The Effects of Using Fitness Journaling with GPS Technology

on

Middle School Adolescents to Increase Cardiovascular Endurance

By Michael N. Potter

Submitted in Partial Fulfillment of the Requirements for the

Degree of Master of Education

July 2013

Graduate Programs in Education

Goucher College

Table of Contents

List of Tables

Abstract

The purpose of this study was to investigate the effect of using fitness journaling in association with GPS technology to monitor speed and distance traveled on middle school students' cardiovascular endurance. A quasi-experimental pretest-posttest design was used for this study. The treatment group used GPS receivers to track and set goals which they recorded and monitored in fitness journals. The control group used the technology but did not participate in the fitness journaling activities. Cardiovascular fitness was assessed in terms of the number of laps completed using the FITNESSGRAM PACER test before and after the intervention. Analyses were conducted on data from 14 students in the treatment group (8 males and 6 females) and 19 in the control group (8 males and 11 females). The null hypothesis that participation in goal setting through fitness journaling in conjunction with using data from a GPS receiver would result in equivalent PACER test results compared to a group using only the GPS technology was rejected, as the mean PACER test results of the group which used journals to track fitness results were significantly higher than those of the control group. In fact, the treatment group made small gains on the PACER while the control group's results actually decreased over the intervention period. Recommendations for future research include using a larger sample, using random selection to identify participants, using alternate technologies to measure fitness outcomes, and investigating the effects of changing students' perception of the PACER test. This study and similar follow-up research may have positive consequences for students' health and development. Developing effective fitness applications for technology towards which students are receptive may extend their fitness practices into adulthood and improve their long-term health.

CHAPTER I

INTRODUCTION

Overview

Adolescent fitness levels have become a growing concern in our nation due to increases in childhood obesity and the various health conditions associated with being overweight. The lack of fitness exhibited by our youth has been labeled as an "epidemic." This "epidemic" is being addressed in schools by making regular physical activity a priority and using fitness testing to assess current fitness levels. Through fitness testing, students are being asked to understand their individual fitness levels and how to improve upon on it. Various forms of technology are being utilized in physical education curricula to allow for this individualization and goal setting. Technology such as heart rate monitors, pedometers, and Global Positioning Systems (GPS) receivers provide the data needed to allow students more personal insight into their well-being. The use of technology to provide personal fitness data for goal setting is one avenue being used to establish life-long fitness habits and reverse the trend of poor adolescent fitness. Anderson (2004) states that "in light of the pervasiveness of physical inactivity, a growing amount of research has been aimed at developing effective interventions for promoting regular physical activity" (p. 659).

This researcher became interested in exploring the issue of adolescent fitness in his role as a Physical Education teacher in a middle school setting for the past eight years. He observed that scores for fitness testing revealed large numbers of adolescents who consistently tested outside of the parameters for what is considered "healthy." In addition, adolescents did not seem to understand how to assess their own fitness levels using data and nor how to create a fitness plan to improve their health. As a result of his desire to have more adolescents understand the relationship between regular physical activity and their own well-being, he decided to conduct a study that focused on helping them use the readily available technology of the GPS receivers to track their daily fitness levels, set goals based on the data, and create a fitness journal to document their progress.

Statement of Problem

The purpose of this study is to determine if using fitness journaling in association with technology in the form of GPS receivers equipped to monitor both average speed and distance traveled affects middle schools students' cardiovascular endurance.

Hypotheses

Students who participate in goal setting through a fitness journal using data from a GPS receiver will have equal cardiovascular endurance during the PACER test for the FITNESSGRAM when compared to a control group who also uses the GPS technology, but does not participate in goal setting through a fitness journal.

ho1: Pre-Intervention PACER Scores for treatment group = Pre-Intervention PACER Scores for control group

ho2: Post Intervention PACER Scores for treatment group = Post Intervention PACER Scores for control group

Operational Definitions

The terms below have been defined for purposes of this study. The definitions are based upon descriptions provided in FitnessGram and ActivityGram: Test Administration Manual (Meredith & Welk, 2010) and the 2008 Curriculum Guide for Physical Education (Harford County Public Schools, 2008).

- *Body Mass Index (BMI)*: A ratio of height to weight that correlates with body fat/leanness and determines body composition.
- *Caloric expenditure*: The number of calories expended or burned during cardio-respiratory activities (e.g. stationary bikes/fitness days).
- *Calorie*: The unit for measuring the energy produced by food when oxidized in the body.
- *Cardiovascular endurance/aerobic capacity/cardio-respiratory endurance*: The body's ability to take in and use oxygen so that muscles can function; it is defined by the number of laps performed during the PACER test of the FITNESSGRAM.
- *Coordinates*: The latitude and longitude data used to find unknown waypoints or destinations in a geocache.

