determine if a PE program that utilizes moderate-to-vigorous physical activity (MVPA) can improve academic achievement and behaviors of NMS students immediately following participation in the program. This is an important area of study because relatively few, if any, studies have looked at both academic achievement and behavior together, as outcome measures of physical activity with middle school students. Even fewer studies have utilized randomized trials to investigate these relationships.

Although a meta-analysis of research on physical activity and student performance at school found mostly short-term improvement in students' concentration (Taras, 2005), another meta-analysis by Singh (2012) finds that on average, physically active students perform better in school than those less active. Previous research findings consequently have been found to vary widely on the effects of physical activity on student outcomes. Therefore, more specifically, it can be hypothesized; that through strategic placement of an MVPA PE program in the school day's schedule, students in the program, compared to students in the traditional PE program, will have greater academic achievement and less disruptive, off-focus behaviors during the classes that immediately follow the students' gym class (see Figure 2). This investigation can be achieved at NMS through the incorporation of Wii aerobics PE classes, and the monitoring of student participant's fitness levels and short-term academic and behavioral outcomes. A school like NMS, that has failed to make AYP in math and language arts in

recent years, cannot afford to ignore any possible solutions to the achievement and behavioral problems it continues to endure.

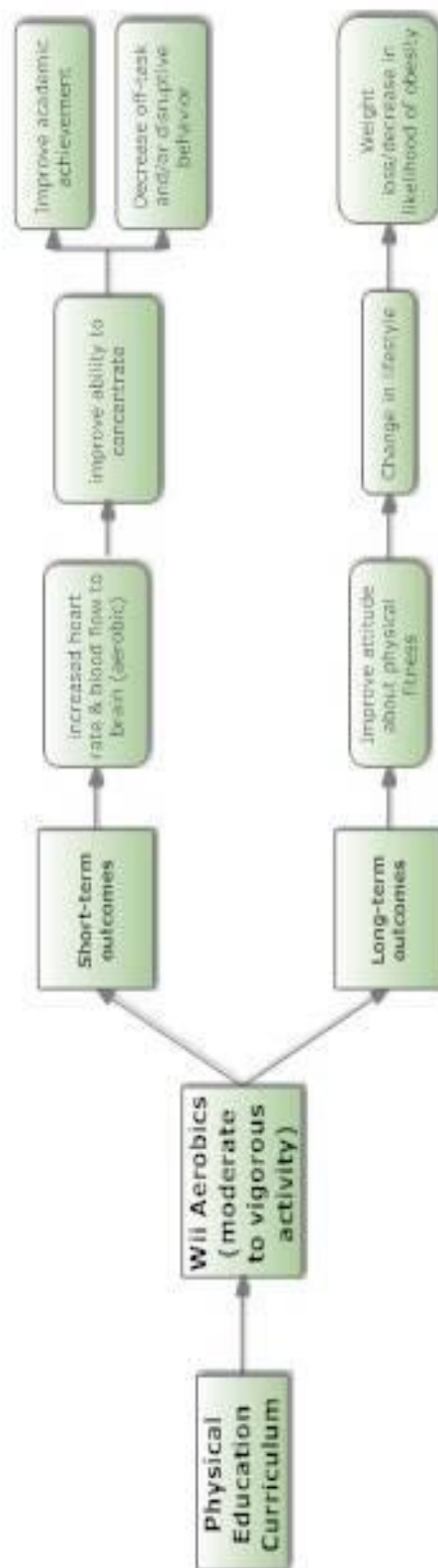


Figure 2. Predicted outcomes associated with participation in a moderate to vigorous physical education program

Chapter II: Literature Review

Fitness and Health Concerns

The 2008 Physical Activity Guidelines for Americans suggest, “being physically active is one of the most important steps that Americans of all ages can take to improve their health” (U.S. Department. of Health and Human Services, 2008). However, in a recent review of the epidemiologic literature from the past 40 years, Liese, Ma, Maahs, and Trilk (2013) found significant negative health effects related to certain health conditions and inactivity (i.e. sedentary behavior). Over the last 20 years, there has been a marked increase in children and adolescents with type 2 diabetes (T2D). This is important because diabetes has been found to be one of the most common chronic conditions for this age group. Even more alarmingly, T2D was not historically seen in youth, but was a condition found in middle-aged or older adults. In their review of 480 epidemiological studies, Liese et al. (2013) found that a high percentage of children with diabetes do not meet the minimal recommended amounts of intensive physical activity on a daily basis. Compared to children without diabetes, those with T2D were found to engage much more in sedentary behavior, particularly behavior consisting of electronic media use. On average, boys with T2D used electronic media 3.6 hours per day, and girls were found to spend 2.9 hours per day sedentary, much of which was watching TV.

Referring to cardiorespiratory fitness as physical fitness, Liese et al. (2013) found significantly lower levels of fitness in children with T2D compared to those without diabetes. It is important to point out though, a large percentage of descriptive papers the researchers reviewed were found to utilize small student sample sizes of less than 100. As a result, determining causality can be difficult. However, what was clear is the fact that

90% of youth with T2D are overweight and/or obese, and 92% are found to have two or more cardiovascular disease risk factors.

Using current data from the CDC, the Endocrine Society and the Hormone Health Network published a report in their *ObesityinAmerica.org* (2012) online journal suggesting that the increasing sedentary behavior of many of today's youth has directly contributed to childhood weight gain and obesity, and the continual increase in T2D among children and adolescents. Furthermore, obesity rates are on the rise for Whites, Blacks, and Hispanics; with significantly more Hispanic males and Black females identified as obese when compared to their White counterparts (Ogden & Carroll, 2010). According to the CDC (2011a), approximately 17% of 2-19 year olds in the United States can be categorized as obese. That equates to 12.5 million children and adolescents. Childhood obesity can be defined as having a body mass index (BMI) equal to or greater than the 95th percentile of the sex-specific BMI growth charts (Barlow & Dietz, 1998). More specifically, in the United States obesity has been defined as having a BMI greater than 30. In a recent study that looked at medical care costs of obesity, researchers utilized natural experiments of more than 22,000 men and women, and concluded that obese individuals have yearly medical costs of \$2,741 higher than those not obese. This amount translates into a staggering \$190.2 billion per year in medical costs as a direct result of obesity (Cawley & Meyerhoefer, 2012).

A comprehensive health initiative developed by the U.S. Department of Health and Human Services entitled *Healthy People 2010* (2010), reported that the objective they established for increasing the physical activity levels for middle school aged children had not been met. The objective to improve weight management and reduce

childhood obesity was to show progress over time; reaching desired targets by the year 2010. Accordingly, one of the major problems with middle school students is the amount of television they watch on a daily basis. This problem is especially prevalent among minority students. While 25% of White, non-Hispanic students reported watching more than two hours of television daily, considerably more Hispanic and Black non-Hispanic students watched in excess of two hours per day at rates of 58% and 44% respectively.

Differences in activity levels among today's adolescents go beyond race and ethnicity. Jago, Anderson, Baranowski, and Watson (2005) found significant differences in amounts of physical activity engaged in by adolescent boys and girls. More specifically, girls engage in more sedentary behavior than boys do during the late afternoon. Although boys spend more time engaged in sports, and girls spend more time engrossed in personal care, boys spend more time occupied with television and electronics (Jago et al., 2005). Not surprising, physical activity has been identified as a major factor in decreasing the risk of cardiovascular disease along with many other chronic conditions (Liese et al., 2013). Consequently, a high level of sedentary behavior is an obvious health concern. Beyond health issues, sedentary behavior unfortunately may also limit children's ability to concentrate and learn (Caterino & Polak, 1999). Additionally, improving students' health through physical activity has a direct positive effect when these students get fit and are less likely to miss school, which ultimately improves student attendance rates and consequently school funding (Taras, 2005).

In their review of the literature on the determinants of adult physical activity and exercise, Dishman, Sallis, and Orenstein (1985) found that adults reporting a history of participation in two or more sports during their youth were two to three times more likely

to continue participating in vigorous physical activity compared to those that were not as active during adolescence. Although improving attitudes about exercise was not found to show a strong relationship with increased adherence, the researchers specifically suggested that, “those who strongly value exercise, who believe they have control over health outcomes, and who expect personal health benefits from exercise are likely to engage in much exercise” (Dishman et al., 1985, p. 165). Moreover, improving ones knowledge about health and exercise has been found to foster lifestyle changes for both men and women.

Since not all physical activity is the same, school leaders should be mindful of the importance that the Centers for Disease Control and Prevention (CDC) (2011b) places on fitness, how they define appropriate physical activity intensity levels, and their recommendations for being physically fit. Accordingly, aerobic activity is any physical activity that causes you to breathe harder and make your heart beat faster for at least 10 minutes at a time. This activity must be at a moderate or vigorous intensity in order to be considered aerobic. When a person's heart rate is between 50 to 70% of his or her maximum heart rate, which can be calculated by subtracting their age from 220, the activity that they are doing is considered to be at a moderate intensity. Therefore, a moderate intensity physical activity for a 13-year-old would require a target heart rate between 103 and 145 beats-per-minute (bpm) during the activity.

To be considered vigorous intensity physical activity, a person's heart rate needs to be between 70 to 85% of his or her maximum heart rate. Thus, the same 13-year-old would require a target heart rate between 145 and 176 bpm during the activity. Furthermore, in order to reach the CDC's recommended guidelines for vigorous intensity

fitness levels, the activity must utilize large muscle groups, and should be conducted for at least 20 minutes per day; three days per week (Centers for Disease Control and Prevention, 2011a). A simple description of vigorous intensity aerobic activity is that when you are doing the activity you are breathing hard and fast enough that you should not be able to say more than a few words without pausing to catch your breath. Likewise, for moderate intensity aerobic activity you should be able to break a sweat while your heart rate increases. Participation in MVPA is therefore defined as a level of physical activity that causes a person's heart rate to remain between 50%-85% of their target heart rate for at least 20 minutes.

Role of PE in Public Schools

The National Association for Sport and Physical Education and the American Heart Association (2006) have indicated that the requirements of the No Child Left Behind Act, along with limited school funding, have created a situation where schools have found themselves fighting increased pressure to reduce the length or number of PE classes offered. This is done in order to make more time for math and language arts classes. Nevertheless, tight budgets should not mean schools should look toward PE as being an expendable program that can be watered-down to the point of uselessness. Shortening time for PE classes, having activities requiring little to no student effort, or even the elimination of classes, suggests a lack of insight into the importance of PE programs.

Although there is varying debate regarding what constitutes appropriate levels of student physical activity, there is widespread acceptance that participating in physical activity in or outside of school offers significant health benefits (Centers for Disease

Control and Prevention, 2011b). As such, schools should instead practice fiscal responsibility when utilizing limited resources such as personnel that may be needed elsewhere in order to provide sufficient opportunities for PE regularly. This may involve the sharing of PE teachers between schools or even increasing class sizes. Unfortunately, it is easy to disregard programs that have minimal accountability requirements or clearly established standards, regardless of the benefits or importance of the program. Policy makers therefore have an opportunity to make an impact in schools, and can be vital to the process of implementing lasting PE program changes that address the amount of time and intensity levels needed to promote a healthy lifestyle (Eyler et al., 2010).

In New Jersey, the minimum required amount of weekly PE is only 150 hours (New Jersey Department of Education, 2010b). According to the 2009 Comprehensive Health and Physical Education Core Curriculum Content Standards for NJ (i.e., 2.6.4.A.2), "students are to participate in moderate to vigorous age-appropriate activities that address each component of health-related and skills-related fitness" (New Jersey Department of Education, 2009, para. 3). It is important to note that although the state requires all public schools to use these standards, there is no specific mandated curriculum.

Unfortunately, although policy makers may take an interest in creating legislation to address the physical activity needs of children, they have done so on an inconsistent basis. In a comprehensive inventory of all 50 states' PE legislation from January 2001 to July 2007, Eyler et al. (2010) looked at legislation introduced and enacted that focused on minimum time requirements and activities considered vital in creating an effective PE program. The researchers found that of the 781 bills analyzed, 162 were enacted.

However, of the original bills analyzed, only 272 were found to contain one or more evidence-based criterion of effective interventions proven to increase physical activity in children. Of those, only 43 were actually enacted. Thus, although many bills related to increasing physical activity in children are introduced around the country, few are actually based on empirical evidence, and even fewer of those are actually made into law. Eyler et al.'s (2010) findings are however limited to the six years inventoried. Additionally, their data may not include bills that were introduced before 2001 and not enacted by 2007.

Nevertheless, even when legislation related to children's physical activity is passed it is not necessarily comprehensive or enforceable. According to a report by the CDC (2007), only 39 states require middle schools to teach PE by law. Of those states, only 16 require specific amounts of time per week for students to participate in PE. Research looking at cross-sectional data from the National Survey of Children's Health found that individual and state-level PE requirement policies from 2002-2003 and 2006-2007 showed a weak relationship between state PE policy requirements and actual school-level implementation (Kim, 2012). It was also found that although there was a 10% increase in the percentage of schools requiring PE from the 39 states, there was only a 28% increase in the number of days per week that the students actually participated in vigorous activities. Thus, even PE policies that are evidenced-based cannot be effective if they are not implemented as prescribed within the schools.

Schools provide students with a certain amount of time for math and language arts instruction. That allocation is hopefully enough time to educate the students to at least a minimum proficiency level. If effectively designed and implemented, PE is a

subject area that could be viewed as similar to math and language arts; requiring a certain amount of education in order to promote life-long learning (National Association for Sport and Physical Education, 2007). Unfortunately, PE is not state tested in New Jersey as is the two academic subjects mentioned. Although high stakes tests do not necessarily measure the value of math or language arts, they are used as barometers of achievement by policy makers, school officials, and parents. Consequently, this lack of accountability of the PE curriculum allows school officials to water-down their PE programs and schedule gym classes based on convenience rather than possible efficacious outcomes. However, in addition to learning math and language arts, it is important for the students to become physically educated and incorporate what they learn into their daily lives. According to The National Association for Sport and Physical Education (NASPE, 2007), a physically educated person is someone who:

- demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities,
- demonstrate understanding of movement concepts, principles, strategies and tactics as they apply to learning and performing physical activities;
- participates regularly in physical activity,
- achieves and maintains a health - enhancing level of physical fitness,
- exhibits responsible personal and social behavior that respects self and others in physical activity settings, and
- values physical activity for health, enjoyment, challenge, self-expression and/or social interaction (p. 3).

School administrators and their curriculum supervisors are responsible for ensuring that all curricula are rigorous and meet their intended goals. Thus, school leaders should look at research for best practices related to fitness programs in and outside of school that have demonstrated positive results as described by Healthy People 2020 (2013). In order to do this effectively, schools ought to conduct program evaluations, in this case, evaluations of their existing PE programs as well as after-school physical activity programs. A PE program evaluation, particularly for public school programs, can be a very useful tool for the school community (i.e., the stakeholders) in terms of helping to improve student health and fitness, budgetary usage, staffing, and use of existing facilities. According to Rossi, Lipsey, and Freeman (2004), if done correctly, program evaluations can help an organization determine if a program or intervention is being implemented as intended, appropriately directed toward those it was targeted for, and if it is providing the benefits that its original goals suggested.

In an effort to address concerns that their youth were more prone to physical inactivity, obesity, and high cholesterol and blood pressure, the Michigan Department of Education evaluated their PE program. The program the state was using was the Exemplary Physical Education Curriculum (EPEC 4 Kids, 2011). According to the EPEC program provider:

True physical education teaches students the skills and knowledge they need to be active now and in the future. What separates EPEC from the competition is that it's a true curriculum, based on the NASPE standards. Unlike physical activity programs that assume children already know how to perform skills; EPEC

provides step-by-step instruction, enabling all students to be successful. (EPEC, 2011, Para. 1)

However, the Michigan DOE was not sure the program goals were being met; consequently, they utilized a quasi-experimental design that investigated two separate and distinct goals of the PE program; an outcomes goal and a process goal (Laris, Russell, & Potter, 2007).