- *Dependent variable*: The number of laps completed on the PACER test.
- *Fitness plan*: A plan developed after a self assessment of the health-related components of fitness.
- *Fitness*: The capability of the body to distribute inhaled oxygen to muscle tissue during physical exertion.
- *FITNESSGRAM Progressive Aerobic Cardiovascular Run (PACER) test*: The default aerobic capacity/cardiovascular endurance test for FITNESSGRAM using the number of laps performed to a CD cadence that is progressive in intensity. It was adapted from the 20 meter shuttle run.
- *Flexibility*: The ability to move a joint or muscle throughout its entire range of motion.
- *Geocaching*: A world-wide activity where people hide inexpensive treasures and log the coordinates on the internet for others to find.
- *Global Position System (GPS):* A locating system that uses the triangulation of declassified military satellites to track one's position on Earth and help one find new locations through the coordinates of latitude and longitude.
- *Heart rate*: The number of heartbeats occurring during a specified time.
- *Independent variable*: Fitness journaling by setting goals above baseline scores for average speed (MPH) and distance traveled (ft/mi) during the GPS Geocaching unit.
- *Muscular endurance*: The ability to contract one's muscles repeatedly without excessive fatigue.
- *Muscular strength*: The maximal force that individuals can exert when they contract their muscles.
- *Navigate*: To travel using specific coordinates.
- *Receiver*: The Garmin Geko handheld GPS unit.
- *Triangulation*: Measurements from three locations.
- *Way Point*: A destination identified by coordinates.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Early adolescent fitness has become an important topic in education due to the increasing need for teaching life-long habits that will lead to better overall health as an adult. Current concerns about adolescent fitness include the rate of obesity, poor eating habits, and lack of participation in extracurricular activities. Physical Education is trying to meet these new concerns with improved curricula that are science and health based and incorporate fitness testing. Current fitness testing standards are constantly being scrutinized and improved upon to increase validity and reliability and better match the developmental milestones of these unique subjects. Due to the importance of early adolescent fitness, it is important to understand the various benefits of fitness, the current practices for fitness testing, factors adversely affecting fitness, and possible interventions for improving early adolescent fitness.

Benefits of Early Adolescent Fitness

The benefits of fitness are apparent in both the physical and psychological domains. In the physical domain, youths and adolescents with good fitness levels demonstrate lower rates of forms of disease. Anderson (2004) reports that "there is an expansive and strong body of scientific evidence that demonstrates that regular physical activity can prevent or control a number of chronic diseases and conditions, including cardiovascular disease, stroke, type 2 diabetes, hypertension, obesity, osteoporosis, and certain types of cancer" (p. 659). Of all the conditions associated with poor fitness, obesity is most frequently referenced in education and research. Obesity is when one has an unhealthy BMI, meaning their body weight is not proportionate to their height. Jago et al. (2010) claim that "higher levels of obesity among children and adolescents have been associated with low levels of aerobic fitness" (p. 1503). Early adolescents who are physically fit are also more likely to maintain their fitness as they transition into adulthood. Matton et al. (2006) note that "weight status during adolescence is indicative of adult weight status, and a pattern of less activity rather than activity tends to be continued from youth into adulthood" (p. 1118).

Outside of the physical benefits of good fitness, there are psychological and social benefits. Psychologically, Matton et al. (2006) observe that fitness "appears to reduce depression and anxiety and improve mood" (p. 1114). Socially, good physical activity and fitness levels are shown to improve the overall family dynamic. Kuo, Voorhees, Haythornthwaite, and Rohm Young (2007) state that "family support for exercise, family involvement in activities, and general family intimacy may be important predictors of physical activity" (p. 102).

Current Fitness Testing In Early Adolescents

Fitness testing is becoming more standardized throughout the country with many state's adopting the FITNESSGRAM assessment developed by the Cooper Institute because it is the national assessment for AAPHERD (American Association for Physical Education, Health, Recreation, and Dance). The FITNESSGRAM is also widely used in educational research. Le Masurier (2004) states that prior to 1985, several fitness tests were used, but the FITNESSGRAM became the nation fitness test for AAHPERD. The FITNESSGRAM uses a battery of one-time assessments broken down into categories that address all three major components of fitness: cardiovascular endurance, muscular strength and flexibility. Each of these categories uses standards for fitness based on the variables of gender, age, and body mass index (BMI). Stellino, Sinclair, Partridge, and McClary-King (2010) stress the importance of schools to consider age, BMI, and gender in creating physical activity opportunities to allow for differentiation and individualization in instruction. The standards give a range of scores to determine the approximate fitness level of the child. Outside of assessment-based fitness testing, the tracking of general physical activity levels through the use of pedometers and other forms of technology offers an alternative way of assessing fitness levels.

Aerobic capacity can be described using many terms such as cardiovascular fitness or endurance, physical working capacity, etc. and is one of the categories of fitness that has the most emphasis placed on it because of its positive correlation to general overall fitness in other categories and negative correlation with cardiovascular disease, obesity, and other risk factors. Beets and Pitetti (2004) explain that when considering the components of fitness, aerobic capacity is considered the most important because of its relationship to

lowering adult risk factors. Meredith and Welk (2010) further say that "aerobic capacity is the most important area of any fitness program" (p. 27). Aerobic capacity is the measurement of maximal oxygen intake (VO_2max) linked to one's body size (BMI). This is expressed through the liters of oxygen consumed per kilogram of body weight per minute or $ml \cdot kg^{-1} \cdot min^{-1}$. Aerobic capacity can be tested through any cardiovascular endurance activity such as running, biking, etc. The FITNESSGRAM uses three different tests: PACER, one mile run, and walk test. Each of these has scores that can be comparable due to the use of estimated VO_2max based on criterion standards in FTINESSGRAM.

Muscular strength and flexibility all test the functionality of the muscular system. Muscular strength can be defined through the frequency and intensity of an activity with frequency being the number of times one does an activity and intensity being the difficulty of the activity. The FITNESSGRAM, along with other previous fitness tests, selected the upper body (push-up and pull-up), back (trunk lift), and abdominal region (curl-up) as the areas to test for muscular strength. Flexibility can be defined as measuring the range of motion in a joint through various measurement tests. Flexibility is normally considered the easiest of the categories because most adolescents have great range. Flexibility does affect the other categories of fitness because lack of range of motion in a joint can lead to injury. Marshall, Sarkin, Sallis, and McKenzie (1998) report that muscular strength, endurance, and flexibility are associated with lowering the risk of back pain and osteoarthritis.

Age, gender, and BMI are the three main variables used in determining fitness standards in early adolescents. Age and gender have been used the longest, but have recently been scrutinized as lacking reliability due to the fact that both variables fail to take into account maturation differences from puberty. Marshall et al. (1998) concluded that these maturation differences in children affect correlations in studies because they create greater variability in the group. Body Mass Index or BMI is now used in most fitness testing including the FITNESSGRAM because it better takes into account maturation differences to determine more appropriate fitness standards and allowing for more accurate and reliable results. BMI is the use of height and weight to determine the appropriateness of height relative to weight using the formula: weight (kg) / height² (m). Marshall et al. acknowledge that BMI shows the highest level of reliability in tracking fitness components and is a stable

attribute in boys and girls based off higher tracking correlations from childhood to adulthood.

Some fitness testing strives to track overall levels of physical activity using technology rather than relying on one-time battery of tests. Le Masurier (2004) notes that using technology to track and measure the physical activity levels of children has become popular. Physical education programs and fitness interventions have adopted the use of the following technologies: pedometers, accelerometers, heart rate monitors, and web-based journaling or tracking. Pedometers are easy to use and can track the number of steps taken during an activity based on the stride (distance of each step) of the individual. Accelerometers are similar to pedometers, but track the patterns of movement or steps during specified intervals to estimate the intensity of an activity. Heart rate monitors can be used in conjunction with the target heart rate zone to evaluate the intensity of activities and make adjustments. Heart rate monitors are available in a watch, belt, or baton form to allow for ease of use. The use of web-based fitness tracking allows for an extracurricular approach, where parents work with their child outside of school to set goals and track them through the use of websites. Sinclair et al. (2010) feel that all of these technology alternatives to one time fitness testing are now considered reliable and valid for assessing fitness levels.

Adverse Factors on Early Adolescent Fitness

Currently, overall adolescent fitness levels are low and many factors can be related to this lack of fitness. A factor adversely affecting the fitness of all youths and adolescents is overall activity levels either in physical education (PE) class or outside of school. Gillespie (2003) notes that "it appears that these physical activity opportunities in current form are not having a positive impact on the health of young individuals with mental retardation" (p. 299). Generally, activities in PE are not allowing for enough moderate to vigorous activity for the entire school demographic. Many PE classes do not have enough time spent actively moving due to increases in cognitive testing and lecturing due to the shift to a more science-based curriculum. Pate et al. (2005) revealed that "a school-based intervention can increase vigorous physical activity" (p. 1584), but "traditional PE programs often provide students with relatively little physical activity" (p. 1585). PE programs are trying to utilize more fitness tracking with the previously discussed technology like pedometers and limit

time spent not moving by applying alternatives for cognitive assessment like exit tickets, online lectures, blackboard, and take home assignments. These alternative assignments extend the lesson to outside the classroom making learning more student-driven and providing more time in class to be active.

Outside of PE, the home environment can also adversely impact-fitness levels. The home environment has shown to have both cultural and social variables which can change one's perception of physical fitness. Cooper et al. (2006) acknowledge that the environment outside of school is an important influence on fitness and an area that is greatly under researched. Research based on the role of race and social variables has shown that there are significant trends among certain groups towards fitness. Beets and Pitetti (2004) explain that differences in fitness may be due to "cultural variations between ethnic groups regarding views about physical activity, physical fitness, and body image." Generally, poor fitness is correlated with a lack of support from family. Kuo et al. (2007) explain that "family support for exercise, family involvement in activities, and general family intimacy may be important predictors of physical activity" (p. 102).

The factor of personal motivation is also a significant factor impacting fitness. Huang and Malina (2007) state that "the physical fitness of youth is influenced by a variety of factors including psychological factors related to attitude and motivation" (p. 701). The attitude towards physical activity, as previously stated, is strongly linked to the home environment. Motivation to be physically fit is strongly shaped by their home environment and the role fitness has there. Kuo et al. (2007) reiterate that "physical and social environments interact with individual behavior to support or hinder physical activity" (p. 101). Motivational techniques in PE class and further involvement from the family outside of class can change this dynamic and increase motivation towards fitness. Colchico, Zybert and Basch (2000) explain that verbal praise, positive reinforcement, and individualized instruction are important in promoting positive attitudes towards fitness.

Interventions for Improving Fitness in Youth through Adolescence

Several interventions aimed at improving the fitness levels throughout development from youth to adolescence with most interventions have focused on curriculum changes. The Sports, Play, and Active Recreation for Kids (SPARK) study aimed at comparing total minutes of PE, minutes of physical activity, and

use of quality teaching methods (Anderson, 2004). Researchers found that trained classroom teachers could increase their minutes and trained PE teachers could even further increase the minutes. Another youth study was the Child and Adolescent Trial for Cardiovascular Health (CATCH) (Anderson, 2004). This study involved an intervention aimed at increasing moderate and vigorous activity levels by training teachers in making lessons more enjoyable and student driven. It found that activity levels could be increased by 8% over the control and even incorporated a home/family component outside of school.

At the adolescent level, studies tended to focus on environmental factors outside the PE classroom, along with providing interventions in school. The Stanford Adolescent Heart Health Program used an intervention which focused on several components of risk reduction from increases in physical activity to decreasing smoking to establishing a better diet (Anderson, 2004). During their PE class, students were taught skills similar to a Health class, aimed at changing negative health behaviors and resisting per influence towards unhealthy behaviors. Treatment schools from this study boasted students with more knowledge and more sedentary students adopting healthy lifestyles. The Patient-Centered Assessment and Counseling for Exercise Plus Nutrition (PACE+) study again looked at environmental factors by not only increasing moderate and vigorous activity in treatment groups, but also decreasing participants' fat intake and increasing fruit/vegetable consumption in their diets (Anderson, 2004). The study showed that moderate, but not vigorous activity was increased.