The evaluation's outcome goals measured the effectiveness of the EPEC program's ability to improve student psychosocial precursors and motor skills, increase student participation in physical activity, and improve the students' fitness levels. The process goal assessed the level and quality of implementation of the EPEC program in order to make suggestions for needed improvement. Some of the questions used to determine the program's effective implementation and outcomes were (a) to what extent do teachers implement EPEC, (b) does EPEC improve student fitness levels (i.e., aerobic fitness, muscle strength, and flexibility), and (c) does EPEC motivate students to be physically active (Laris, Russell, & Potter, 2007)?

Because the school leaders' evaluated their PE program in an effort to identify weaknesses, and improve deficiencies, they were able to determine that the EPEC program demonstrated fidelity by doing what it was intended to do, and determined that marked gains were made in students' motor skills, compared to students that engaged in alternate physical education curricula.

As the Laris, Russell, and Potter (2007) demonstrated, evaluations of PE programs can be commonplace, however, what is not usually the case are randomized studies of health-related PE interventions. McKenzie et al. (2010) realized there was a

lack of empirical investigations on PE programs, and was prompted to conduct their own randomized study. The researchers conducted a two-year intervention utilizing environmental, policy, and social marketing interventions that included professional development for the PE teachers to increase physical activity during PE classes and reduce caloric intake of middle-school students. This was a large-scale study, consisting of approximately 25,000 students from twenty-four Southern California middle schools. The study took place over a two-year period, and included an evaluation of the intervention (i.e. M-SPAN: Middle School Physical Activity and Nutrition).

Part of McKenzie et al.'s (2010) M-SPAN evaluation consisted of providing sample materials to the PE teachers during professional development sessions. According to the researchers, the greatest benefit of the professional development was providing the teachers with instructional strategies and techniques for revising the existing PE program; both which were aimed at increasing students' MVPA. The researchers' evaluation of the intervention suggest that by standardizing the PE programs there was a positive effect on students' activity levels in MVPA. More specifically, MVPA was increased in the PE classes by 3 minutes per lesson. Additionally, by the end of the two year intervention participating schools demonstrated an increase of 18% in MVPA. Through evaluation of the professional development that was provided to the PE teachers it was determined the intervention had positive results, increasing MVPA without the need to increase the amount of time students were required to participate in the PE classes. It was further suggested that these results would not have been the same if the students were not actively engaged in the activities; particularly if they did not enjoy the specific fitness activities they took part in (McKenzie et al., 2010).

Physical Activity and Behavior

Medical studies have found that immediately following physical activity the body increases blood flow to the brain and improves general circulation (Fleshner, 2000; Morgan, 1994). Exercise also has the ability to reduce stress, improve a person's mood and create a calming effect because of the release of norepinephrine and endorphins to the brain. Researchers have also suggested that students' affective behaviors are significantly associated with high levels of exercise because they are less stressed (Prasad, St-Hilaire, Wong, Peterson, & Loftin, 2009). Concentration, or time on-task, has also been found to have short-term improvement among students immediately following physical activity (Caterino & Polak, 1999). Additionally, physical activity has been found to improve executive functions in children, allowing them to better monitor their own actions, thus possibly reducing impulsive behavior (Diamond & Lee, 2011). However, some studies have found that physical activity may actually impede learning for some students due to the calming effect that results from the increased transfer of serotonin precursor tryptophan in the brain (Cook, Leventhal, & Freedman, 1998; Kuperman, Beeghly, Burns, & Tsai, 1987). Nevertheless, studies finding negative associations between physical activity and behavior are limited. In fact, participation in a majority of structured physical activities has been found to significantly reduce many short-term disruptive behaviors in disturbed students (Trudeau & Shephard, 2010).

In their investigation of various factors that affect the executive functions of children age 4 to 12, Diamond and Lee (2011) found that among other activities, aerobic exercise has the ability to improve executive functioning development in children. More directly, frequent participation in aerobic exercise improves the cognitive flexibility of 8

to 12 year olds significantly more than less demanding physical activity which usually taking place in PE. However, as suggested by McKenzie et al. (2010), Diamond and Lee (2011) also believe that student outcomes resulting from MVPA is contingent upon the student's enjoyment of the physical activity. Nevertheless, participation in MVPA is suggested, in an indirect way, to reduce disruptive behavior that may be caused by students' impulsivity, by providing them the ability to utilize cognitive functioning that enables them to *think before they act*. However, these suggested correlations by Diamond and Lee (2011) are based on a review of the literature, and not through a direct randomized study.

As I have found, few studies investigate the relationship between physical activity and student behaviors (Caterino & Polak, 1999; Diamond & Lee, 2011; Jarrett et al., 1998). Of those studies found, most did not utilize randomization needed for determining causality. Utilizing the Woodcock-Johnson Test of Concentration, Caterino and Polak (1999) studied a group of second, third, and fourth grade students to see if directed PE activities affected the students' concentration in classes immediately following the activity. The fourth grade students were found to have statistically significant improvement in concentration after participating in the physical activity. However, results were not the same for the second and third-grade students. Although participation in the activity was not found to improve student concentration, taking students away from their academic classes to participate in the physical activity did not have a detrimental effect on concentration or achievement either.

In another study utilizing multivariate analysis of variance with repeated measures, Jarrett et al. (1998) found that on days that fourth graders were provided recess

(i.e. physical activity) both boys and girls were significantly more on-task and less fidgety, compared to their prerecess behaviors, than when they did not participate in recess. Although the previous studies were conducted with elementary grade classes, and not middle school students like the proposed current study, it is interesting to see that a statistically significant effect on classroom behavior was found when students participated in physical activity for even just one day per week (though only on that one day). However, the researchers suggest that these findings may be primarily due to the interruption of instructional time rather than the physical activity. Regardless, negative student behaviors can be serious distracters for the individual and other students' learning, particularly for students with emotional and/or behavior disorders, as this has been found to significantly lead to academic difficulties for these students (Landrum, Tankersley, & Kauffman, 2003). Thus, reducing negative classroom behaviors, whether through physical activity or other means, is important to the academic success of the general education and special needs students.

It is important to understand and identify factors that may influence the impact of MVPA on behavioral outcomes. Brodersen, Stepto, Williamson, and Wardle's (2005) study of 4,320 children found that sedentary behavior was greater in ethnic minority children than with non-minority children. This is important because it was also found in their study of physical activity and sedentary behavior of 11 to 12-year-old boys and girls that an association exists between a sedentary lifestyle and low prosocial behavior scores when measured using the Strengths and Difficulties Questionnaire (SDQ). Furthermore, children with high prosocial scores are more likely to participate in vigorous activities and sports; thus, stratifying by race is important because of race differences in sedentary

behavior. Additionally, according to Brodersen et al. (2005), gender differences may also be a factor in sedentary behavior of children. Accordingly, girls from more deprived backgrounds reported more sedentary behavior than that of their male counterparts. However, the student self-reports in Brodersen et al.'s (2005) study did not measure factors such as the students' attitudes toward the activities they were offered or to which they had access. As has been suggested by McKenzie et al. (2010) and Diamond and Lee (2011) this could have a deleterious effect on student outcomes. Consequently, it is unclear if the female students in Brodersen et al.'s study would have been more or less active if provided activities they enjoyed.

Physical Activity and Academic Achievement

Numerous studies have been found to suggest an association between student academic performance and the amount and intensity of physical activity by secondary school children (Coe, Pivarnik, Womack, Reeves, & Malina, 2005; Fox, Barr-Anderson, Neumark-Sztainer, & Wall, 2010; Shephard, 1996; Strong et al., 2005). However, very few studies have looked at the relationship between MVPA and student achievement at the middle school level. Additionally, even fewer studies have focused on the effects that gender, race, educational program, and/or grade level have on the varying levels of physical activity outcomes. For some of the studies that have done so across all grade levels, the results are mixed (Coe et al., 2005; Fox et al., 2010; Shepard, 1996; Strong et al., 2005).

Looking at the effects of physical activity on academic achievement through grades and standardized test scores of sixth grade students, Coe et al. (2005) found that only students that reached or exceeded the vigorous activity guidelines recommended by

a national health promotion and disease prevention initiative sponsored by Healthy People 2010, had significantly higher grades than students who did not. It was also suggested that less than 20 minutes of MVPA is not enough to improve academic achievement. Because the researchers also looked at moderate physical activity, they were able to determine if a difference existed between the two levels of participation among students. The findings suggest that there does not appear to be a relationship, long or short-term, between moderate physical activity and academic achievement. This again supports the need for schools to move away from the traditional PE programs of *stand around and wait your turn* to activities that are more intensive and engage the students for at least 20 minutes within the class period. In their popular review of the connection between PE and its connection to public health, Sallis and McKenzie (1991) suggested that the difference between low and high-quality PE could be determined by how each influence lifetime activity goals and health consciousness. Accordingly, high quality PE programs maximize their impact on public health by influencing consistent patterns of physical activity outside the classroom and into adulthood. Low-quality PE programs are suggested to focus only on a student's current fitness.

When attempting to conduct a control study of the impact MVPA has on academic achievement and behavior of middle school students it is important to determine the possible influences it has on the effectiveness of such factors as:

- students' ability to participate in aerobic exercise,
- attitudes of students and staff about an aerobic program,
- staff training and delivery of a more intensive PE program,
- student attendance and initial fitness levels, and

- whether or not the students participate in team sports.

Team sports participation, for example, has been found to have a positive association between physical activity and academic achievement, making it difficult to determine if a school's PE program is the true cause of the outcomes desired when this factor is not controlled for (Fox et al., 2010). For example, being a member of an athletic team may cause students to maintain better behavior in order to remain on the team. These factors are important to consider, particularly due to the limited number of reliable studies previously conducted on this topic. In Singh's (2012) meta-analysis of 10 observational and 4 intervention studies that looked at physical activity and student performance at school, their findings suggested a positive relationship between the two, however, their findings are limited because they did not look at research that utilized an objective measure of physical activity.

Although many middle schools have academic eligibility requirements to play team sports, they are usually not as stringent as those found at the high school level. In a study of 4,746 ethnically and socioeconomically diverse middle and high school students from 31 schools, Fox et al. (2010) sought to determine if sport team membership had an effect on academic achievement. It was found that the mean Grade Point Average (GPA) was significantly higher for middle school boys who participated on sports teams than for those that did not. Girls on middle school sport teams, however, did not have significantly higher GPA's than their middle school counterparts who were not members of a sport team. Both male and female high school students who were active members of sports teams had higher GPA's than their counterparts who were not members of sport teams. Unfortunately, these findings do not necessarily support the argument that

participation in intensive physical activity alone results in higher academic achievement. However, they do support the importance of the proposed study's need to account for the possible confounding influence of team membership.

Additionally, due to the strong association between MVPA and student achievement, as suggested by Coe et al. (2005), it can be difficult to identify the specific, individual factors that result in student achievement when investigating sport team participation and MVPA. What is difficult to determine is if the association is due to the participation in team sports, or because the students are involved in MVPA, which is usually the case in sports teams (Fox et al., 2010). In their study, Fox et al. (2010) found that MVPA and sport team participation combined (i.e. in the same regression analysis) showed an increase in academic achievement for middle school boys and girls. Conversely, there was no direct association found when looking at these causal variables separately. Looking at cross-sectional studies of the relationship between academic achievement and sport team participation, Trudeau and Shephard (2010) also concluded that although significant associations were found in various studies, causality could not be determined. Additionally, unlike the relationship between the covariate (i.e. sport team participation) and academic achievement and physical activity, socioeconomic status has been found to be a strong predictor of academic achievement for students involved in some form of physical activity.

An obvious connection could be made between sport team participation and fitness levels. As such, children athletes might be considered to be in better physical condition than those that are not athletes, or spend less time engaged in aerobic fitness. In a recent study that investigated the connection between physical fitness and academic

performance the researchers found a significant relationship between aerobic fitness levels and academic achievement for both boys and girls (Bass, Brown, Laurson, & Coleman, 2013). Utilizing a criterion-referenced test battery called FitnessGram, the researchers studied 838 middle school students in Illinois from a school having a 50% low-income rate. Their findings suggest that after controlling for socioeconomic standards and age, boys that met the FitnessGram standard for Healthy Fitness Zone (HFZ) for aerobic fitness were 2.5 to 3 times more likely to pass their standardized math and reading tests compared to boys that were not categorized as being in the HFZ for aerobic exercise. These students were in the Needs Improvement Zone (NIZ). Additionally, girls identified as being in the HFZ for aerobic fitness were 2 to 4 times more likely to pass the Illinois standardized math and reading tests than girls in the NIZ.

Bass et al.'s (2013) findings were found to support similar findings from Wittberg, Northrup, and Cottrell (2012) that suggest that aerobically fit children also have higher academic achievement levels than students not as fit. Bass et al (2013) also utilized FitnessGram to determine students' HFZ and the relationship between aerobic fitness and achievement on standardized tests. Wittberg et al. (2012) found that 5th and 7th grade students in the HFZ scored significantly higher on the WESTEST assessment used by West Virginia schools than did students in the NIZ as determined by the FitnessGram standards. Similar to studies by Bass et al. (2013) and Wittberg et al. (2012), the relationship between academic achievement on standardized math and English tests and fitness levels of elementary and middle school students were investigated by Chomitz et al. (2009). Although they too found statistically significant relationships between

fitness and academic achievement, they concluded that the direction of causality is difficult to determine.

Van Dusen, Kelder, Kohl, Ranjit, and Perry (2011) also conducted a non-randomized study to investigate the association of physical fitness and academic performance among middle and high school students that utilized FitnessGram test records to measure fitness levels of a large sample of students against standardized test scores. In their review of over 250,000 students in 13 Texas school districts, grade 3 to 11, they found that cardiovascular fitness was strongly associated with academic achievement, particularly for 7th - 10th grade students. Their findings suggest that grade-level was significantly associated with the relationship between fitness and academic performance. Utilizing six measures of fitness, (a) aerobic capacity, (b) BMI, (c) abdominal strength and endurance, (d) trunk extensor strength and flexibility, (e) upper body strength and endurance, and (f) flexibility, all fitness variables except for BMI were found to have a significant positive association with academic achievement.

Scheduling of Physical Activity

In a study that examined the effects of time-of-day of instruction on 8th-grade students' English and mathematics achievement, it was found that the schedule of instruction influenced student achievement (Davis, 1987). There was a statistically significant increase in achievement of eighth-grade students' English scores when they had class later in the day compared to the early morning. Because the current study will look at student achievement, and the effects that an MVPA PE program will have on the students' scores, it is important that the PE program schedule is consistent between intervention and control groups. Furthermore, Taras' (2005) meta-analysis of the

relationship between childhood physical activity and school performance found many studies suggesting short-term cognitive benefits of physical activity during the school day. Thus, in order to discount for time-of-day variances, the current study will focus on the MVPA immediately prior to the academic class being measured.

Implications and Rationale for the Present Study

The increase in sedentary behavior of today's youth has contributed to an increase in health issues and a decrease in fitness levels for children of all ages (Liese et al., 2013); particularly for minority middle school-aged children (Healthy People 2010; & Ogden & Carroll, 2010). A review of the literature has found numerous studies that support the need for increased rigor in school PE programs in order to address the health related issues associated with decreased fitness levels of the nation's youth (Brodersen et al., 2005; Centers for Disease Control and Prevention, 2011b; Coe et al., 2005; Fox et al., 2010). However, improved health is not the only possible outcome from being physically active.

It is important for children to take part in appropriate levels of physical activity during the school day. Physical activity levels vary, thus, there are varying degrees of student outcomes as a result according to much of the research (Centers for Disease Control and Prevention, 2011b). Although PE curricula that incorporates MVPA have been shown to produce positive results in student outcomes, there is much discrepancy among researchers about; (a) what constitutes adequate levels of physical activity, (b) how long and how often students should be engaged in the activity (Coe et al., 2005; Jarrett et al., 1998), (c) the length of time outcomes such as academic achievement and behavior are affected after participation in the physical activity (Taras, 2005), and (d) the

types of activities most effective for achieving the desired outcomes (Coe et al., 2005; Diamond & Lee, 2011; McKenzie et al., 2010).