Overall, fitness interventions at the youth through adolescent level were limited in several ways. The studies all lacked poor-quality measures for physical activity that did not take in the individuality of the subject. Many of the interventions still do not offer an accurate measurement for physical activity that accounts for factors affecting fitness like demographic, gender, and maturation or puberty. Anderson (2004) explains that "risks for physical inactivity are associated with certain demographics, including persons with lower income, racial and ethnic minorities, and those with disabilities" (p. 663) and that "another area of research requiring more attention is research on gender differences" (p. 664). These challenges along with others are beginning to be taken into account to help better guide curriculum development, fitness testing, and identification of those at

risk of poor fitness.

Conclusion

Early adolescent fitness will continue to be an important issue not only in schools, but in society. As fitness testing becomes more standardized and physical education curricula change based on research from fitness interventions, early adolescent fitness will hopefully become an important topic both in and outside of school with families and communities.

CHAPTER III

METHODS

The purpose of this study was to examine the effect of technology-driven fitness journaling on cardiovascular endurance levels in adolescents. The researcher's students participated in goal setting through a fitness journal using data from a GPS receiver to determine the effect, if any, on cardiovascular endurance using the PACER test for the FITNESSGRAM as the instrument. Results were compared to a control group who also uses the GPS technology, but did not participate in goal setting through a fitness journal. A sample of the fitness journal is provided in Appendix A.

Design

A quasiexperimental design with a pre- and post-test was used for this study. The treatment group used GPS receivers to track and set goals in fitness journals. Performance was measured by the number of laps completed using the FITNESSGRAM PACER test on the pre- and post-test. In addition, the treatment group's fitness journal data (student-generated feedback on their success with goal setting and the number of times the fitness goals were met) were used as supporting data.

Participants

The participants in this study were selected using convenience sampling because they were enrolled in one of two eighth grade Physical Education classes that the researcher taught on a daily basis. Class 1 (Period 3) consisted of 16 students (10 males and 6 females) and served as the treatment group. Class 2 (Period 8) consisted of 21 students (9 males and 12 females) and served as the control group. Both classes had Physical Education five days a week for 44 minutes under a rotation "A" and "B" schedule. On "A" schedule, Class 1 met from 9:44-10:28 and Class 2 met from 2:04-2:48. On "B" schedule, Class 1 met at the same time (from 9:44-10:28), but Class 2 met from 8:12-8:56. The school included the sixth, seventh, and eighth grade levels and had an enrollment of 1,043 students. The demographics for both Class 1 and Class 2 were consistent with the demographic composition of the school. The attendance rate of the school was 94%.

Instrument

The instrument used for the pre- and post-test for this study is the Progressive Aerobic Cardiovascular Endurance Run (PACER) test from the FITNESSGRAM program. The instrument used as the independent variable for the treatment group (Class 1) was fitness journaling. Fitness testing is becoming more standardized throughout the country, with many states adopting the FITNESSGRAM assessment developed by the Cooper Institute because it is the national assessment for the American Association for Health, Physical Education, Recreation, and Dance (AAPHERD). The FITNESSGRAM also is widely used in educational research. The FITNESSGRAM uses a battery of one-time assessments broken down into categories that address all three major components of fitness: cardiovascular endurance, muscular strength, and flexibility.

The PACER test is a test of aerobic capacity or cardiovascular endurance requiring students to "pace" their jogging speed to the beep of a FITNESSGRAM supplied compact disc (CD). Students are asked to travel a distance of 20 meters from one line to another line with each 20 meters counting as one lap on the test. For the lap to be considered successful, students must reach the line before they hear the beep of the CD. The cadence of the CD gradually will become more rapid with less time given between each beep, forcing students to adjust their pace from jogging to sprinting. Students try to complete as many laps as possible and are finished with the test once they either are too exhausted to continue or if they fail two times to make it to the line before the beep. It does not matter if the two occasions of not making it to the line are sequential or spaced out; students are simply instructed to stop on their second failed attempt. The PACER test is widely considered to be the best indicator of overall good health and fitness.

The fitness journals included their goals for both average speed (mph) and distance traveled (mi.) based on students' baseline goals for each category. The baseline scores were determined by the mean average from a three day cross-country course run/jog. During these three days, students were partnered with another student with a similar PACER score form the pre-test and asked to pace themselves and perform an "average" workout. The groups used the mean average for speed and distance from this three day workout as their starting point in their fitness journal. The groups recorded their scores for average speed and distance traveled each day. In

addition, they were asked to reflect on whether their scores met their daily goals and write a brief statement about what factors influenced their performance. If the goal was met, groups would increase the goal by .25 mph for average speed and .10 miles for distance traveled for the next day (Example: average speed: 6.5 mph to 6.75 mph and distance traveled: 1.25 miles to 1.35 miles). If the goal was not met, students were asked to keep the same goal until it was met. Students participated in this method of fitness journaling daily for the length of the unit.

Procedure

As stated above, the purpose of this study was to examine whether students improved their cardiovascular endurance through the use of technology-driven fitness journaling. Students from the treatment group (Class 1) and control group (Class 2) were pre-tested using the FITNESSGRAM PACER test by counting the number of laps completed. The PACER was administered using the guidelines set forth in the Instrument section.

All data were collected during the GPS Geocaching unit in April. Class 1 and Class 2 both received the PACER pre-test prior to starting the unit. Class 1 and Class 2 received the same training on the GPS receivers in order to understand their basic functions for geocaching, how to track their distance traveled, average speed (mph), and time spent traveling. Both classes performed several geocaching activities including a mini-cache with six waypoints, a full geocache with 15 waypoints, creating their own geocache, and working on the cross-county course with the GPS receivers. After the PACER pre-test, Class 1 established their individual baseline scores for their distance traveled and average speed over the course of three days using the cross country course. Class 1 was placed in groups of two due to the number of GPS receivers available based upon their baseline scores. The Class 1 groups then used the independent variable of fitness journaling to track their average speed and distance traveled over the course of the 12 day GPS Geocaching unit. Class 1 was asked to set initial goals based on their baseline scores, reflect on factors that contributed to their performance, and set new goals once the previous goal was met based upon criteria discussed in Instrument section. The control group (Class 2) did not use fitness journaling with the GPS receivers, nor did they have to perform the three-day baseline scores assessment. Class 2 never had to set daily performance goals or reflect on their performance. Finally, both the

control and treatment groups received the FITNESSGRAM PACER test as a post-test to determine if the independent variable impacted their cardiovascular endurance by looking for a change in the number of laps completed.

CHAPTER IV

RESULTS

The purpose of this study was to examine the effect of technology-driven fitness journaling on cardiovascular endurance levels in adolescents. Students' gender and PACER pretest and posttest scores were collected for all of the students in both classes participating in this study. For the treatment group, baseline (minimum) speed and distance goals were set for each group, with groups being paired using comparable PACER pre-test results. The study took place over eight days during a GPS Geocaching unit, where fitness journals were used to set and monitor both speed and distance goals and the actual speeds and distances attained, which are summarized in this chapter.

PACER Results and Pre and Posttest Comparisons

Descriptive statistics for the pre and posttest PACER results for the treatment and control groups are presented in Table 1.

Table 1

Descriptive Statistics for PACER Pre and Posttest Results by Group and for the Entire Sample

	PACER Results	N	Mean	Std. Deviation	Range
Treatment Group	PRE	14	47.357	18.350	15-80
Treatment Group	POST	14	49.500	17.060	25-83
Control Group	PRE	19	36.000	22.752	10-91
Control Group	POST	19	28.000	14.372	9-54
Entire Sample	PRE	33	40.818	21.459	10-91
Entire Sample	POST	33	37.121	18.731	9-83

The PACER results for participants the two groups were compared to determine whether the Control and Treatment groups differed significantly on the PACER prior to the implementation of the fitness journal intervention. Due to the convenience nature of the samples, it was understood that the groups might not be

similar. However, the researcher hoped that the groups' pretest scores would be roughly equivalent in order to validly compare the groups' posttest results. The posttest results were intended to reflect the impact of the independent variable, which was the fitness journal intervention. The PACER test results collected after the intervention had been completed also were compared across the treatment and control groups. Results of T tests for independent samples comparing the pre and post PACER scores across groups are presented in Table 2.

Table 2

Independent Samples T tests comparing PACER Pre and Posttest Results across Groups (Hypotheses 1 and 2)

PACER Test	**t-test for Equality of Means**						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
PRE	1.534	31	.135	11.357	7.403	-3.742	26.456
POST	3.924	31	.000	21.500	5.479	10.325	32.675

Equal variances assumed*

Results of T tests for Independent samples comparing the treatment and control groups' pre and post intervention PACER scores indicated that the pretest scores did not differ significantly for the two groups. The mean difference in pretest scores was 11.3571 (t= 1.534, $p < .135$). The PACER scores did differ significantly after the intervention, however. The mean difference in posttest scores was 21.5, t =3.934, $p < .000$. Given these results, hypothesis one, which posited that the treatment and control groups would not differ on the PACER test before the fitness journal intervention, was retained. Hypothesis two, which posted that the treatment and control groups would not differ on the PACER test after the fitness journal intervention was rejected, as the groups' posttest means were significantly different. While the treatment group demonstrated a small improvement on the PACER test (2.14 points), the control group's PACER scores actually decreased 8 points over the intervention period.

Speed and Distance Performance

Based on their baseline performance, the students in the fitness journal group set speed and distance goals each day as part of the fitness journal intervention. Once partners' met a goal for either speed or distance, that goal was increased according to a predetermined plan as described in Chapter III of this paper. The mean daily speed goals and actual speeds attained during the study are presented in Table 3. The differences were calculated to determine if the mean goals and attainments were similar.

Table 3

Mean Speed Goal and Actual Speed by Day

Day	Mean Speed Goal	Mean Actual Speed	Mean Differences Actual-Goal Speeds
1	3.707	4.000	**0.293**
2	3.750	2.614	**-1.136**
3	3.750	2.636	**-1.114**
4	3.750	2.821	**-0.929**
5	3.750	2.979	**-0.771**
6	3.793	2.950	**-0.843**
7	3.836	3.193	**-0.643**
8	3.836	3.221	**-0.614**

The mean daily distance goals, distances attained, and the differences between them for the eight days of the study are presented similarly in Table 4.

Table 4

Mean Goal and Actual Distance by Day

Day	Mean goal	Mean actual	Mean Differences Actual-Goal Distances
1	.8179	.3907	**-0.4272**
2	.8179	.5071	**-0.3108**
3	.8321	.6207	**-0.2114**
4	.8464	.8221	**-0.0243**
5	.8893	.7393	**-0.15**
6	.9036	.5264	**-0.3772**
7	.9036	.5893	**-0.3143**
8	.9107	.4057	**-0.505**

Effects of Fitness Journaling and Goal Setting on PACER Results by Gender

To assess whether the intervention had similar effects on male and female PACER results, the PACER pre

and posttest scores were further disaggregated for males and females. Table 5 below presents the mean PACER pretest, posttest, and gain scores for the males and females in both the treatment and control groups. Overall, males in the treatment group improved their PACER scores 2.667 points, from 52.56 to 55.22 ,whereas PACER scores for males in the control group decreased 16.375 points, from 51.25 to 34.875. Females in the treatment group demonstrated slight gains in PACER scores (up 1.2 points on average, from 38 to 39.2) whereas the mean PACER scores of females in the control group decreased a bit, declining 1.909 points from 24.91 to 23.