Schools should continually evaluate the effectiveness of their PE programs, and not only look at the health benefits of appropriately implementing the PE curriculum, but should also look at the possible academic and behavioral outcomes, which have been found to have many positive results (Coe, Pivarnik, Womack, Reeves, & Malina, 2005; Jarrett et al., 1998). Specifically, the research suggests that taking part in frequent aerobic exercise can improve students' cognitive functioning, which has been found to improve academic performance and reduce negative behaviors (Diamond & Lee, 2011). However, as the research also suggests, effective PE programs must be implemented correctly and require students to be engaged in activity levels that are moderate-to-vigorous (Coe et al., 2005). Additionally, these activities should be enjoyable to the students in order to promote life-long fitness, and in some cases, short-term academic achievement and positive behavior outcomes (Diamond & Lee, 2011; Dishman et al., 1985; McKenzie et al., 2010). Thus, student attitudes about a PE activity are determinants of the effectiveness the curriculum, and can have an impact on short and long-term outcomes.

A frequent conclusion in the research is that team sport participation is a factor that makes determining a causal relationship between participation in physical activity at the middle/high school level and student academic performance levels and behavior very difficult (Coe et al., 2005; Fox et al., 2010; Trudeau & Shephard, 2010). It is not clear, but this may be one reason that research on the effects of a MVPA PE program on student achievement at the middle school level has remained so limited. For those studies that have investigated the effects of physical in PE taking into account participation in

team sports, few have investigated the roles of gender, race, educational program, and/or grade-level as mediators or moderators of effects or even as independent variables that should be controlled in a non-experimental study. Based on this understanding of the past research, I believe these factors are important to investigate with the aim of better understanding any associations they may have between the intervention and desired outcomes.

A thorough review of the literature on the relationship between physical activity and student achievement and behaviors has been an important factor in helping to guide the current study. After reviewing a plethora of studies it is clear that very few have been intervention studies with sufficient experimental or statistical controls to determine causality with confidence. Many, if not most, of the studies that have investigated the effects of physical activity on student achievement and/or behaviors were found to utilize historical data rather than prospective investigations that used randomization (Caterino & Polak, 1999; Diamond & Lee, 2011; Jarrett et al., 1998). Understandably, creating the conditions for the current study to determine causality has also limited this study's reliability (i.e. replication of results in other school settings) due to the very specific, controlled conditions put in place. Based on my review of past studies, the current investigation is designed to estimate the effects of an aerobic exercise program during PE on the academic achievement and behaviors of middle school students with a more rigorous methodology. It will employ a randomized design that seeks to ensure that the participants (treatment group) and nonparticipants (control group) do not differ in any significant way, measured or unmeasured) prior to the introduction of the more intensive physical activity in PE. In addition, my approach uses statistical controls for factors such

as sport team membership, student attitudes about the intervention, and prior fitness levels as well as examining whether the effects of physical activity vary with such student characteristics as gender, ethnicity, and grade level.

Chapter III: Method

Research Questions

The researcher for the current study was interested in the influence aerobic exercise has on the two dependent variables included in the study, as specifically discussed in the methods section. In addition to the treatment, there were six independent variables investigated for their effects on the dependent variables. Based on these variables, and within the context of NMS, this study sought to answer the following questions:

1. Does a PE program that utilizes MVPA influence academic achievement for students in their classes that immediately follow PE?
2. Does participation in a MVPA PE program decrease student classroom removals, which result from discipline in the classes that immediately follow gym?
3. Do the effects of a moderate-to-vigorous PE program vary by gender, race/ethnicity, grade level, and education classification on student's achievement and classroom removals?

Logic Model

A logic model has been included here to help the reader understand the program's processes related to their effect on academic achievement (see Figure 3) and the effect they have on the outcome variable behavior. In addition, inherent fitness, participation in team sports, and student attitudes were investigated to determine any possible effects they might have on the outcome variables. Although not listed as predictor variables, these inputs precede the treatment and need to be examined to determine if they influence how the treatment affects the students' amount of heart rate in target zone (Baron & Kenny,

1986). The activity is student participation in the more intense Wii aerobics PE program. Demographic factors such as gender, ethnicity, grade, and student classification are predictors that may affect the strength of the relationship between the outcomes that are academic success and classroom behavior. Other influences that may affect the outcomes could be a possible lack of support by stakeholders, school holidays and events, and professional development opportunities for staff members utilizing the program. A residual direct effect would indicate that the intervention affects the distal outcomes, regardless of the students' heart rate; thus, other factors not accounted for must exist (Donaldson, 2001).

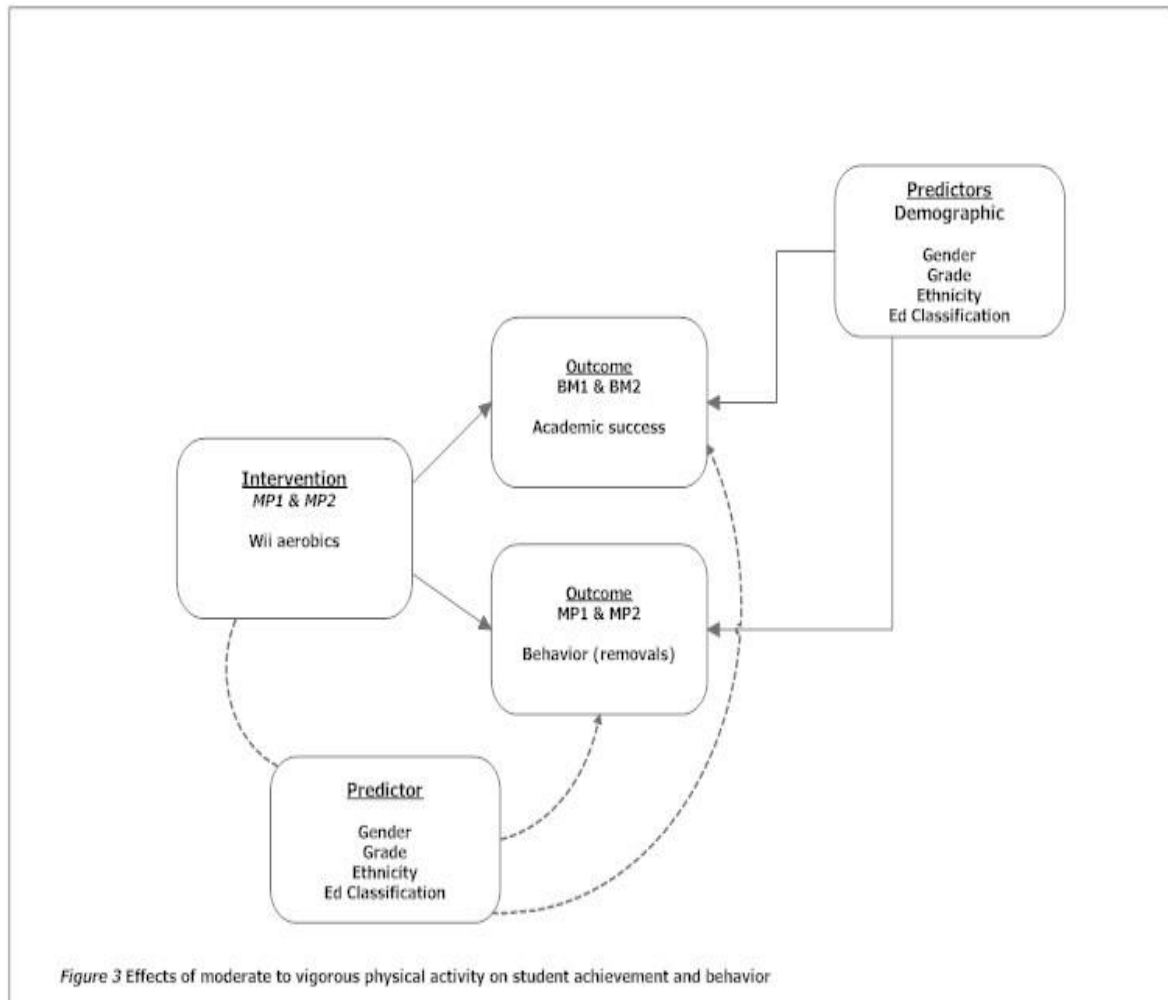
It is anticipated that consistent participation in the Wii aerobics classes provided by a well-trained PE instructor will enable the students to maintain their target heart rate zone for at least 20 minutes each session. This should ultimately result in a positive change in fitness levels. Additionally, the intensive activity is expected to improve academic achievement. The processes through which this occurs are: (a) increase in oxygen saturation and angiogenesis due to the PA, which leads to (b) an increase in neurotransmitters (e.g. serotonin), and (c) results in improved brain functioning (Basch, 2011a). Put in more simplistic terms, "Physical activity affects metabolism and all major body systems, exerting powerful positive influences on the brain and spinal cord and, consequently, on emotional stability, physical health, and ability to learn" (p. 627). Physical activity has been found to enhance brain functioning and produce cognitive and physiological benefits, particularly in the areas of language arts (Dishman, et al., 2006; Tremarche, Robinson, & Graham, 2007). The intense workouts such as Wii aerobics may also allow students to work off stress, resulting in improved student classroom behaviors.

The results of the current study will help guide the creation of evidence-based strategies for appropriate modification of the PE curriculum. Findings may also be used to help optimize the daily schedule's impacts on learning. If the findings show a significantly positive impact on students' academic achievement and behavior during the classes immediately following the aerobic exercise, then perhaps schools should review the possibilities of scheduling intensive PE classes prior to core academic classes. There is no evidence that indicates schools purposefully arrange PE classes in their schedules so that they occur prior to the four core subject areas. This is definitely not the case at NMS; PE classes are scheduled in a manner that provides relief for the content area teachers to have their prep, duty, professional learning community meeting, and lunch during the PE scheduled classes. These PE classes currently occur during blocks two, four, and five of a five-block day. It is understood that even if a purposeful schedule is proposed, which places PE prior to the core subject areas, it may not always be possible to implement because of the complexity of middle school schedules. As with any other sound research-based recommendation, implementation of changes will be dependent on resources and logistics.

Furthermore, in my own experience resonating with the literature, I have found that there is limited research that examines primarily urban middle school students; specifically, where gender, race, and sport team affiliation are all main effects or crucial factors in looking at the effects that intensive physical activity PE programs have on student achievement and behaviors.

Figure 3 illustrates the logic model for the current study. This model shows the predictor variables: gender, grade, race/ethnicity, and education classification as having possible

interaction effects on the outcome variables. Additionally, it illustrates the possible direct effects that a PE program incorporating MVPA will have on middle school students' academic achievement and classroom behaviors.



Pilot Study

During the 2011-2012 school year, a pilot program utilizing the Wii aerobics was conducted. Wii dance videos played on a large screen in the gym as students danced along, attempting to mimic the movements of the animated dancers in the dance videos. Students in grades seven and eight were randomly assigned to this program in place of their regular gym class for one of four marking periods. The PE teacher taught the

students how to calculate their target heart rate, and explained the importance of working within their target zone. Each student was provided a heart rate log that he or she was responsible for filling in three times during each class in order to ensure that students reached their target heart rate. To simplify the process of determining heart rate, Mio brand heart rate monitor watches were provided to each student during each class. These watches utilized an active heart rate wrist monitor technology (i.e. they work without the use of a chest strap).

The use of heart rate monitors during the pilot study provided the researcher an opportunity to determine the Wii games that best stimulate high aerobic activity levels among the students. Additionally, certain dance songs/games were identified as being most enjoyable to the students. During the pilot study, the PE teacher had an opportunity to address issues related to effective use of the heart rate monitors and the Wii system console and controllers. In some cases, it was found that special education students had difficulty recording the data and/or effectively following the videos' instructions. Consequently, all students were monitored for understanding and reporting accuracy, particularly the lower functioning special needs student. Additionally, some athletes (i.e. those on school or recreational sports teams) had difficulty reaching their target heart rate. As a result, only the more fast paced, enjoyable songs and videos were utilized in the current study. In addition, special needs students were also provided added personalized attention to ensure appropriate data collection and accuracy in following instructions.

The researcher of the pilot study, and the current investigative study, was also the middle school principal. Working closely with the guidance staff and PE teachers, the

principal/researcher was able to utilize material resources and historical student data that he was already authorized access use. Because the researcher had a thorough understanding of the PE staff, he was able to assign a PE teacher to teach the Wii PE program based on the understanding that this person was an avid proponent of aerobic fitness and dancing. Additionally, as the principal, it was evident to the researcher that the PE teacher selected to provide this intervention had a good rapport with her students.

Design

The current experimental study used a pretest-posttest control-group design with randomization (Gall, Gall, & Borg, 2010). This design provides a basis for valid estimates of the effects of the Wii PE program compared to the traditional PE program, without bias due to self-selection into the alternative types of PE. The study measured academic achievement and removals from class (disciplinary incidents) as the primary outcomes of interest. In addition, the study considered the effects of student background characteristics, the potential for heterogeneous effects by student background, and examined the quality of implementation of the PE programs.

Gender, ethnicity, classification, grade level, inherent fitness and attitudes are potential moderating factors that the students bring with them prior to the intervention, and could be related to the outcomes on their own. Although these inputs precede the treatment, they may still influence how the treatment affects the students' time with heart rate in their target zone. As students were randomly assigned to Wii or traditional PE, it was expected that no significant differences between groups on these variables would be found that would affect estimates of the treatment effect.

The activity is student participation in the more intense Wii aerobics PE program. Attendance and execution by instructor are both potential mediators of the program, and could have had a bidirectional effect with the Wii aerobic intervention. These variables however cannot be measured prior to treatment. Attendance data are relevant because poor attendance may negatively affect the results, and may hinder a valid evaluation of the quality and effectiveness of the program. More specifically, lack of consistent student attendance during the intervention may influence any possible effects of the intervention (Lamdin, 1996). Similarly, the PE teacher's content knowledge and lesson delivery of the program may have an impact on the expected outcomes. As a result, the researcher utilized the Danielson Model for teacher evaluations (Danielson, 2007), in addition to general walkthrough observations. During all observations of the PE teacher, she was found to be proficient (i.e. scoring at least a 3 on a 4-point evaluation rubric) in her lesson delivery, planning, creating an environment conducive to learning, and assessment of student achievement. This was an important factor to address because faulty execution of instruction by the teacher could have the potential to influence the level of student participation in the activity, thus, affecting the students' heart rates.

Participants

Students who participated in this study were from Neptune Middle School, located in Neptune Township, New Jersey. This urban community, with a population of approximately 30,000, is primarily residential and is one hour from New York City and Philadelphia (Alfone & Mooij, 2010). The students were selected utilizing the 7th and 8th-grade rosters of 499 students already assigned to one of four PE classes. They were

all provided an assent form to complete and a consent form for their parents to complete and sign (see Appendices B and C).

All students were then screened to see if they had written parental permission to participate in the study. Students that were given permission to participate were randomly assigned to treatment group one, treatment group two, or the control group.

Randomization was conducted by choosing every fourth student from an alpha list for each of the two grades. Utilizing marking period one and marking period two student rosters for the seventh and eighth graders, each student was listed in alphabetical order by grade. Students were selected to participate in the intervention during either the first or the second marking periods (MP1 or MP2); totaling approximately 256 student participants between both grade levels. The first sets of 32 students selected were assigned to treatment group one. The second sets of 32 students were assigned to treatment group two. There were two 7th-grade control and treatment groups, as well as two 8th-grade treatment and control groups during each of the two sessions. All students not selected for either of the two treatment groups remained in the regular PE classes and were considered the control group.

Treatment

Attendance and participation in the Wii aerobics PE class for one full marking period (i.e. 10 weeks) was required for all students in the treatment groups. Students in the treatment groups were coded with a “1” for treatment group one (i.e. first marking period), a “2” for treatment group two (i.e. second marking period), and those in the control group were coded with a “0” (see Table 2). Students in this PE program interacted

with various Wii dance games during a 72-minute PE class. As they danced, students were encouraged to move in unison in order to receive high game scores as a group/team.

Students in the intervention program monitored their heart rate consistently. Heart rate was used as an objective measure of aerobic exercise. These students wore heart rate monitor watches, and documented their heart rate at three equal intervals during each class. Students were provided breaks between songs to document their results.

Approximately every 10 minutes students took a quick break to chart their heart rate on their individual log sheets. At the conclusion of the marking period, the teacher collected all log sheets, determined each student's average heart rate, and reported these averages along with the student's target heart rate on a master log sheet.