Table 5

Descriptive Statistics for PACER Results by Gender and Treatment Condition

Group	**Sex**	**PACER Test**	**N**	**Mean**	**Minimum**	**Maximum**	**Std. Deviation**
Treatment	Males	PRE	9	52.556	30.00	80.00	17.6572
		POST	9	55.222	34.00	83.00	16.6266
		GAIN		**2.667**			
	Females	PRE	5	38.000	15.00	56.00	17.3349
		POST	5	39.200	25.00	60.00	13.6638
		GAIN		**1.2**			
Control	Males	PRE	8	51.250	10.00	91.00	27.0858
		POST	8	34.875	9.00	54.00	16.7881
		GAIN		**-16.375**			
	Females	PRE	11	24.909	15.00	47.00	9.8433
		POST	11	23.000	9.00	40.00	10.4499
		GAIN		**-1.909**			

CHAPTER V

DISCUSSION

A quasiexperimental study using a pretest-posttest design was conducted to determine if students' cardiovascular endurance was affected by participating in goal setting using a fitness journal and setting and monitoring goals and progress using data from a GPS receiver. A control group used the GPS devices but did not participate in the fitness journal and goal setting intervention. Cardiovascular endurance was assessed using the PACER test.

In this study, two null hypotheses were tested which compared the pre and post intervention PACER test scores of the treatment and control groups. These hypotheses are as follows:

ho1: Pre-Intervention PACER Scores for treatment group = Pre-Intervention PACER Scores for control group

ho2: Post- Intervention PACER Scores for treatment group = Post- Intervention PACER Scores for control group

Hypothesis one, which posited that the treatment and control groups would not differ on the PACER test before the fitness journal intervention, was retained as the groups' pre-intervention PACER scores were not significantly different. Hypothesis two, which posited that the treatment and control groups would not differ on the PACER test after the fitness journal intervention, was rejected, as the groups' posttest means were significantly different. The treatment group's mean post-intervention PACER score was significantly higher than that of the control group.

Implications of Results

Two groups whose pretest PACER scores were similar participated in the GPS activity, while only the treatment group used the Fitness Journaling intervention, which was the independent variable. The results of the study appear to suggest that the use of a daily journal to track fitness results can have a positive impact on student performance on tasks requiring cardiovascular endurance. This finding implies that student-driven lessons where performance data is accessible and tracked may result in improvement of individual cardiovascular endurance and that these types of interventions might be applied to other facets of physical

fitness. The descriptive statistics in Table 1 show that mean post-test PACER scores for the treatment group, which supplemented use of GPS technology with fitness journaling and goal setting, improved from 47.3571 to 49.5000 while the control group's mean post-test PACER scores decreased from 36 to 28. While this is only a slight improvement for the treatment group, in contrast to the decrease exhibited by the control group it suggests that fitness journaling provided a means of tracking progress which may have motivated the intervention group students by providing a daily reflection of their performance.

As stated above, the improvement in cardiovascular endurance demonstrated by students in the treatment group appears to be associated with students' reflection that is done on a frequent basis. This finding is consistent with many new curricular models that are based on Bloom's Taxonomy. These models suggest that greater retention is evident through students' reflection and creation than through teacher-driven lessons focused on remembering and understanding. Students in this study were able to apply fitness concepts from class to their physical performance, evaluate their daily results in their journals, and then create goals. The use of a daily reflection helps both the student and teacher evaluate progress and implement necessary differentiation and changes in instruction.

That this intervention was effective was supported by the mean differences for both speed and distance exhibited by the intervention group, which demonstrated the steady, small gains in improvement needed to improve one's physical fitness level. As shown in Table 3, students in the treatment group increased their mean actual speed from a Day 2 score of 2.6143 to a final score of 3.2214, which was just below the baseline mean of 4.0 from Day 1. As presented in Table 4, the treatment group students increased their mean actual distance from .3907 to a Day 4 high of .8221 and a final score of .4057. Both the actual speed and actual distance means had the same trend of improvement over the course of the study as a positive correlation is evident between the two variables. Baseline scores were slightly elevated due to the way in which the data were acquired. While students were asked to perform an "average" workout for the three day baseline scores, their results benefited from constant movement on the cross country course, thus resulting in slightly higher speed and distance scores when compared to results during the GPS Geocaching unit, which required more stopping and starting during the

lessons.

Theoretical Consequences

The main theoretical consequence from this study is that educators must understand how current and future generations of students can use technology to track progress and gain deeper meaning and retention in their coursework through "real world experiences" that can be applied outside of the classroom. The use of technology in Physical Education classes is still fairly new. With all subject areas focusing on using student data to drive instruction, technology provides an avenue for physical educators and their students to collect meaningful data that are easy for students to interpret and use to improve their overall physical well-being. Current Physical Education classes do use some technology, but typically the data acquired are not applied over the course of a unit or semester. Typical applications of such technology also are infrequent and often do not provide the necessary time for students to reflect on the data. Such inconsistent use of technology leads to students having trouble understanding and applying the data for future lessons. "New technologies are having an influence on physical activity interventions. Another issue for this type of research is ensuring those that may not have current ready access to several technologies, but likely will in the future, are included in these studies" (Anderson, 2004). The methods of tracking and reflection on the data provided from the GPS receivers in this study also might change the subjective approach to grading used in Physical Education by providing teachers a model for setting more individualized goals and collecting objective data on which to base student evaluations. Those changes might align grading criteria and assessment methods in Physical Education with those of other core subjects, which also use data tracking through formative and summative assessments to assess learning.

This study's use of fitness journals to track speed and distance provided the students with concise data on which they could reflect. GPS technology was familiar to all the students, as they were accustomed to using it through experiences with devices such as smart phones. The data in the fitness journals were easy for the students to interpret and provided feedback on their performance that enabled self-reflection, which led to better performance. As the study progressed, most students in the fitness journal intervention group were able to see steady improvement and the attainment of their goals which they had identified at the beginning of the study.

This was a real world experience in how one would go about developing a fitness plan to improve or maintain his or her health through daily exercise with realistic goal setting. In addition, students found that the technology provided a means for some friendly competition among the groups regarding who could achieve "high scores" for speed and distance. This competition also was similar to real world programs and applications that allow users to track fitness goals and compare their progress with that of their peers using social media.

Threats to Validity

Several factors may have had a negative impact on the validity of this study and its conclusions. These factors include the sample size and nature, the study duration, and student perceptions.

The first factor was the size of the sample and the use of convenience sampling. The two groups had a combined size of 33 students with only 14 students in the treatment group. This limited sample may not have represented the demographic make-up of the school or, for that matter, average adolescents. The total number of participants was reduced to 33 students from an original sample of 37 as four students had to be withdrawn from the study due to incomplete or missing data from their journals. The use of convenience sampling is not ideal when trying to sample a population, but was necessary due to the schedule limitations of the researcher.

The duration of the study originally was intended to be 12 days, but was reduced to eight days due to inclement weather which did not permit use of the GPS receivers. This inclement weather led to an intermittent schedule for the study and caused students to miss days of the intervention and to not complete their work on a daily basis. Fitness plans yield the best results when they follow a consistent schedule.

Another threat to the validity of the study was the students' overall perception of the PACER test for FITNESSGRAM. Improving performance on the PACER test has been a school system-wide focus, with many schools trying to change student perceptions by offering incentives such as membership in a "PACER club" which includes t-shirts and free periods as rewards. Even with such incentives, many students still appear to dread this test, primarily because it is quite physically demanding, forces one to exercise in front of peers, and is not perceived as important by students because it does not count towards their grade. Negative perception of the test may have been the cause of the control group's decrease and the treatment group's minimal gains on the

PACER post tests, as many students from both the treatment and control groups commented that they did not want to have to take the PACER test twice.

Connections to Previous Studies/Existing Literature

Many studies have focused on changes in curricula, lesson planning, or student diet as interventions to improve physical fitness for adolescents, but relatively few focus on the use of technology in Physical Education to attain this goal. Examples of adolescent physical fitness studies include the Child and Adolescent Trial for Cardiovascular Health (CATCH) and the Patient-Centered Assessment and Counseling for Exercise Plus Nutrition (PACE+) studies (Anderson, 2004). The CATCH study was designed to increase moderate and vigorous activity levels by training teachers in use of strategies to make lessons more enjoyable and student-driven. The PACE+ study examined the impact of environmental factors by not only increasing moderate and vigorous activity in treatment groups, but also decreasing participants' fat intake and increasing fruit/vegetable consumption in their diets. Both of these studies could be replicated to include the use of technology and fitness journaling to increase student engagement in the interventions and enhance results.

Implications for Future Research

Technology-based studies primarily have been conducted with adult participants. These studies have incorporated various types of technology to collect and analyze results. This researcher has observed that many adolescent studies rely too heavily on subjective interventions that diminish student retention because the interventions are teacher-driven and do not accommodate the variations in fitness and physical abilities which exist among adolescent students. This lack of differentiation generates few productive habits among adolescents that can be carried into adulthood. The use of technology as part of a fitness journal or regimen allows students to set goals, track results, and build on both short and long term goals. With more curricula and school missions focusing on creating "life-long learners," it is important that any interventions done at the adolescent level can extend into adulthood and employ technology that is familiar to students and convenient for them to use. Therefore, future studies might assess the long term benefits of having students track their performance and set fitness goals as they progress from elementary to high school levels to see if mean and/or individual

performance levels improve on the mandated fitness testing. Additional studies might examine how student data collection and goal setting impact physical fitness as students transition out of school and into adulthood.

Conclusions/Summary

This study suggests that the use of technology-based fitness journaling provides students with simple data that can be easily interpreted for use in improving aspects of their overall health. Students who engaged in daily recording of data in their journal appeared to develop insight into their performance and receive the necessary motivation to work to attain their goals. In turn, they outperformed students who used similar technology but did not engage in fitness journaling, reflection, and goal setting. In addition to student benefits, this type of data can be used by Physical Educators in the grading process to provide feedback and scores that reflect the individuality and ability of their students. Use of data in this way may further align assessments conducted in Physical Education classes with those done in core areas.

By supplementing familiar technology as an effective means for data collection and goal setting in education, students can become more engaged in lessons. Tracking progress with technology allows for lessons to become more student-driven, where students are empowered to be part of the creative process and take ownership of their education and progress. The challenge facing educators lies in training teachers to be comfortable implementing lessons which successfully integrate the use of technology with appropriate methods for data collection and progress monitoring and place more control for learning in the hands of the students.