Since this alternative PE program was developed to address a need for improved student physical conditioning and health, and academic and behavioral discipline through more intense physical activity, it was important to ensure that students were being physically challenged. This is the rationale behind the use of heart-rate monitors. As students participated in the aerobic dance while utilizing the Wii game console and various interactive dance games the students and teacher were able to monitor the level of exercise/effort students engaged in. The games selected were those found to be most effective at having students reach and maintain their target heart rate (i.e. Just Dance: Run the Show, Satisfaction, Apache, Pump It, Dogma, I Like It, and Black or White). In order to be considered aerobic exercise, the students were required to exercise at an intensity level that allows them to reach and maintain their identified target heart-rate zone for at least 20 minutes. Each student participated in the aerobics class every-other day for an entire marking period. Thus, students in the experimental and control groups

participated in PE five times during a two-week period, totaling 25 PE sessions over the marking period.

During the Wii PE program, all participants were actively engaged in the aerobic dance activity. Accordingly, greater than 75% of all participating students were found to be in their target heart rate zone for a minimum of 20 minutes during each of their Wii aerobics classes. Thus, most students participating in the intervention maintained either a moderate target heart rate of 103-145 bpm's, or a vigorous target heart rate of 145-176 bpm's for 20 consecutive minutes (Centers for Disease Control and Prevention, 2011a). This suggests that the treatment was appropriately implemented, allowing the goal of reaching an aerobic state to be met.

Having a treatment and control group provided an opportunity to evaluate how the treatment group would have performed had they not participated in the intensive PE program.

Students in the control group were provided the regular PE curriculum during the same time of day for 72 minutes as those in the treatment group. The control group participated in the general PE class, and was provided the current curriculum that consisting of various sports. These sports included soccer, golf, football, racquet sports, track, basketball, softball, tennis, volleyball, and floor hockey (Neptune Township School District, 2012). These activities did not require the students to be actively engaged for a minimum of 20 minutes. Nor did these activities include the requirement of reaching and maintaining a target heart rate. Consequently, many of the activities incorporate large percentage of *wait your turn* time.

Measures

Student Characteristics.

Two continuous variables, pre-assessment score and prior number of behavioral removals were examined to determine their effects on the outcome variables in both the treatment and control groups. Pre-assessment scores ranged from 0 to 100 for each of the content subjects of math, science, social studies, and language arts. These assessments were given to the entire student population during the first week of September. They were developed and used by each department in collaboration with the department supervisors, and mimic the final exam. Prior removals ranged from zero, or no removals, and had no set limit (see Table 2). Records of prior removals were obtained from the in-school suspension (ISS) database from the 2011-2012 school year (Alfone, 2012).

For the current study, six variables were investigated to determine their effects on the outcome academic achievement and the outcome behavior for both the intervention and control groups. There were three dichotomous variables: gender, grade, and education classification. Gender was coded with a “0” for female and a “1” for male. Grade was coded with a “0” for 7th grade and a “1” for 8th grade (see Table 1). Education classification was coded with a “0” for general ed., and special education students were coded with a “1”. For purposes of analysis, race/ethnicity was categorized as Black, White, and Hispanic. The variable *White* was utilized as the reference group for the analyses.

Table 2

Independent and Dependent Variables: Descriptive Statistics (N = 499)

Variables	Definition and Categories
Independent	
Grade	Participant's grade level during the 2012-2013 school year Coded (1) if in grade 8; if not, coded (0)
Gender	Participant's gender (1 = male, 0 = female)
Special Education	Participant's educational classification whereas any student with an IEP is classified as special education or SpEd. Coded (1) if SpEd; if not, coded (0) for regular ed.
Ethnicity	Participant's race (Black, White, Hispanic, Asian, Mexican) with White coded as the reference group
Pre-assessment	Participant's score on the the pre-assessment given in their respective content class that immediately follows PE. Class after PE (Math, Language Arts, Science, Social Studies) with Math coded as the reference group
Prior Removals	Number of times the participant was removed from class due to negative behavior during the 2011-2012 school year.
Dependent	
Achievement	Participant's score on their end of marking period benchmark assessment given in November 2012 (BM1) and January 2013 (BM2) for their respective content class that immediately follows PE.
Classroom Removals	Participant's total number of classroom discipline removals at the end of marking period 1 in November 2012 and marking period 2 in January 2013 from their respective content class that immediately follows PE.

Achievement and Classroom Behavior.

Student academic achievement was measured after the intervention using benchmark assessment data. The benchmark assessments for math, language arts, social studies, and science have been found to be valid predictors of the NJ ASK ($R^2 > .47$) from statistical measurements within the Link It software (LinkIt, n.d.). More specifically, NMS benchmark assessments for each of the core content areas have been found to predict achievement levels on the NJ ASK with greater than an 80% overall reliability rating. LinkIt (n.d.) utilizes the Kuder-Richardson Formula 20 (KR20) to determine the reliability of a test, which looks at the internal consistency of measurements with dichotomous choices (Warner, 2013). Accordingly, tests with a KR20 greater than .85 are considered to have great reliability. Tests with a KR20 between .70 and .85 are considered to have good reliability. Lastly, tests with a KR20 less than .70 are considered to have poor reliability. All subject area benchmarks for the 7th and 8th-grade received a KR20 score of .77 or greater; with math receiving an average score of .77, language arts had an average KR20 of .81, social studies had an average KR20 of .78, and science had an average KR20 of .83 (see Appendixes E, F, G, & H) .

The benchmark assessments are administered to the entire student population over a three-day period at the end of each marking period. They have been developed by each department and are identical within each subject area, across the individual grade levels. Each student's benchmark assessment utilizes a continuous variable that ranges from 0-100. All core-subject area benchmarks consist of 50 questions; 48 of which are multiple-choice and two are short-answer or essays. The assessments are recorded using bubble

sheets, and uploaded by the department chairperson into the Link It database for scoring and analysis (LinkIt, n.d.).

For the current study, benchmark data from the subject area class immediately following PE was collected. Each student had only one consistent subject area class (i.e. math, LAL, social studies, or science) that immediately followed their PE class. In each of these classes, the benchmark assessments utilized the same zero through 100 scoring rubric. These classes for the 7th grade students took place during block four of the school day. The 8th grade students had these classes during block three.

Although meticulous efforts were made by the researchers to gather complete data for all students, achievement data for benchmark assessments had a few missing cases. There was one missing case for math, two missing cases for LAL, and three missing cases for science. As is typical with the collection of longitudinal data in an educational setting, attrition tends to occur to some extent (Barry, 2005). However, because the characteristics of those cases that dropped out of the study, or failed to participate in their benchmark assessment, were representative of those that remained in the study, the external validity of the study was not weakened. Consequently, the small number of attrition cases (i.e. 6 cases out of 127) is not expected to have decreased the power of the findings.

Behavioral measures included the review of discipline records prior to treatment. These records are generated and are maintained by the ISS teacher. The ISS teacher logs the frequency and period of each behavioral incident for every student that is removed from class due to negative behavior. When a student is removed from class due to discipline, the teacher must follow up with a disciplinary referral, indicating the incident

that led to the removal and the classroom management techniques they used to address the behavior prior to the removal. This requirement sets a guideline for determining that the level of discipline was extreme enough to warrant removal. At the conclusion of each of the 10-week programs, discipline reports were again collected and compared against the baseline reports. For the purpose of this study, only classroom removal data from the class that immediately followed PE was investigated, and these continuous variables were recorded; whereas a value of zero represented no discipline removals. Again, short-term outcomes were investigated because prior research has shown that such effects are to be expected (Jarrett et al., 1998). As with the benchmark assessment data, discipline removals were collected for the seventh grade students for their block four class, and the same was done with the 8th-grade students during for their block three class.

All student data was collected and input into an Excel spreadsheet for both treatment and control groups during each of the two 10-week sessions. Students in the study were assigned ID numbers. Student ID's were recorded and stored on my personal, password protected computer. Any references to behavioral or academic outcomes of students during data collection were associated with the students' ID only. To address these objectives the researcher examined the effects of a moderate-to-vigorous PE program, using Wii dance videos, on academic achievement and behavior of NMS's 7th and 8th-grade students.

Data Analysis

The first step in data analysis was to produce descriptive statistics on the sample and compare the treatment and control groups to evaluate the randomization. Groups were compared on initial characteristics based on means and percentages using t-tests and

chi-square tests, as appropriate. Based on the analyses decisions were made about how to proceed in estimating program effects. Additionally, information collected on attitudes toward dancing, prior levels of physical activity, team sport participation, and comfort with dancing in front of peers were analyzed using descriptive statistics. Using a Likert-type scale, self-reflective surveys were administered by the PE teacher on the first day of class to all students prior to their participation in the intervention in order to gauge their inherent fitness levels and attitudes about the intervention they were about to participate in (see Appendix A).

If students are favorably predisposed to this type of program then they are likely to participate as desired. However, if they are not, unenthusiastic participants could limit the effectiveness of the intervention (Martin, 2008). Motivation and engagement are vital to student achievement, and can be affected by various factors such as socio-demographic status, gender, and age (Martin, 2008). In addition, students' weight and height were recorded for all students enrolled in the school during the first week of school in September. This information was utilized to calculate the students' BMI using the formula $[\text{weight (lb)} / (\text{height (in)} \times \text{height (in)}) \times 703]$ (Centers for Disease Control and Prevention, n.d.).

Analyses to estimate the effects of Wii PE compared to the traditional PE class were conducted for two outcomes. The first was academic achievement. The analyses are designed to assess whether the Wii intervention group had greater gains in achievement over the marking period during which they participated in Wii compared to the traditional PE control group, and to estimate the size of the average gain. The second was the number of students removed from the class immediately following PE during the

concurrent marking period. Using regression analysis, I estimated the differences between treatment and control groups for the outcome variable measuring academic achievement while controlling for differences due to other independent variables. Additionally, regression analysis was used to determine if differences in these other independent variables can help to explain possible heterogeneity in the effects of Wii on the outcome variables. More specifically, regression analysis was used to determine the degree to which the six student background characteristic variables interact with treatment in influencing academic achievement and behavior (Warner, 2013).

I employed an Ordinary Least Square (OLS) regression model to address the first research question of whether a moderate-to-vigorous PE program influences student's academic achievement. This model was used because of its ability to minimize the sum of squared prediction errors, thus, making the errors in predicting the outcome (Y) as small as possible (Warner, 2013). The model for the current study is as follows:

$$Y_i = \beta_0 + \beta_1(Wii) + \beta_2(\text{Pre-assessemnt}) + \beta_3(\text{Race/Ethnicity}) + \beta_4(\text{Male}) + \beta_5 (\text{Special education}) + \beta_6(8^{\text{th}} \text{ grade}) + \varepsilon_i$$

Y_i is the test score of children i . β_1 is the effects of intervention Wii PE program, after controlling for a vector of controls for student background characteristics. β_2 represents the expected change in achievement associated with a unit increase in Pre-assessment. β_3 represents the expected difference in achievement between White (reference group) versus Black, Hispanic and Asian students. β_4 represents the expected difference in achievement between Male and Female (reference group) students. B_5 represents the expected difference in achievement between students in General education

(reference group) and Special education. β_6 represents the expected difference in achievement between students in 7th (reference group) and 8th grades. Analyses for the main effect and the subgroups of gender, education classification, grade levels, and race/ethnicity were conducted separately. While conducting the separate analyses for (a) Math, (b) LAL, (c) Science, and (d) Social Studies we controlled for pre-test scores and child background characteristics.

Poisson regression was employed to address the second research question of whether participation in this type of moderate-to-vigorous PE program helps to decrease student discipline related to classroom removals. Since the outcome measure variable Y is a count variable that reflects the number of classroom removals, it was necessary to use Poisson regression, which is a Generalized Linear Model (GLM) with Poisson distribution error structure and the natural log (ln) link function (Agresti, 2007). The Poisson regression technique is a well-suited model to account for the skewness and the limited variability of the dependent variable. This method modeled the log of the probability of a classroom removal outcome as a linear function of the PE program and other sets of covariates. The Poisson regression model can be depicted as follows:

$$\begin{aligned} \text{Log}_e(\text{classroom removal}) = & \beta_0 + \beta_1(\text{Wii}) + \beta_2(\text{prior removals}) + \beta_3(\text{Race/Ethnicity}) + \\ & \beta_4(\text{Male}) + \beta_5(\text{Special education}) + \beta_6(8^{\text{th}} \text{ grade}) + \beta_7(\text{LAL Class}) + \beta_8(\text{Science Class}) + \\ & \beta_9(\text{Social Study Class}) \end{aligned}$$

The outcome variable is the number of classroom removals for children i. β_1 is the expected difference in log count between intervention and control group. β_2 represents the

expected increase in log count for a one-unit increase in prior class removals. β_3 represents the expected difference in log count for differences between Black, Hispanic, Asian, Other and White (reference group). β_4 represents the expected difference in log count between Male and Female (reference group). β_5 represents the expected difference in log count between 7th graders (reference group) and 8th graders. $\beta_7, \beta_8, \beta_9$ represent the expected log counts of LAL, Science and Social Study classes versus Math class (reference group), respectively.

Chapter IV: Findings

This study is primarily designed to help the NMS administration determine if a more rigorous PE curriculum could aid in improving academic achievement and reducing high number of student classroom removals that currently exists amongst their student population. An increase in student achievement and a decrease in classroom removals for those students participating in a moderate-to-vigorous PE program were the expected outcomes of the study based on prior research and my theoretical model. This analysis of the Wii intervention addressed the following three questions:

(a) Does a moderate-to-vigorous PE program influence academic achievement for students in their math, social studies, language arts, or science class that immediately follows PE during the marking period they participate in the Wii intervention;

(b) Does participation in a moderate-to-vigorous PE program influence student discipline related to classroom removals in those same classes that immediately follow PE; and

(c) Do the effects of a moderate-to-vigorous PE program vary by gender, race/ethnicity, grade level, and education classification in terms of effects on student achievement and classroom removals?

It was important to determine students' attitudes about dancing, and understanding their level of participation in physical activity (i.e. fitness levels) prior to the intervention in order to understand if these factors might have had an impact on the outcomes. Based on survey results, 81% of the students in the intervention group believed their initial fitness level was very low to medium. Interestingly, 73% of the students taking the survey also indicated that they exercise three or more times per week,

and greater than half (i.e. 54%) indicated they play a team sport. Survey results also indicated that 67% of the students in the intervention group stated they are comfortable dancing in front of their peers, and 59% indicated that they had high to very high attitudes about dance. It is important to note, only students participating in the intervention were asked to complete the surveys due to the nature of the questions. Thus, results are only indicative for those students. More specific survey ratings for student self-reported attitudes, fitness levels, and team sport membership are shown in Table 3.

Table 3

Descriptive Statistics for Treatment and Control Groups

Variables	Mean (SD)		
	Full sample	7 th grade	8 th grade
BMI	22.7427 (5.176)	22.348 (5.075)	23.148 (5.262)
Fitness belief	2.5275 (1.090)	2.263 (.955)	2.742 (1.151)
Team sport	.535 (.501)	.5438 (.503)	.5285 (.503)
Attitude about dance	2.724 (1.088)	2.754 (1.169)	2.7 (1.026)
Comfort with dance	2.7952 (.894)	2.649 (.855)	2.914 (.913)

These findings suggest that the majority of students participating in the Wii aerobics were not overly negative about dancing or predisposed to not wanting to dance, or refusing to participate in dance activities in front of their peers. Furthermore, based on student self-reports, a large percentage of students were involved in some form of exercise more than two times per week. However, with an even larger percentage of

students expressing that their starting fitness level was not considered high, it is believed that it would not have been too difficult for the students participating in the Wii aerobics to reach their target heart rate due to effort. Alternatively, with approximately half (i.e. 54%) of the students playing team sports, there is not too much concern that a disproportionate number of students would have difficulty reaching their target heart rate due to the exercise being too easy. Students' BMI is also shown in Table 3. With an average BMI of 22.7 students in both, control and treatment groups, were not considered obese on average. As such, greater than 84% of the student population was not found to be obese. However, these findings do not indicate the number or percentage of students that may have been overweight.

Treatment group one (T1) participated in the intervention during the first marking period (i.e. from September through mid-November). There were 129 seventh and 8th-grade students in this group. Although it was assumed that a reliable and valid process was utilized for randomly selecting participants for this study's treatment groups one and two, there were statistically significant differences between treatment and control groups as determined by t-tests and chi-square tests. Both analyses were used to verify whether the characteristics and achievement of children varied between treatment and control group. As seen in Table 4, treatment group one compared to the control group had statistically significant differences in the number of special education student participants based on chi-square analysis. There were considerably fewer special education students in treatment group one. In addition, scores on the previous year's NJ ASK math and language arts assessments were significantly lower for the students in the control group compared to those in treatment group one. Additionally, t-test analysis revealed that

scores on the pre-assessment were found to be significantly lower for students in the control group compared to those in treatment group one.

Table 4

Frequency Distribution for Treatment (MPI) & Control Group

Variables	Treatment Group (N = 129)		Control Group (N = 243)		Difference
	Mean	SD	Mean	SD	
Pre-assessment					
Math	49.917	15.545	42.407	16.423	**
LAL	58.208	17.956	53.136	17.424	
Science	40.778	12.284	40.415	15.171	
Social Studies	42	13.220	29.788	11.535	***
	N	%	N	%	
Black	78	60.47	161	66.26	
Hispanic	16	12.40	30	12.35	
Asian	5	3.88	5	2.06	
Male	56	43.41	140	57.61	***
8 th Grade	69	53.49	112	46.09	
Special Ed	8	6.20	44	18.11	***

*** p<0.01, ** p<0.05, * p<0.1

The differences that existed between treatment group one, treatment group two and the control group went beyond student characteristics. Achievement scores and classroom behavior outcomes at the end of the first marking period may have been impacted by the occurrence of Superstorm Sandy that hit the Jersey Shore on October 29, 2012. Neptune, like many other neighboring towns suffered severe storm damage, had many of its residences displaced, and had its schools close for multiple days because of

building damage and/or inaccessibility of local roads. Because these events occurred during marking period one, and not marking period two, these disruptions in the home and school environment and schedules created a possible unexpected difference among treatment groups one and two in terms of end-of-marking period benchmark scores and discipline removal totals. It is not clear to what extent the students may have been more distressed and/or off-task during the end of the first marking period, which may have had a negative effect on their performance and behavior.

Based on t-test and chi-square analyses it was further found that treatment group two was not significantly different from the population, except for gender. It is unclear why this difference occurred, and it is possible that it is simply by chance, and not maturation or other conditions. The two groups are statistically indistinguishable with respect to achievement test scores, ethnicity, grade level, and special education placement. The frequency distribution of student characteristics for treatment group two and control group are found in Table 5. As seen in this table, student characteristic variables were not significantly different, except for males in the control group compared to the treatment group, which was not extremely different.

Table 5

Frequency Distribution for Treatment (MP2) & Control Group

Variables	Treatment Group 2 (N = 127)		Control Group (N = 243)		Difference
	Mean	SD	Mean	SD	
Pre-assessment					
Math	43.28	16.875	42.406	16.423	
LAL	56.1276	18.535	53.136	17.424	
Science	49.5384	18.888	40.415	15.171	
Social Studies	32.5	9.402	29.788	11.535	
	N	%	N	%	
Black	75	59.06	161	66.26	
Hispanic	16	12.60	30	12.35	
Asian	3	2.36	5	2.06	
Male	52	40.94	140	57.61	***
8 th Grade	70	55.12	112	46.09	
Special Ed	23	18.11	44	18.11	

*** p<0.01, ** p<0.05, * p<0.1

However, these differences in gender were further investigated by separating the sample by grade. As seen in Table 6, no differences were found with the 7th-grade because of the split. Splitting the sample by grade, however, did show differences for the 8th-grade (see Table 7). These differences, as previously stated, are not enough to bring into question the randomization of the sample chosen.

Table 6

Frequency Distribution for Treatment (MP2) & Control Groups for 7th Graders

Variables	Treatment Group (N =57)		Control Group (N =131)		Difference
Pre-assessment	Mean	SD	Mean	SD	
Math	36.190	14.590	43.956	16.713	
LAL	57.882	15.074	52.186	15.262	
Science	52.2	20.692	45.905	17.149	
Social Studies	37.625	9.531	35.8	10.421	
	N	%	N	%	
Black	37	30.83	83	69.17	
Hispanic	7	25.93	20	74.07	
Asian	0	0	5	100.00	
Male	24	25.53	70	74.47	
Special Ed	11	35.48	20	64.52	

** p<0.01, * p<0.05

Table 7

Frequency Distribution for Treatment (MP2) & Control Groups for 8th Graders

Variables	Treatment Group (N = 70)		Control Group (N = 112)		Difference
	Mean	SD	Mean	SD	
Pre-assessment					
Math	48.4137	16.773	40.707	16.133	
LAL	55.133	20.414	54.2105	19.743	
Science	40.6666	7.767	34.65	10.328	
Social Studies	27.375	6.209	20.538	5.471	*
	N	%	N	%	
Black	38	32.76	78	67.24	*
Hispanic	9	47.37	10	52.63	
Asian	3	100.00	0	0	*
Male	28	28.57	70	71.43	**
Special Ed	12	33.33	24	66.67	

** p<0.01, * p<0.05

There were 127 seventh and 8th-grade students in treatment group two (T2), which took place from mid-November through the end of January. Control group students, those receiving the regular PE curriculum, did not participate in the Wii during the first or second marking periods. Students were randomly assigned to the treatment group using a computer generated scheduling program (i.e. PowerSchool). All students from the regular PE classes were possible candidates for selection. Selection each marking period utilized a mutually exclusive selection process in order to allow for new student participants in the study each marking period that have not already been part of

the treatment group. Using randomization should have allowed the study to establish equivalent groups that provided greater confidence that the difference between Wii and traditional PE was the true cause of any observed differences in outcomes (Rossi, Lipsey, & Freeman, 2004).

The results of the analyses cast doubt on the randomization process. Although the researcher has not been able to identify specific problems with randomization, the initial differences between T1 and Control groups were deemed sufficiently large that T1 is not used. T2 is comparable, and analyses not only control for gender but estimate effect separately for girls and boys thereby eliminating any possible effects of the incidental difference between groups with respect to gender.

Effect of Wii on Achievement

Table 8 presents estimates of the effects of Wii on students' achievement in Math, LAL, Science, and Social Studies after controlling for student's characteristics. The analyses did not indicate any significant effects of the Wii intervention on student achievement after controlling for student background characteristics. Furthermore, separate analyses for each subgroup based on gender, education classification, grade level, and race/ethnicity were conducted to investigate their possible interactions with the Wii PE program. However, the analyses failed to find any significant effects on student achievement. As results did not differ from those of the main effects analysis these additional analyses are not reported in detail.

In terms of the relationship between student's characteristics and posttest scores, students' with higher pre-test scores had significantly higher posttest scores, except for social studies (though the estimated effect of pre-test was essentially the same size as in

other subjects). Furthermore, special education students scored 10 points lower in math, 7 points lower in LAL, and 12 points lower in science, all significantly lower, compared to the general education students. Black students had significantly lower scores in science compared to their White counterparts. Lastly, 8th-grade student scores are significantly lower in LAL than the 7th-grade reference group, but as these are not the same exams this should not be interpreted as meaning that the 8th grade students do worse in LAL, but only as an adjustment in scores for comparability across grades.

Table 8

Regression Analysis Estimating Effects of Wii on Students' Achievements

Variables	Math (se)	LAL (se)	Science (se)	Social Studies (se)
Wii PE program	1.955 (2.795)	1.140 (1.956)	-0.653 (5.201)	-2.201 (5.819)
Pre test score	0.664*** (0.091)	0.550*** (0.0630)	0.455*** (0.168)	0.521 (0.323)
Black	-3.858 (3.474)	-3.318 (2.343)	-10.93* (5.762)	-6.902 (7.032)
Hispanic	-6.357 (4.893)	-1.443 (3.420)	-8.625 (8.482)	-5.686 (8.583)
Asian	-9.834 (8.203)	4.082 (7.509)	-7.684 (11.66)	
Male	2.844 (2.721)	-1.930 (1.912)	-1.077 (4.452)	1.427 (5.374)
Special education	-10.56*** (3.777)	-7.133** (3.198)	-12.98** (5.284)	-6.819 (6.850)
8 th grade	-3.855 (2.661)	4.021** (1.950)	0.694 (4.900)	-9.023 (7.004)
Constant	33.03*** (6.226)	42.96*** (4.741)	58.82*** (10.12)	62.66*** (14.21)
Observations	136	126	53	49

*** p<0.01, ** p<0.05, * p<0.1

Effect of Wii on Removals

I examined the effects of Wii on classroom removals after controlling for prior classroom removals and other student characteristics. These results are reported in Table 9. As hypothesized, the Wii program was found to significantly reduce removals compared to the traditional PE. The estimated effect of the Wii PE program on student removals from class was (0.21, $p < .05$). This translates into a 19% reduction in classroom removals associated with participation in the Wii PE program.

All of the student characteristics measured prior to treatment had independent effects on classroom removals. As shown in Table 9, Black students (1.436, $p < .01$) and Hispanic students (0.875, $p < .01$) were more likely to be removed from the classroom compared to White children. In addition, there was a higher rate of classroom removals for students in special education (0.356, $p < .01$). There was also one significant difference (0.409, $p < .01$) between subject area class after PE, showing that students in the social studies class showed a higher rate of classroom removals compared to math class. As expected, a significant difference (0.530, $p < .01$) was found between male and female students, with males having a higher rate of classroom removals than females. Additionally, grade level also suggest a significant difference between grade levels (0.236, $p < .01$), with 8th grade students receiving a higher rate of classroom removals than 7th graders. Finally, prior classroom removals due to disruptive behavior was found to be significantly associated (0.092, $p < .01$) with later removals.

Table 9

Poisson Regression Analysis Estimating Effects of Wii on Classroom Removal

Variables	Coefficients (se)
Wii PE program	-0.209** (0.093)
Prior classroom removals	0.050*** (0.00217)
Black	1.436*** (0.194)
Hispanic	0.875*** (0.237)
Asian	-14.34 (858.7)
Male	0.530*** (0.087)
Special education	0.356*** (0.089)
8 th grade	0.236*** (0.078)
LAL class	0.084 (0.097)
Science class	0.086 (0.112)
Social Study class	0.409*** (0.113)
Constant	-1.552*** (0.210)
Observations	370

*** p<0.01, ** p<0.05, * p<0.1

In view of the strong differences in removals associated with differences in various background characteristics, the analysis was extended to estimate effects

separately for each race/ethnic group, gender, education classification, grade level, and subject area class after gym. This allowed me to investigate whether there was any significant varying effect of the Wii PE program across these subgroups.

Effects of Wii on Removals by Black, Hispanic, and White students

Next, I examined the effects of Wii on classroom removals by race/ethnicity while having controlled for prior classroom removals and other student characteristics (see Table 10). The findings suggest that Wii PE program resulted in a significant reduction in classroom removals compared to the traditional PE. I found a significant effect (-0.270 , $p < .01$) on reducing classroom removals for Black children, which translates into a 24% reduction in classroom removals for Black students compared to those in the control group. However, no significant effect of the Wii PE program on reducing classroom removals was found for White or Hispanic children. Thus, the Wii intervention appears to be more advantageous for the Black population of students at NMS. Analysis for the Asian population was not conducted or included in these findings due to the small sample size.

Table 10 also shows separate estimates of the Wii PE program effects on student classroom removals by race and ethnicity as measured prior to treatment. Prior classroom removals were found to be significantly associated with later removals for Black (0.045 , $p < .01$), White (0.595 , $p < .01$), and Hispanic (0.170 , $p < .01$) students. The findings also suggest a significant difference between Black (0.384 , $p < .01$) and White (-2.427 , $p < .01$) student removals based on educational program, with Black special education students having a higher rate of removals than the general education students do. Additionally, White special education students actually received fewer classroom removals than did the

general education students. Hispanic special education students on the other hand did not demonstrate statistically different classroom removals compared to the general education Hispanic students.

Table 10

Poisson Regression Analysis Estimating Effects of Wii on Classroom Removal by Race/Ethnicity

Variables	<u>Black</u> (se)	<u>White</u> (se)	<u>Hispanic</u> (se)
Wii PE program	-0.270*** (0.099)	0.192 (0.524)	-0.227 (0.641)
Prior classroom removals	0.046*** (0.002)	0.595*** (0.089)	0.170*** (0.041)
Male	0.365*** (0.091)	1.095* (0.624)	0.396 (0.665)
Special education	0.384*** (0.092)	-2.427*** (0.805)	0.198 (0.914)
8 th grade	0.138* (0.082)	1.301* (0.735)	0.032 (0.752)
LAL class	0.157 (0.101)	-1.518** (0.632)	0.603 (0.638)
Science class	0.127 (0.116)	-0.346 (0.678)	-16.80 (4.023)
Social Study class	0.334*** (0.125)	-15.37 (1.990)	-1.112 (0.688)
Constant	0.095 (0.117)	-3.001*** (0.781)	-1.717** (0.743)
Observations	236	80	46

*** p<0.01, ** p<0.05, * p<0.1

Effects of Wii on Removals by Gender

The effects of Wii on classroom removals by gender were investigated. After controlling for prior removals and other student characteristics, results indicate that there was a significant reduction (.314, $P < .01$) in removals for males that participated in the treatment compared to those in the traditional PE classes (see Table 11). However, no significant effect was found for Female students even when controlling for prior classroom removals and other student characteristics. This effect of the Wii program for Male students translates into a 27% reduction in classroom removals between students who had participated in the Wii PE program compared to those students in the regular PE program.

Table 11 also presents the independent effects the Wii PE program on classroom removals for Male and Female. As shown, female 8th graders (-0.496, $p < .01$) were less likely to be removed from class, while male 8th-graders (.637, $p < .01$) were actually more likely to be removed compared to the 7th-graders. Looking at race/ethnicity, Black female (1.906, $p < .01$) and male students (1.190, $p < .01$) showed significantly higher rates of classroom removals compared to their White counterparts. On the other hand, Female Hispanic students were not found to differ significantly in the number of classroom removals compared to White (Female) students, while Male Hispanic students (.908, $p < .01$) showed higher rates of classroom removals compared to the White (Male) students. Furthermore, special education students showed higher rates of classroom removals for both female (0.506, $p < .01$) and male students (0.260, $p < .01$) compared to those in the general education program. There was also one significant difference (0.792, $p < .01$) between subject area class after PE, showing that female students in the social

studies class showed a higher rate of classroom removals compared to those in math class. Lastly, prior classroom removals due to disruptive behavior was found to be significantly associated with later removals for both Female (0.1478, $p < .01$) and Male students (0.060, $p < .01$).

Table 11

Poisson Regression Analysis Estimating Effects of Wii on Classroom Removal by Gender

Variables	<u>Female</u> (se)	<u>Male</u> (se)
Wii	-0.166 (0.143)	-0.314** (0.125)
Prior classroom removals	0.048*** (0.003)	0.060*** (0.004)
Black	1.906*** (0.366)	1.190*** (0.230)
Hispanic	0.352 (0.503)	0.908*** (0.280)
Asian	-13.74 (1.156)	-12.22 (435.3)
Special education	0.506** (0.198)	0.260** (0.105)
8 th grade	-0.496*** (0.145)	0.637*** (0.103)
LAL class	-0.073 (0.188)	0.030 (0.113)
Science class	-0.050 (0.213)	-0.078 (0.143)
Social Study class	0.792*** (0.167)	0.196 (0.167)
Constant	-1.607*** (0.374)	-1.054*** (0.244)
Observations	178	192

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Effects of Wii PE on Removals by Educational Program Type

Examination of the effects of Wii PE on classroom removals by educational program indicates a significant effect for students in the general education program ($-0.214, p < 0.1$), but not for those in special education, after controlling for prior classroom removals and other student characteristics. The results are reported in Table 12.

Accordingly, general education students that participated in the Wii PE program had a 20% reduction in classroom removals compared to those students in the control group. Although this effect ($-0.214, p < 0.1$) was not statistically significant at the .05 level ($p = .06$), this is still suggestive evidence that the differences are greater for students in the regular education classroom.

Separate estimates of the effects of the Wii PE program on students' number of classroom removals by educational program type. As can be seen in Table 8, Black students in both general education ($1.427, p < .01$) and special education ($1.226, p < .01$) showed a higher rate of classroom removals compared to the White students. The same is true for Hispanic students ($0.868, p < .01$), but only for those in the general education program. A significant difference in classroom removals was also found for male general education students ($0.576, p < .01$) compared to female general education students, conversely, no significant difference was found among those same students in special education. However, it must be taken into account when interpreting the findings that the sample size for students in special education is relatively small. Grade level was found to have an effect on classroom removals for the special education group, with 8th grade students ($1.643, p < .01$) receiving a higher rate of classroom removals than 7th-graders. Again, there were significant differences between subject area class after PE, showing

that both general (0.513, $p < .01$) and special education students (0.494, $p < .05$) in the social studies class showed a higher rate of classroom removals compared to those in math class. As has been consistently found, prior classroom removals due to disruptive behavior was once again significantly associated with later removals; this time for both the general (0.052, $p < .01$) and special education (0.034, $p < .01$) student groups.

Table 12

Poisson Regression Analysis Estimating Effects of Wii on Classroom Removal by Program

Variables	<u>General education</u> (se)	<u>Special education</u> (se)
Wii	-0.214* (0.118)	-0.122 (0.163)
Prior classroom removals	0.052*** (0.002)	0.034*** (0.008)
Black	1.427*** (0.223)	1.226*** (0.396)
Hispanic	0.868*** (0.263)	0.224 (0.644)
Asian	-14.32 (822.8)	
Male	0.576*** (0.098)	0.132 (0.182)
8 th grade	-0.151 (0.094)	1.643*** (0.209)
LAL class	0.051 (0.114)	-0.237 (0.195)
Science class	0.185 (0.143)	-0.100 (0.192)
Social study class	0.513*** (0.133)	0.494** (0.250)
Constant	-1.437*** (0.242)	-1.484*** (0.438)
Observations	303	67

*** p<0.01, ** p<0.05, * p<0.1

Effects of Wii on Removals by Grade Level

Table 13 presents the result of separate analyses of the Wii PE program on classroom removals for each grade level. Accordingly, the findings suggest that the Wii PE program had a significantly reduced classroom removals for 8th-graders (.247, $p<.01$), while no significant difference was found for 7th-graders. This finding suggests that the participation in the Wii PE program reduced the classroom removals of 8th grade students by 22% compared to those in the control group.

In terms of race, 7th grade Black students (1.962, $p<.01$) and 8th grade Black students (1.023, $p<.01$) showed higher rates of classroom removals compared to White students from the same grades. For Hispanic students, only the 8th-graders were found to show higher rates of classroom removals (0.867, $p<.01$) compared to other 8th grade White students. Male 8th grade students were also found to show higher rates of classroom removals (0.867, $p<.01$) when compared to 8th grade Females. Significant differences were also found for subject area class after PE, with social studies class showing significantly more removals for 7th (0.581, $p<.01$) and 8th grade students (0.642, $p<.01$) compared to those grade level students in math class. Finally, while 7th grade special education students showed lower rates of classroom removals (-0.745, $p<.01$) compared to the general education students, 8th grade special education students were found to show higher rates of classroom removals (0.808, $p<.01$). Prior classroom removals due to disruptive behavior was found to be significantly associated with later classroom removals for both 7th (0.061, $p<.01$) and 8th grade students (0.046, $p<.01$).

Table 13

Poisson Regression Analysis Estimating Effects of Wii on Classroom Removal by Grade Level

Variables	7 th Grade (se)	8 th Grade (se)
Wii	-0.221 (0.149)	-0.247** (0.122)
Prior classroom removals	0.061*** (0.004)	0.047*** (0.003)
Black	1.962*** (0.388)	1.023*** (0.228)
Hispanic	0.355 (0.518)	0.867*** (0.277)
Asian	-13.19 (739.3)	-12.63 (694.3)
Male	-0.051 (0.121)	0.867*** (0.128)
Special education	-0.745*** (0.205)	0.808*** (0.112)
LAL class	0.107 (0.147)	-0.202 (0.134)
Science class	0.035 (0.182)	-0.027 (0.151)
Social Study class	0.581*** (0.196)	0.642*** (0.147)
Constant	-1.665*** (0.396)	-1.246*** (0.248)
Observations	188	182

*** p<0.01, ** p<0.05, * p<0.1

Figure 4 provides an overview of the main effect of the Wii PE program on reducing classroom removals compared to the control group, and the effects of this program based on student characteristics. The first bar represents the main effect of the Wii PE program. As shown, there is a 19% reduction in classroom removals for those

students that participated in the Wii PE program when controlling for prior classroom removals and other student characteristics, thus, supporting the hypothesis of the program's effectiveness. In addition, you can see that there was found to be a greater than 20% reduction in classroom removals for the background characteristics Black, male, general education, and 8th grade students, with males having the greatest benefit from participating in an aerobic PE fitness program.

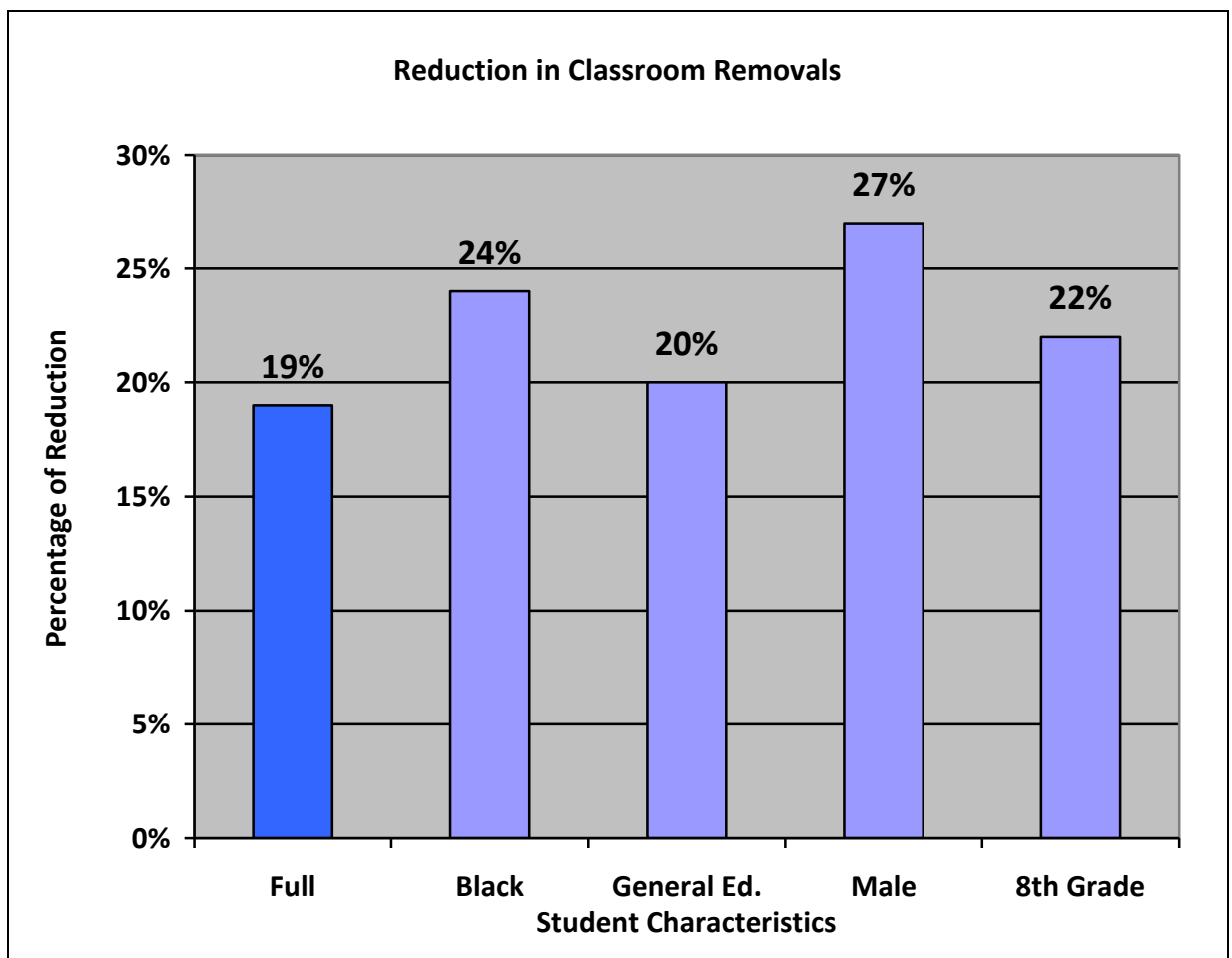


Figure 4. Percentage of reduction in student classroom removals after participation in the Wii PE program.

Chapter V: Discussion

Through direct observations and extensive research, the health and fitness benefits of physical activity for children young and old have been found to be numerous (Caterino & Polak, 1999; Centers for Disease Control and Prevention, 2011a; Fleschner, 2000; Singh, 2012; Taras, 2005). In today's modern society of social interaction via texting, tweeting, chatting on Facebook, or even communicating through videogame consoles, children find themselves spending less time being physically active when not in school. This sedentary behavior has created health concerns for the nation's youth, particularly the Black and Hispanic children who have been found to have the highest rates of obesity (Ogden & Carroll, 2010). Consequently, having children engage in physical activity at school through PE classes is an important tool for improving students' health. Having a PE program that encourages lifelong activities for improving health and well-being can be a testament to the effectiveness of the schools PE program. Looking beyond the health benefits of physical activity for middle school students, other positive outcomes such as academic achievement and student behavior continue to be studied, however, the results have been inconsistent (Coe et al., 2005; Fox et al., 2010; Shepard, 1996; Strong et al., 2005).

The purpose of this study was to determine if an aerobic exercise program during PE could have positive outcomes on academic achievement and behaviors of NMS students. This is particularly important because the students and administration of NMS are continually faced with issues of low academic achievement and disruptive, off-task classroom behavior. NMS has numerous behavior modification and academic enrichment programs already in place to help the students. However, many of the minority students

still struggle to reach academic benchmarks set by the state (New Jersey Department of Education, 2011). Additionally, despite the use of various behavior modification programs, many of these students continue to elicit negative classroom behaviors that result in their removal from class and loss of instructional time. Thus, the utilization of additional programs to address and reduce negative student behaviors and improve academic achievement is warranted at NMS.

Implementation of the Wii PE program at NMS was successful in part because the study design had virtually no pushback from the students or parents. The likely reason for this was due to the prior positive feedback from students during the pilot study, and because student participation was strictly voluntary. Parents were asked to sign permission slips in order for their child to participate. A large percentage of parents (i.e. 79%) willingly agreed to allow their child to take part in the study. Whereas only 107 (21%) of the parents indicated that they did not agree to give permission for their child's participation. Consequently, these students remained in the regular PE class, and were part of the control group.

As suggested by Taras' (2005) meta-analysis that looked at the relationship between childhood physical activity and school performance, various studies concluded that there were short-term cognitive benefits of physical activity when conducted at certain times during the school day. Consequently, the current study focused on the math, LAL, science, and social studies classes that students were in immediately following their participation in the regular PE class (i.e. control group) or the Wii PE program (i.e. intervention group). Although time-of-day of instruction did not equate to academic achievement gains for students participating in aerobic exercise immediately prior to their

academic classes, as was found in other studies (Davis, 1987), the current study's findings do lend support for the scheduling of PE to take place immediately prior to the classes more prone to problem behaviors among the students. This recommendation supports the findings of other researchers that have suggested there is a significant association between vigorous physical activity and a reduction in inappropriate classroom and out of school behavior (Kirkcaldy, Shephard, & Siefen, 2002).

Subramaniam and Silverman (2007) investigated 995 Midwest middle school students' attitudes toward PE. Responding to a 20 question attitudinal survey, students in the 6th, 7th, and 8th-grade were all found to have relatively positive attitudes toward PE. However, the findings suggested that as students got older their attitudes about PE became less positive. It was determined that by the time the students reached the 8th-grade they became bored with the activities and the repetition of the activities year after year led to negative attitudes about the PE program in general. This was a significant reason why the current study utilized the Wii gaming console and dance games to promote aerobic activity. The popularity of this gaming system and its array of aerobic dance videos in recent years make this program a useful physical activity tool for keeping PE enjoyable and cutting edge (Wii, n.d.). The positive student self-reported responses and behavioral outcomes support this choice in programs.

Many studies have investigated the effects of physical activity on academic performance (Coe et al., 2005; Fox et al., 2010; Shephard, 1996; Strong et al., 2005). Some studies (Bass, Brown, Laurson, & Coleman, 2013; Coe et al., 2005; Centers for Disease Control and Prevention, 2011a; U.S. Department of Health and Human Service, 2010) have even investigated the effects of the physical activity based on the level of

intensity of the activity. Results from these studies vary, with some findings suggesting that student participation in MVPA improves academic achievement for those students. Other studies (Fox et al., 2010; Trudeau, & Shephard, 2010) however, failed to find a direct causal relationship.

This study extends past research by looking at both academic and behavior outcomes independently. A strength of the current study was the randomization of middle school students into treatment and control groups without bias, rather than just relying on historical data to investigate the association that MVPA has on achievement and behavior. Based on these factors, significant findings from this study are able to suggest causality. Additionally, the current study attempted to control for factors such as sport team participation, attitudes and enjoyment of the intervention, and student characteristics; many of which were found to be limitations in past studies (Chomitz, 2009; Dishman, Sallis, & Orenstein, 1985; Wittberg, Northrup, & Cottrell, (2012) .

The current investigation was unable to find an association between participation in a MVPA PE program and short-term academic improvement. This could be contributed to the amount of time the students spent engaged in the MVPA. Coe et al. (2006) suggested that perhaps greater than 20 minutes of participation in the MVPA is needed to influence short-term academic achievement. Based on the findings from various studies (Bass et al., 2013; Singh, 2012; Wittberg et al., 2012), it is reasonable to conclude that long-term achievement gains would result from increased student fitness through continuous participation in a MVPA PE program. However, a single 10-week marking period is not long enough to see these results. Heightened fitness level, rather than just participating in a MVPA, has been found to be a better predictor of academic

achievement of students (Chomitz, 2009; Van Dusen, 2011). Perhaps the students in the current study were not provided enough time to increase their overall fitness levels.

With a significantly positive main effect of the Wii PE program on student behaviors, as measured by a reduction in classroom removals for Black, General education, male, and 8th-grade students, it can be concluded that this program was useful for the NMS community. The data suggest that effects of a middle school MVPA PE program are most important for some groups than others, as can be seen in Figure 5.

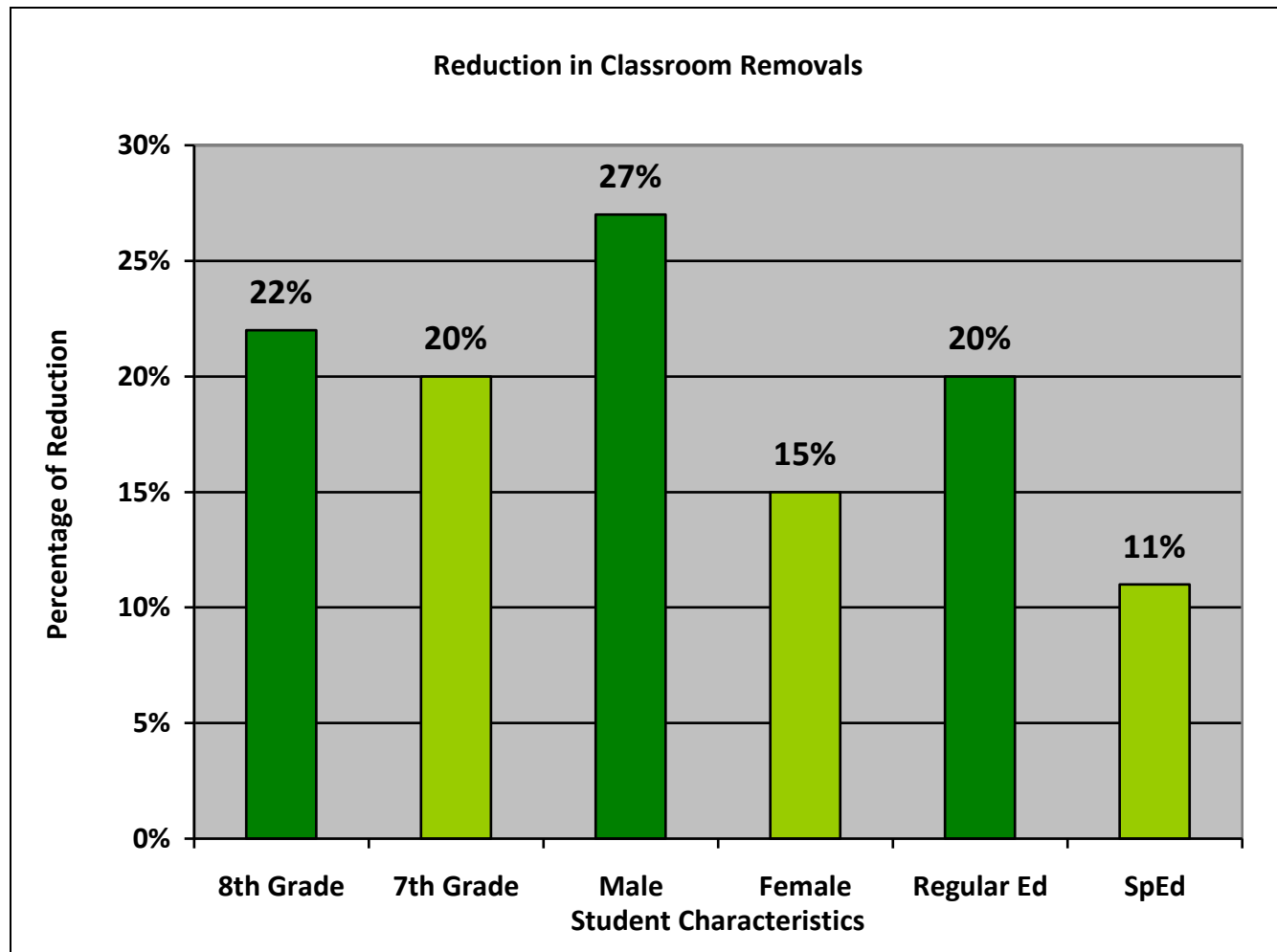


Figure 5. Percentage of reduction in student classroom removals for grade, gender, and educational program after participation in the Wii PE program. Whereas, the darker bars represent various levels of statistical significance and the lighter bars do not.

Whereas the estimated effects of the MVPA were to reduce classroom removals for all of the different groups, there were no negative effects for these groups, however, positive effects were found for all. It appears that a MVPA PE program is particularly beneficial to minority males, which is not surprising, given they are more likely to be removed (Alfone, 2012; Losen & Skiba, 2010). Likewise, the effects of a MVPA PE program may be less helpful in reducing discipline removals for the special needs population when controlling for other student characteristics. This however might have been contributed to the small sample size.

Interestingly though was the lack of significant effect the Wii program had on the White and Hispanic populations. This perhaps was due to the small sample of students in this subgroup. However, with a reduction in student classroom removals equal to 24% for Black and 27% for male as a direct result of participation in the aerobic fitness program prior to the content class, this study has effectively addressed a pressing need for NMS's minority male population. NMS's issue with high levels of discipline for its Black male population is consistent across the country's urban districts (Losen & Skiba, 2010). However, although not statistically significant, it is unclear why there was an increase in discipline related classroom removals for the White students, but not minorities, after participating in MVPA (see Figure 6). It is hoped that the results of the current study can be replicated in an effort to aid schools in keeping this population of students in class and learning, rather than allowing them the ability to be disruptive and removed due to a lack of innovative techniques for addressing this recalcitrant problem.

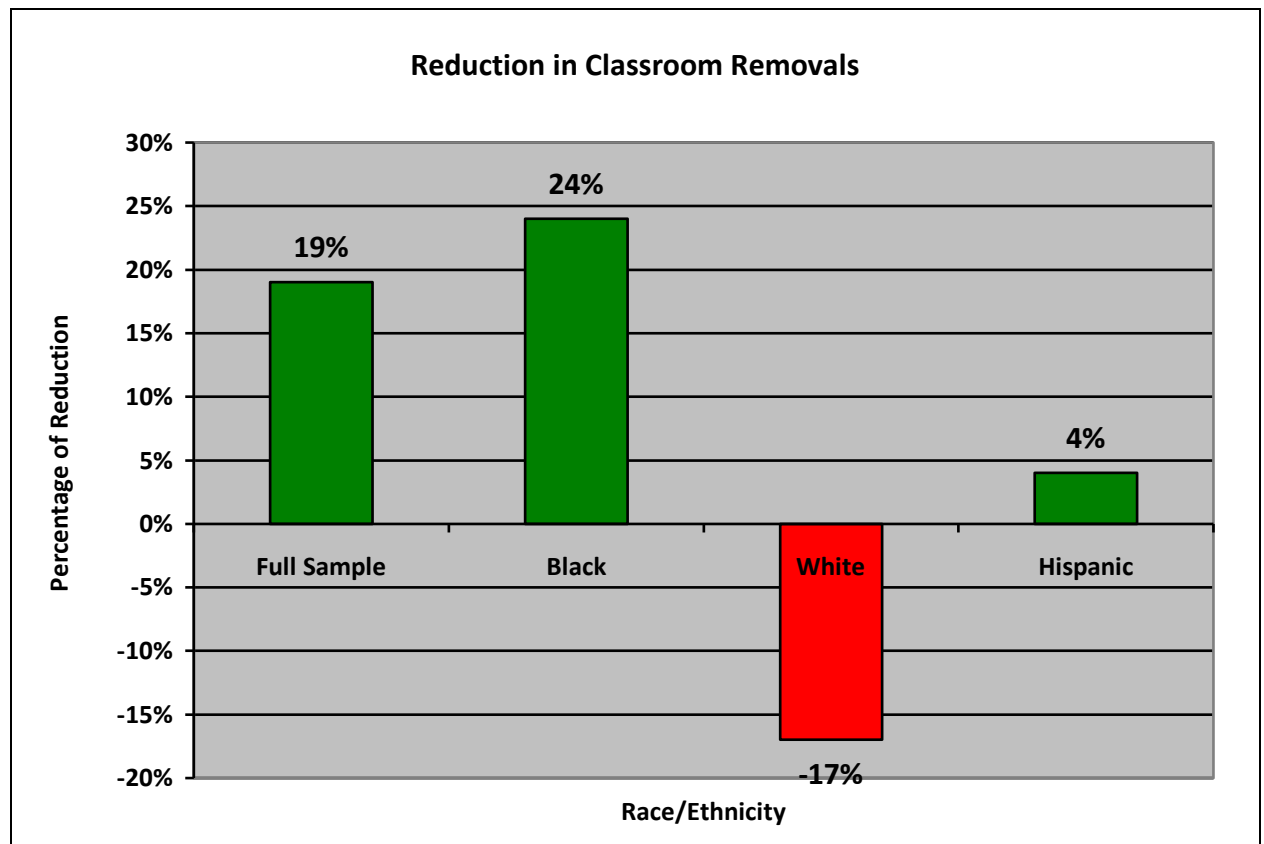


Figure 6. Percentage of reduction and increase in student classroom removals for race/ethnicity after participation in the Wii PE program.

A PE program such as the current study's Wii aerobics may not demonstrate a significant direct effect on students' academic achievement; however, results from the current study suggest it had a significant positive effect on student behaviors as measured by the reduction in classroom removals. One study that looked at the relationship between academics and problem behaviors found a significant interaction between academic scores and students' negative behaviors, as indicated by discipline referrals (McIntosh, Flannery, Sugai, Braun, & Cochrane, 2008). The researchers' findings suggest that 8th-grade discipline has a significant effect on those students' academic scores when they attend 9th-grade. The current study's findings suggest that 8th-grade students participating in a Wii PE program will have a 22% reduction in classroom

removals. These findings are encouraging for the academic success of these students as they transition to Neptune High School.

This study further extends past research examining the short-term effects MVPA has on student behaviors by not only defining the particular activity utilized, but also by ensuring through strict measurement practices that each student was individually responsible for reaching an aerobic level as defined by the CDC (Centers for Disease Control and Prevention, 2011a). One study that investigated students' unstructured physical activity and the effects it had on their classroom behaviors was able to suggest that boys' behaviors significantly improved as a result of being physically active (Jarrett et al., 1998). However, unlike the current study, the physical activity level was not measured for intensity, and more importantly, the activity occurred during the academic class, resulting in an interruption of the instructional time; limiting the study's ability to generalize. The current study utilized PE class time to provide the physical activity. A significant effect of the MVPA was still found. Student classroom removals due to disruptive behaviors were found to decrease significantly because of participation in the Wii PE program. Thus, these findings suggest that interruption of instructional time is not a sole determinant of the effects of physical activity on student behaviors.

Vigorous exercise has been found to be significantly associated with reducing the levels of certain forms of childhood depression (Prasad, St-Hilaire, Wong, Peterson, & Loftin, 2009). Ninth and tenth-grade students that exercise regularly were found to have lower scores on the *Children's Depression Inventory* (Kovacs, 1992). This is important to note because boys that experience certain forms of depression have been found to elicit more disruptive, off-task behaviors when faced with stressful events in and outside the

classroom (Leadbeater, Blatt, & Quinlan, 1995). Findings from the current study do not attempt to suggest that NMS students who took part in the intervention suffered from depression, however, the high rate of negative behaviors found to exist at the school may be the result of factors unclear, or difficult to address head-on by school staff. Thus, the ability to have a PE program that offers vigorous exercise, which may aid with even the smallest number of discipline cases related to a child's depression, is advantageous.

Turning once again to achievement outcomes, the current study might have found significant effects of the Wii PE program on student achievement if the measures also included the students' affective behaviors such as self-esteem and levels of depression (Prasad et al., 2009). Additionally, the current study did not take into account student eating habits, or the time of day that they ate lunch. Research on these variables has found a strong relationship (Basch, 2011b), and has established that academics do improve for students that eat a nutritious breakfast lunch within a specific timeframe prior to the academic class. Results of a study conducted by Sigfusdottir, Kristjansson, and Allegrante (2006) with 5,810 junior high school students in Iceland found that BMI levels, eating habits, self-esteem, and levels of depression were all significantly related to academic achievement when investigating their interactions with each other. Apparently, the children that engaged in healthy behaviors such as regularly exercising and eating nutritious foods, and had a more positive outlook on life were more likely to have better academic achievement and mental health than those students that did not. However, within the limitations of the current study (i.e. time) these variables were not controlled for or monitored.

With about half (54%) of the students that participated in the Wii PE program also playing team sports, as indicated by student responses on the pre-intervention surveys, any association between the intervention and academic achievement would have been valid measures since the current study utilized an objective measure of physical activity. In studies that found a positive associations between physical activity and academic achievement, the researchers also found that improved academic performance might have been more related to physical activity of team sport participation (Fox et al., 2010) and socioeconomic status (Coe et al., 2005) rather than just physical activity in gym class. In the current study, the random balance of the number of students playing team sports, and those that did not, provided the researchers an opportunity for reliably assessing the Wii PE program's effects, rather than the possible overwhelming outside influence of the relationship between team sport membership and athletic eligibility requirements. As Fox et al. (2010) suggests, these requirements can be the defining catalyst for students to perform well in class. Unfortunately, students' socioeconomic status was not controlled for in the current study.

Students' attitude about dancing, particularly doing so in front of their peers, was assessed in the current study through self-response surveys. This researcher felt that it was important to know if the students would actually enjoy the Wii PE program as an alternative to their regular gym class. The feedback from the students was rather positive, with 59% of the students indicating that they had high to very-high attitudes about dancing. A limiting predictability factor of the association between physical activity and student behaviors that was suggested by other researchers was students' enjoyment of the activity they engaged in (Brodersen, Steptoe, Williamson, & Wardle, 2005). They

concluded any association found between physical activity and student sedentary behavior for middle school aged children was limited due to a lack of knowledge about the participants' attitudes about the physical activity they engaged in. Consequently, this is not a limiting factor of the current study.

Limitations

Although this study extends past research, there are limitations that warrant attention for future studies. First, this study focused on students only from NMS. Thus, the results may not be generalizable to other schools with differing demographic factor groups, particularly for schools with higher White and Hispanic student populations. As a whole, NMS students have demonstrated difficulty meeting proficiency levels on the NJ ASK. In past years, the school failed to make annual yearly progress, and now struggles to meet progress targets, now called "annual measurable objectives" (AMOs) set by the New Jersey Department of Education (2013). Perhaps schools that have differing achievement levels and frequencies of disruptive behavior might benefit more, or even be hindered, by the effects of vigorous physical activity in the PE classes.

Second, influences by the students' parents were not measured for their effect on student outcomes. Perhaps those students whose parents agreed to have their child participate in the research project were more astute and accepting of educational research. Their possible differing parental involvement, compared to the parents that refused to give permission, may have provided more support for the students to succeed throughout the year and improve on any possible behavioral issues. Future research looking to replicate the current study may have great difficulty in determining the parents' influence on academic and behavioral outcomes; however, it is worth considering.

Third, the measure of student attitudes was conducted through student self-reports on pre-intervention surveys. Research has found cases where students' self-reported data were discrepant from measured findings when the information reported was perceived as unfavorable (Brener, McManus, Galuska, Lowry, & Wechsler, 2003). This is particularly true if the students possess unwarranted concerns of the teacher/investigator's knowledge about their responses on the surveys. It is therefore recommended that future research investigating student attitudes about a potential class they are in, or might have in the future, utilize an online survey collection system in order to provide the students confidence of their anonymity. Finally, other specific PE programs that would also require students to be engaged in MVPA were not utilized in conjunction with the Wii PE program. Therefore, research that allows for varying program choices might enable causal inferences to be drawn.

Recommendations

The Wii PE program itself was a fitness program that was utilized to spark student interest and encourage them to become highly active in the physical activity. However, a PE curriculum that is to include MVPA does not need to limit itself to this exact program. A PE program that supports a high level of fitness, while also utilizing the aspects of teamwork should be the goal of NMS's curriculum. Based on the positive behavioral outcomes resulting from this intervention, other demographically similar schools would likely benefit if their PE curriculum supported a MVPA program that is considered aerobic in nature, and aligned in their daily schedule where it is most beneficial. According to the CDC (2011b), these programs could consist of swimming laps, jogging or running, cycling (fast), singles tennis, dancing, or basketball to name a few. The CDC

also suggests that a rule of thumb is, “1 minute of vigorous-intensity activity is about the same as 2 minutes of moderate-intensity activity.” Thus, PE programs should require students to double the time engaged if they are participating in the following moderate-intensity activities during gym class: fast walking, water aerobics, cycling at a relaxing pace, or playing doubles tennis.

Within the context of physical activity in the school setting, the rigor of the PE curriculum is an important area of attention for the CDC, policymakers, school administrators, and parents that believe schools have the greatest impact on students’ academic and health outcomes. Schools that can provide an effective PE curriculum that address these needs with success should be studied, and other schools should look to replicate these programs. With a majority Black population in an urban school district, NMS is faced with the need to evaluate the current PE curriculum to ensure that the students are engaged in MVPA on a regular basis. This type of curriculum will not only positively address the obesity epidemic that continues to plague the nation’s primarily poor minority adolescent population (Ogden & Carroll, 2010); it can also help in reducing short-term classroom behaviors that result in removals and loss of instructional time. Using an effective program evaluation, schools should look to determining if their PE programs engage their students in 20 minutes or more of MVPA at least three times per week. Additionally, capitalizing on the positive effects of this type of curriculum, NMS and other middle schools might consider scheduling PE class at the end of the day for their self-contained special needs population, and prior to the content area classes for all educational program groups.

Future research on this topic might benefit from providing the students with differing programs to achieve moderate-to-vigorous levels of physical activity so the researchers could compare their effects. It is important however to keep in mind that meeting the requirements of the curriculum may create limiting factors. For example, NMS's curriculum requires that golf, softball, floor hockey, and badminton be addressed for a set number of days/weeks throughout the year. These activities do not require high levels of intensive student participation for an extended amount of time. Therefore, moderate-to-vigorous PE programs can be limited by the need to address all areas of the curriculum. This is particularly difficult in districts that have not recently updated their curriculums to meet the goals set by Healthy People 2020 (2013). Their 10-year national objectives for improving the health of all Americans include a recommendation of a 1.8% gain, from 18.4% in 2009 to 20.2% in 2020, in the number of adolescents meeting the physical activity guidelines for aerobic physical activity. Future researchers looking to build upon the current study are encouraged to investigate the curriculum's alignment to these newer established goals at the onset of their investigation.

Appendix A

Student Physical Education Survey (ver. 1.1)

1. I can run at least ____ minutes without getting tired:

- ☐ 1 to 5 minutes
☐ 5 to 10 minutes
☐ 10 to 30 minutes
☐ 30 to 60 minutes
☐ greater than 1 hour

2. What grade are you in?

- ☐ 7th grade
☐ 8th grade

3. Exercise is extremely important to me

Where 1= Strongly disagree; 2= Disagree; 3= Agree; 4= Strongly agree

1	2	3	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. On a weekly basis I usually exercise at least ____ times per week:

- ☐ One
☐ Two
☐ Three
☐ Four
☐ Five or more

5. What do you most often do for exercise?

- ☐ Basketball
☐ Walk
☐ Run
☐ Hike
☐ Swim
☐ Dance
☐ Aerobics
☐ Cycle (bike)

Other (please specify)

6. Do you play team sports such as: soccer, basketball, softball, wrestling, baseball, track, field hockey, swimming, or lacrosse?

- ☐ Yes
☐ No

7. If you answered "yes" to question 6 are you currently playing a team sport?

- ☐ Yes
☐ No

8. Do you feel you get too much exercise, too little exercise, or about the right amount of exercise?

- ☐ Much too much
☐ Somewhat too much
☐ Slightly too much
☐ About the right amount
☐ Slightly too little
☐ Somewhat too little
☐ Much too little

9. I love to dance

	1	2	3	4
Where 1= Strongly disagree; 2= Disagree; 3= Agree; 4= Strongly agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. I am very good at using video dance programs such as "Dance Dance Revolution" and "Just Dance"

	1	2	3	4
Where 1= Strongly disagree; 2= Disagree; 3= Agree; 4= Strongly agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. I am comfortable dancing in front of my classmates:

	1	2	3	4
Where 1= Strongly disagree; 2= Disagree; 3= Agree; 4= Strongly agree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. Your name?

Appendix B

ASSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Investigator: Mr. Mark Alfone

Rutgers University

Study Title: Academic and Behavioral Effects of Aerobic Exercise on Middle School Students

This assent form may contain words that you do not understand. Your teacher or I will read it to you as you read along. Please ask the researcher or your parent or teacher to explain any words or information that you do not clearly understand before signing this document.

1. Mr. Alfone is inviting you to take part in his research study. Why is this study being done?

The purpose of this study is to see if participation in high-intensity physical activity improves academic and behavioral performance of middle school students. It is expected that approximately 200-240 middle school students will take part in this study. Mr. Alfone and the physical education teacher(s) are authorized to do this type of research as part of their job in Neptune Middle School.

2. What will happen?

Some students will be asked to take part in the Wii aerobic fitness class each day they have gym, for one marking period. If you participate in the Wii aerobics class, you will monitor your heart rate periodically and chart your progress. You will be provided breaks between songs to document your results on a chart. I will monitor your academic and behavioral performance in the classes immediately following your physical education class. With your permission indicated below, you can begin the Wii aerobics sessions. Your parent will also need to give their permission.

3. What does it cost and how much does it pay?

There is no cost to you for participating in this study and you will not be paid for your participation.

4. There are very few risks in taking part in this research, but the following things could happen:

Nothing bad would happen. Your teacher will provide breaks during each session to minimize any discomfort that you may have.

5. Are there any benefits that you or others will get out of being in this study?

All research must have some potential benefit either directly to those that take part in it or potentially to others through the knowledge gained. A direct benefit to you may be your physical conditioning and improved health. You may also gain knowledge as to how participation in physical activity affects your academic performance and behavior. The knowledge gained through this study may allow me to develop more effective student schedules that optimize the benefits of physical education classes within the school day (i.e. helps us make better student schedules).

It is your choice!

Both you and your parents have to agree to allow you to take part in this study. If you choose not to take part in this study, I will honor that choice. No one will get angry or upset with you if you do not want to do this. If you agree to take part in it and then you change your mind later, that is OK too. It is your choice!

6. **CONFIDENTIALITY: I will do everything I can to protect the confidentiality of your records.** If I write professional articles about this research, they will never say your name or anything that could give away who you are. I will do a good job at keeping all our records secret by following the rules made for researchers.
7. Do you have any questions? If you have any questions or worries regarding this study, or if any problems come up, you may call or visit the principal investigator Mr. Mark Alfone at: 732.776.2000 ext. 6018, Neptune Middle School.

You may also ask questions or talk about any worries to the Institutional Review Board (a committee that reviews research studies in order to protect those who participate).

Please contact the IRB Administrator at Rutgers University at:
Rutgers University, the State University of New Jersey
Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559
Tel: 848.932.0150
Email: humansubjects@orsp.rutgers.edu

Your parent or guardian will also be asked if they wish for you to participate in this study. You will be given a copy of this form for your records.

Please sign below if you assent (that means you agree) to participate in this study.

Signature Date

Name (Please print): _____

Investigator's Signature: _____ Date: _____

Appendix C

RESEARCH SUBJECT INFORMATION AND PARENTAL CONSENT FORM

TITLE: Academic and Behavioral Effects of Aerobic Exercise on Middle School Students

INVESTIGATOR: Mark K. Alfone, Ed.D. Candidate

This consent form may contain words that you do not understand. Please ask the study staff to explain any words or information that you do not clearly understand. You may discuss with family or friends before making your decision.

PURPOSE AND DESCRIPTION OF THE STUDY:

The purpose of this study is to examine the effects of moderate to high-intensity physical activity on academic and behavioral performance of 200 to 240 middle school students. As part of their gym class, some students will take part in Wii fitness aerobic dance and others, in a control group, will be provided traditional physical education curriculum activities. Your child will be given an identification number, and he or she will not be identified by name. If you decide for your child to be in this research study, you will be asked to sign this consent form. Your child will be asked to give his or her assent to participate in the research. If you decide for your child to be in this research study, your child will be asked monitor their heart rate periodically and chart their progress. Students will be provided breaks between songs to document their results on a chart. I will monitor the participants' academic and behavioral performance in the classes immediately following their physical education class. The 72-minute gym classes will take place over a 10-week marking period. All Neptune Middle School students have 72-minute gym classes, five times over a two-week period for 10 weeks. In addition, Mr. Alfone will provide your child with a survey to measure their pre-existing attitude, knowledge, and beliefs toward an aerobic dance fitness program. Mr. Alfone will also review your child's school record to collect demographic and behavior information such as, achievement test scores, ethnicity, gender, and discipline infractions. Furthermore, Mr. Alfone is authorized to do this research as part of his job at Neptune Middle School.

RISKS AND DISCOMFORTS

There are no foreseeable risks to participate in this study. You will be made aware of any significant new findings that may change your decision to remain in this study. *Your child's performance in this study will not be used to assess his/her intelligence, compare him/her with other students, affect his/her grades, not affect his/her standing in school.*

BENEFITS

You have been told that the benefits of taking part in this study may be improved physical conditioning and health. Participants may also gain knowledge as to how participation in physical activity affects their academic performance and behavior. The knowledge gained through this study may allow me to develop more effective student schedules that optimize the benefits of physical education classes within the school day.

CONFIDENTIALITY

This research is confidential. Confidential means that the research records will include some information about your child, such as test scores, demographic information, etc. I will keep this information confidential by limiting individual's access to the research data and keeping it in a secure location. All the student data from this study will be destroyed on or before August 1, 2013. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated, unless you have agreed otherwise.

VOLUNTARY PARTICIPATION AND WITHDRAWAL

Your consent for your child's participation in this study is voluntary. You may decide for your child not to participate in this study. If you decide your child may be in the study, your child may withdraw from the study at any time with no penalty of any kind.

Initial Here _____

QUESTIONS

In the future, you may have questions about your child's study participation. If you have any questions, contact:

Mr. Mark Alfone, Principal
Neptune Middle School
2300 Heck Avenue
Neptune, NJ 07753
Email: mkalfone@neptune.k12.nj.us
Tel: 732.776.2000 ext. 6018

If you have any questions about your rights as a research subject, you may contact the IRB Administrator at Rutgers University at:

Rutgers University Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza
New Brunswick, NJ 08901-8559
Tel: 848.932.0150
Email: humansubject@orsp.rutgers.edu

Do not sign this consent form unless you have had a chance to ask questions and have received satisfactory answers to all of your questions.

CONSENT

Your child will also be asked if they wish to participate in this study. You will be given a copy of this consent form for your records. Please sign below if you agree to allow your child to participate in this research study.

Name of Child

Parent of Legal Guardian (name printed)

Parent of Legal Guardian signature

Date

Investigator signature

Date

Appendix D

Timeline

Date	Measure/Procedure	Individual Involved
9/10/12	Pre-assessment of all students	All content teachers
9/11/12	Consent/Assent forms given out	PE teachers
9/14/12	Assignment of (1 st MP) students to Wii PE class	Lead investigator & guidance counselors
9/14/12	Pre-intervention survey	PE Teacher
9/17/12	Develop tool to measure time-on-task	Lead investigator
9/20/12	Obtain weight & height data for students in the intervention program	Lead investigator & school nurse
11/1/12	Quarterly benchmark assessment	All content teachers
11/2/12	Post-intervention survey	PE Teachers
11/12/12	Assignment of (2 nd MP) students to Wii PE class & Pre-intervention survey	Lead investigator & guidance counselors- & - PE Teacher
11/19/12	Obtain weight & height data for students in the intervention program	Lead investigator & school nurse
1/22/13	Quarterly benchmark assessment	All content teachers
1/23/12	Post-intervention survey	PE Teacher
1/31/13	Collect discipline reports for all students	Lead investigator & VP

Appendix E

Summary

Grade	Subject	Test Name	# of Test Results	Mean Score	Standard Deviation	KR20	Questions to Review
6	Language Arts	Grade 6 ELA Pre-Assessment	293	49%	17%	0.85	9, 18
6	Language Arts	6th Q1 Nov9	291	56%	16%	0.80	
6	Language Arts	6th Grade Midterm January 2013	293	66%	17%	0.80	
7	Language Arts	Grade 7 ELA Pre-Assessment	282	53%	14%	0.81	20, 24, 39, 46
7	Language Arts	Grade 7 ELA Q1	277	53%	15%	0.78	30
7	Language Arts	Grade 7 ELA Q2	280	66%	18%	0.83	
8	Language Arts	Grade 8 ELA Pre-Assessment	281	52%	20%	0.90	
8	Language Arts	Q1 Assessment - 8th Grade ELA	285	55%	17%	0.81	
8	Language Arts	Q2 Assessment - 8th Grade ELA	290	73%	14%	0.74	7

Tests included in this analysis:

- 1) Have more than 40 results,
- 2) Are administered prior to April 1st, 2013, and
- 3) Are tagged with either standards or topics

KR20 is a statistical measure of the reliability of the test.

- 4) Tests with KR20 greater than 0.85 are considered to have great reliability.
- 5) Tests with KR20 greater than 0.70 but less than 0.85 are considered to have good but not great reliability.
- 6) Tests with KR20 less than 0.70 (highlighted in red) are considered to have poor reliability.

Appendix F

Summary

Grade	Subject	Test Name	# of Test Results	Mean Score	Standard Deviation	KR20	Questions to Review
6	Math	G6 Math Pre-Assessment	290	49%	17%	0.85	
6	Math	6th Grade Midterm	210	55%	16%	0.74	18
6	Math	6th Grade Honors Math Midterm	89	76%	9%	0.66	7, 8
7	Math	G7 Math Pre-Assessment	285	47%	18%	0.86	6, 26
7	Math	G7 Math Midterm Exam	282	63%	21%	0.82	
8	Math	G8 Math Pre-Assessment	283	42%	16%	0.83	14
8	Math	G8 Pre-Algebra Midterm Exam 2012	200	46%	18%	0.82	
8	Math	G8 Algebra 1 Midterm Exam 2012	45	76%	9%	0.63	8, 9, 17, 23, 27, 28, 51
8	Math	G8 Algebra 1 Honors Midterm Exam 2012	47	70%	11%	0.66	8, 14, 19

Tests included in this analysis:

- 1) Have more than 40 results,
- 2) Are administered prior to April 1st, 2013, and
- 3) Are tagged with either standards or topics

KR20 is a statistical measure of the reliability of the test.

- 4) Tests with KR20 greater than 0.85 are considered to have great reliability.
- 5) Tests with KR20 greater than 0.70 but less than 0.85 are considered to have good but not great reliability.
- 6) Tests with KR20 less than 0.70 (highlighted in red) are considered to have poor reliability.

Appendix G

Summary

Grade	Subject	Test Name	# of Test Results	Mean Score	Standard Deviation	KR20	Questions to Review
6	Science	Grade 6 Science Pre-Assessment	305	43%	13%	0.78	
6	Science	2012-13 6th Grade Q1 Science Assessment	298	57%	17%	0.79	
6	Science	Grade 6 Science Q2/Midterm 2012-2013	296	59%	18%	0.80	
6	Science	Unit III Earth's Properties and Tectonics	68	50%	15%	0.79	12, 17
6	Science	Unit IV: Reinforce I	84	52%	23%	0.46	
7	Science	Grade 7 Science PreAssessment	279	49%	15%	0.81	
7	Science	Grade 7 Science Q 1 Assessment 2012	278	69%	15%	0.79	
7	Science	Grade 7 Science Q2 Assessment 2012-2013	283	67%	19%	0.85	29
8	Science	Grade 8 Science PreAssessment	275	46%	17%	0.85	39, 40
8	Science	2012-2013 Q1 Grade 8 Science Assessment	274	63%	18%	0.82	
8	Science	Q2 Midterm Grade 8 Science	283	71%	17%	0.83	

Tests included in this analysis:

- 1) Have more than 40 results,
- 2) Are administered prior to April 1st, 2013, and
- 3) Are tagged with either standards or topics

KR20 is a statistical measure of the reliability of the test.

- 4) Tests with KR20 greater than 0.85 are considered to have great reliability.
- 5) Tests with KR20 greater than 0.70 but less than 0.85 are considered to have good but not great reliability.
- 6) Tests with KR20 less than 0.70 (highlighted in red) are considered to have poor reliability.

Appendix H

Summary

Grade	Subject	Test Name	#of Test Results	Mean Score	Standard Deviation	KR20	Questions to Review
6	Social Studies	Grade 6 World History Pre-Assessment	299	35%	14%	0.72	5
6	Social Studies	Grade 6 Civics Midterm	308	67%	20%	0.90	
7	Social Studies	Grade 7 World History Pre-Assessment	275	32%	13%	0.73	
7	Social Studies	Grade 7 World History Midterm	268	78%	13%	0.82	
8	Social Studies	Grade 8 World History Pre-Assessment	184	25%	9%	0.62	9, 33
8	Social Studies	Grade 8 World History Midterm	287	68%	21%	0.93	

Tests included in this analysis:

- 1) Have more than 40 results,
- 2) Are administered prior to April 1st, 2013, and
- 3) Are tagged with either standards or topics

KR20 is a statistical measure of the reliability of the test.

- 4) Tests with KR20 greater than 0.85 are considered to have great reliability.
- 5) Tests with KR20 greater than 0.70 but less than 0.85 are considered to have good but not great reliability.
- 6) Tests with KR20 less than 0.70 (highlighted in red) are considered to have poor reliability.

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