References

Anderson, N. (2004). Physical activity interventions. Kaplan, R., Kumamyika, S., Salovey, P., Kawachi, I., Dunbar-Jacob, J., & Kemeny, M. (Eds)., *Encyclopedia of Health and Behavior* (Vol. 2, pp. 659-665). Thousand Oaks, CA: Sage Publications.

Beets, M., & Pitetti, K. (2004). One-mile run/walk and body mass index of an ethnically diverse sample of youth. medicine and science in sports and exercise. *Journal Title*, *36*(10), 1796-1803. Retrieved from Education Full Text database.

Colchico, K., Zybert, P., & Basch, C. (2000). Effects of after-school physical activity on fitness, fatness, and cognitive self-perceptions: A pilot study among urban, minority adolescent girls. *American Journal of Public Health*, *90*(6), 977-8. doi: 10.2105/AJPH.90.6.977

Gillespie, M. (2003). Cardiovascular fitness of young Canadian children with and without mental retardation. *Education and Training in Developmental Disabilities*, *38*(3), 296-301. Retrieved from Education Full Text database.

Harford County Public Schools (2008). *2008 curriculum guide for physical education*. Retrieved from http://share.hcps.org/sites/CurriculumandInstruction/HealthPhysicalEducationAthletics/PhysicalEducation/2008%20Middle%20School%20Curriculum%20Guide%20PE/Forms/AllItems.aspx

Huang, Y., & Malina, R. (2007). BMI and health-related physical fitness in Taiwanese youth 9-18 years. *Medicine and Science in Sports and Exercise*, *39*(4), 701-8. doi: 10.1249/mss.0b013e31802f0512

Jago, R., Drews, K., & McMurray, R., Thompson, D., Volpe, S., Moe, E., Jakicic, J., Pham, T., Bruecker, S., Blackshear, T., & Zenong, Y. (2010). Fatness, fitness, and cardiometabolic risk factors among sixth-

grade youth. *Medicine and Science in Sports and Exercise*, *42*(8), 1502-10. doi: 10.1249/MSS.0b013e3181d322c4

Kuo, J., Voorhees, C., Haythornthwaite, J., & Rohm Young, D. (2007). Associations between family support, family intimacy, and neighborhood violence and physical activity in urban adolescent girls. *American Journal of Public Health*, *97*(1), 101-3. doi: 10.2105/AJPH.2005.072348

Le Masurier, G. (2004). Health-related physical fitness and physical activity trends among American youth. *International Journal of Physical Education*, *41*(2), 48-59. Retrieved from Education Full Text database

Marshall, S., Sarkin, J., Sallis, J., & McKenzie, T. (1998). Tracking of health-related fitness components in youth ages 9 to 12. *Medicine and Science in Sports and Exercise*, *30*(6), 910-16. doi: 10.1097/00005768-199806000-00021

Matton, L., Thomis, M., & Wijndaele, K., Duvigneaud, N., Beunen, G., Claessens, A., Vanreusel, B., Philippaerts, R., & Lefevre, J. (2006). Tracking of physical fitness and physical activity from youth to adulthood in females. *Medicine and Science in Sports and Exercise*, *38*(6), 1114-20. doi: 10.1249/01.mss.0000222840.58767.40

Meredith, M., & Welk, G. (Eds.). (2010) *FitnessGram and ActivityGram: Test Administration Manual*. Champaign, Illnois : Human Kinetics.

Pate, R., Ward, D., Saunders, R., Felton, G., Dishman, R., & Dowda, M. (2005). Promotion of physical activity among high-school girls: A randomized controlled trial. *American Journal of Public Health*, *95*(9), 1582-7. doi: 10.2105/AJPH.2004.045807

Stellino, M., Sinclair, C., Partridge, J., & McClary-King, K. (2010). Differences in children's recess physical activity: Recess activity of the week intervention. *The Journal of School Health*, *80*(9), 436-44. Retrieved from Education Full Text database

Appendix A
Sample fitness journal entry

Name:
Name:

GPS Fitness Journal

GPS Baseline Scores

Date	Average Speed (mph)	Distance Traveled (ft. /mi.)
4/3/13		
4/4/13		
4/5/13		

Baseline Mean Averages		

GPS Geocaching Daily Goals
Directions: Your group is to record your scores for average speed and distance traveled each day. In addition, you must reflect on whether your group met your daily goals and write a brief statement about what factors influenced your performance. If the goal was met, your group must increase the goal by .25 mph for average speed and .10 miles for distance traveled for the next day (Example: average speed: 6.5 mph to 6.75 mph and distance traveled: 1.25 miles to 1.35 miles). If the goal was not met, you must keep the same goal until it is met.

Date:	Speed Goal:	Distance Goal:
	Actual Speed:	Actual Distance:
	Goal Met: Yes / No	Goal Met: Yes / No

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	Speed Goal:	Distance Goal:
	Actual Speed:	Actual Distance:

	Goal Met: Yes / No	Goal Met: Yes / No

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	Speed Goal:	Distance Goal:
	Actual Speed:	Actual Distance:
	Goal Met: Yes / No	Goal Met: Yes / No

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	Speed Goal:	Distance Goal:
	Actual Speed:	Actual Distance:
	Goal Met: Yes / No	Goal Met: Yes / No

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	Speed Goal:	Distance Goal:
	Actual Speed:	Actual Distance:
	Goal Met: Yes / No	Goal Met: Yes / No

Reflection: Name one factor that helped or prevented you from meeting your

speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**

	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today:

Date:	**Speed Goal:**	**Distance Goal:**
	Actual Speed:	**Actual Distance:**
	Goal Met: **Yes / No**	**Goal Met:** **Yes / No**

Reflection: Name one factor that helped or prevented you from meeting your speed and distance goal today: