January 2012

Changes in Attitudes and Behaviors Toward Physical Activity, Nutrition, and Social Support for Middle School Students Using the AFIT App as a Suppliment to Instruction in a Physical Education Class

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Changes in Attitudes and Behaviors Toward Physical Activity, Nutrition, and Social Support for Middle School Students Using the AFIT App as a Supplement to Instruction in a Physical Education Class

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
Department of Adult, Career and Higher Education
College of Education
University of South Florida

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Date of Approval:
November 28, 2012

Keywords: Middle School Physical Education, Self-Determination Theory, Technology, iPad app, Psychosocial variables

Dedication

I would like to dedicate my dissertation to the two people that inspire me on a daily basis. To my wife, Sherri, who has kept me upbeat in the hardest times of my journey. Her compassion and tolerance helped keep me grounded in what truly matters - our family, and I will always be blessed by her presence.

Secondly, to my sister, Jennifer Cancello, her strength in times of adversity has been inspiring. I have always looked up to her as my big sister, but even more lately. I have been very fortunate to have someone that leads by example on how to be a great role model, teacher, and most importantly family member. I have not had to look far for strength and excellence in life.

Acknowledgments

The author would like to acknowledge the special efforts of the school's Principals in allowing the researcher to conduct the study at their locations. The district representative, who went out of his way to help approve my lessons as part of the physical education curriculum, allowing every student (over 600) to participate without having to be in the research study. The constant guidance and help by my dissertation committee, Dr. William Young, Dr. Stephen Sanders, Dr. Robert Dedrick, and Dr. Sara Flory, with a special appreciation for Dr. Nell Faucette and all of her assistance throughout my studies.

As I have always strived for each finish line, I found that the journey along the way has been more rewarding than the finish. As I have worked through all my challenges, I have come to realize they are truly the essence of learning. Because of the people I have been surrounded by, I will graduate a better husband, father, teacher, and forever student.

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Abstract

Finding ways to improve nutritional and physical activity components with today's adolescents is a significant problem. The obesity epidemic is over 10 years old and little research has been done on successful interventions that motivate today's students using the latest technology. A total of 140 middle school students and four physical education teachers participated in a 4-week study using a newly created application (AFIT app) for supplemental teaching in and out of the classroom. Combining a theoretical framework of Self-Determination and motivating strategies implored in today's mobile technology, significance was found using the PACE (2001) instrument in fruits and vegetable and physical activity psychosocial behaviors. The pretest to posttest for fruits and vegetables revealed a decrease in confidence for behaviors that support meeting recommended daily requirements in eating fruits and vegetables. The pretest to posttest for physical activity highlighted an increase in supporting behaviors for meeting the daily physical activity requirements, and an increase in friend support for meeting those daily physical activity requirements. Intrinsic and extrinsic motivators were incorporated in the app design and the tenets of autonomy, competence, and relatedness were used as adolescent motivators. At the end of the 4-week study, benefits and obstacles were also noted for both teachers and students with recommendations to increase teachers' in-services with regard to the latest technology and troubleshooting procedures. A home survey highlighted the need for more adult

education in the household and stressed the importance of family support in both fruits and vegetables and physical activity behaviors.

Chapter One

Introduction

There is growing interest among researchers about the use of technology to change students' behaviors relative to nutrition and physical activity inside and outside of school, especially in light of the growing epidemic of childhood obesity (World Health Organization, 1997). Over the last 10 years, the number of calories consumed daily by adolescents has increased while their time spent engaging in daily physical activity has decreased (Spruijt-Metz, 2011). In addition to this increase in calories, few girls (36%) and boys (30%) between the ages of 12 and 19 currently meet the objective of having less than 30% of their total calories come from fat (Zabinski et al., 2006). During the transition from childhood to adolescence, average total daily fruit and vegetable servings decreases by 0.7 and 0.8 among girls and boys, respectively (N. Larson, Neumark-Sztainer, Hannan, & Story, 2007).

Regarding physical activity, Nader, Bradley, Houts, McRitchie, and O'Brien (2008) found that by age 15, only 31% of adolescent males and 17% of adolescent females met the recommendations of healthy activity set forth by the Centers for Disease Control and Prevention (CDC). A recent review of over 25 longitudinal studies showed that overweight and obese youth are at a significantly increased risk of becoming overweight adults (Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). The per

capita medical spending for an obese individual is roughly 42% higher than for a person of normal weight (Finkelstein, Trogdon, Cohen, & Dietz, 2009). This outranks health costs from both smoking and alcohol use (Sturm, 2002). Understanding, preventing, and treating childhood and adolescent obesity are, therefore, top public health priorities (Koplan, Liverman, & Kraak, 2005).

Obesity and Physical Activity

Between 1976 and 1980, the percentage of adolescents aged 12 to 19 who were labeled obese was 5.0% (CDC, 2010b). Between 2007 and 2008, obesity rates for the same age group increased to 18.1% (CDC, 2010b). Type II diabetes, once considered an adult disease, is now being diagnosed in very young children. According to the American Diabetes Association (2011), one in every 400 children and adolescents has this disease. Type II diabetes and obesity have been reported to be at epidemic levels (Rocchini, 2002), which has drawn a great deal of attention to levels of physical activity in children.

Today, inactivity rates for adolescents' leisure time activities range from 10.1% to 43.0%, which can lead to obesity, type II diabetes, and related diseases (CDC, 2010a). Engaging in physical activity has been linked to improved health status in children and adults, and is considered to be one way to fight the obesity epidemic (Berkey, Rockett, Gillman, & Colbitz, 2003).

Obesity and Nutrition

Another element in the fight against obesity is nutrition – a focus in the middle school curriculum today. Adolescence is an important time relative to fruit and vegetable intake because nutrient needs are high to support rapid growth and dietary patterns for adulthood are being developed (N. Larson et al., 2007). Using concepts such as calories in versus calories out (i.e., energy balance) can be a key to helping children understand the importance of a healthy balanced diet. Hellmich (2010) found that having a frame of reference for calories is important, stating that "there is confusion on all sides of the calorie equation. People don't know how many calories they should consume in a day and even more are unclear how many they burn" (p. 6). Therefore, combining information about proper nutrition along with guidelines for physical activity can give students a picture of their lifestyle needs versus reality.

Mobile Learning (M-Learning)

Research suggests that people born between similar periods will share common characteristics (Strauss & Howe, 1991). For instance, students born in the 1990s and beyond, have been classified as the *iGeneration* (Rosen, 2011). According to Rosen (2011), the "*i*" represents types of digital technology that are popular with children and adolescents (e.g., iPhone, iPod, iPad, Wii, etc.) and the highly individualized activities that these technologies make possible. Children in this age range in developed nations often expect technology to be available and do not question its existence.

By the time these students reach middle school, between 25% and 35% have personal computers and 81% have cell phones (Rosen, 2010). Today, they frequently

have iPads, iPods, Smartphones, minicomputers, musical devices, or other devices in their possession.

According to Gartner Research Firm (2011), about 65% of the U.S. population, or over 200 million people, will have a Smartphone or computer tablet by 2015. These new devices have led to the term *M-learning*, which stands for mobile learning (Keegan, 2002). Less expensive costs and the advent of wireless networks have made these devices available to many (Soloway et al., 2001).

According to the 2005 Pew Internet and American Life Project, 87% of 12- to 17-year-olds (21 million) are now Internet users, an increase of 24% from the year 2000, and three-quarters of today's teens use at least two digital devices a day. In a study by the Kaiser Family Foundation (2010), students between the ages of 8 and 18 reported spending more than 7.5 hours a day engaged with computers, cell phones, TV, music, or video games. During the time the students reported being on a computer, they also were using another media device. Therefore, they actually may be logging more than 10 hours a day due to multitasking.

According to a report by Apple Classrooms of Tomorrow – Today (ACOT2, 2008), students are required to power down when entering schools, which represents a disconnect between a student's digital life inside and outside of school. Pedagogically, the issue of how students learn becomes important in light of their appreciation for increased engagement when using technology (ACOT2, 2008).

Program Goals

The use of iGeneration technology may contribute to enhanced learning for students in the areas of nutrition and physical activity at the middle school level. In 1992, the National Association of Sport and Physical Education (NASPE) published content standards calling for physical education programs to develop the physically educated person (NASPE, 2004). These standards are at the core of achieving and maintaining a healthy standard of living. Written by a panel of experts in physical education, six national standards describe what students should be able to know and do as they travel from elementary through middle and high school. These standards are built into each curriculum and are used as goals for achieving the physically educated person.

Schools in Florida currently use a new set of standards that complement NASPE's standards called the Florida Next Generation Sunshine State Standards (Florida Department of Education [FDOE], 2008). These additional resources are designed to help achieve benchmarks in each grade level of physical education. Some of the new benchmarks under the middle school lifetime fitness strand are to demonstrate achievement and maintenance of a health-enhancing level of personal fitness by creating, implementing, and assessing a personal fitness program in collaboration with a teacher, and to use a variety of resources including available technology to assess, design, and evaluate the student's personal physical activity plan (FDOE, 2008). Combining the use of technology with teacher instruction in nutrition and physical activity could help achieve these new goals for middle school physical education.

Theoretical Framework for the Study

In 1995, George Graham discussed his concern that the traditional teaching methods and curricula that are common to physical education programs are not necessarily providing students with experiences that are enjoyable, meaningful, or beneficial. Around the same time, the theoretical framework of Self Determination Theory (SDT) was being established. SDT uses motivation to better understand the physical activity and lifestyle changes that have become critical issues in today's society (Ryan, Williams, Patrick, & Deci, 2009).

According to Ryan and Frederick (1997), under SDT, physical activity can be inherently rewarding to both happiness and subject vitality and can satisfy deep psychological needs that contribute to an overall sense of wellness. The psychological needs fall under the Basic Psychological Needs Theory (BPNT) that is incorporated under SDT, which specifies the role of autonomy, competence, and relatedness in satisfying and sustaining motivation, as well as the impact of intrinsic and extrinsic goals on physical activity and a healthy lifestyle (Ryan et al., 2009). Therefore, the motivational strategies under SDT were used in this study to try to address the needs of iGeneration students through the implementation of an application (i.e., app).

Purpose of the Study

There is a lack of research on the use of technology in the form of a mobile application (app), a specialized program downloaded to a mobile device, with adolescents in the areas of nutrition and physical activity. This mixed methods study recorded changes in adolescents' behaviors related to meeting recommended daily requirements in

physical activity and nutrition as measured by a psychosocial instrument and reported perceptions gathered from teachers' and students' about using technology in the form of an app in and out of the physical education classroom. The theoretical framework of SDT (Deci & Ryan, 1985) was used to describe the motivational strategies, such as autonomy, competence, and relatedness, employed in developing an iPad app that was used as a supplemental teaching tool for physical education. A pretest versus posttest statistical analysis was used to compare the psychosocial measures, while interviews, journals, and class observations were used to gather qualitative data about teachers' and students' perceptions of their use of the app.

Hypothesis for Quantitative Measures

It was hypothesized that by combining specific lessons with technology in the form of an app, a significantly higher level of psychosocial measurements in behaviors for eating fruits and vegetables would be achieved from comparing the pre and posttest. The nutritional psychosocial measurements were based on the PACE (2001) instrument, which asked a series of questions about each participant's ability to eat fruits and vegetables throughout the day. It was also hypothesized that by combining specific lessons with technology in the form of an app, a significantly higher level of psychosocial measurements in behaviors for meeting recommended daily requirements in physical activity would be achieved from comparing the pre and posttest. The physical activity psychosocial measurements were based on the PACE instrument, which asked a series of questions about each participant's ability to engage in physical activity throughout the day.

Research Questions

The following research questions were addressed in this study:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

1b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for behaviors that would result in eating more fruits and vegetables?

1c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for behaviors that would result in eating more fruits and vegetables?

2) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

2a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for engaging in behaviors that would result in the meeting the daily recommended requirements for physical activity?

3) How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

4) How do middle school teachers perceive using the AFIT app for teaching nutritional and physical activity content in their physical education classes?

Importance of the Study

This study will provide teachers and students another avenue with which to teach and learn about nutrition and physical activity in physical education classes. Because it used a mobile learning device, it was able to address the motivational needs of current iGeneration students who are defined by their technology and media use, their love of electronic communication, and their need and ability to multitask (Keegan, 2002; Rosen, 2011).

Self Determination Theory (SDT) incorporates strategies that can complement the use of technology in curriculum practices to increase student engagement. In a brief overview of literature about SDT, Ryan et al. (2009) noted that "Clinical interventions

focused on motivating change are effective through their support of patients' autonomy and competence in the process of change, fostering greater internalization and maintenance of behavior change over time" (p. 120). Therefore, it is important to implement and explore the effectiveness of innovations that incorporate such motivational strategies in an effort to combat today's obesity epidemic.

Definitions of Terms

For the purpose of this study, the following terminology was used:

Adolescence: The period between the ages of 13 and 19. The adolescent experiences not only physical growth and change, but also emotional, psychological, social, and mental change and growth (National Institutes of Health, 2011).

App: An application, typically a small, specialized program downloaded onto mobile devices ("App," n.d.).

Autonomy: Refers to the regulation of self (Ryan et al., 2009).

Body mass index (BMI): A practical measure used to determine whether an individual is overweight. BMI is a measure of weight in relation to height that is used to determine weight status (CDC, 2010a).

Calorie: A unit of energy derived from food regardless of whether it comes from proteins, carbohydrates, or fats (CDC, 2010a).

Childhood overweight: Defined as a BMI at or above the 85th percentile and lower than the 95th percentile for children of the same age and sex (CDC, 2010a).

Childhood obesity: Obesity is defined as a BMI of 30 or above, or that is above the 95th percentile for children of the same age and sex (CDC, 2010a).

Competence: Refers to the effectiveness and confidence or efficacy in a person's skill level (Ryan et al., 2009).

Mobile learning (M-learning): The provision of education and training on personal digital assistants (PDA)/palmtops/handhelds, Smartphones, or mobile phones (Keegan, 2005).

Moderate physical activity: Physical activity that can be performed for relatively long periods of time without fatigue. On an absolute scale, physical activity that is done at 3.0 to 5.9 mets. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0 to 10, rating of perceived exertion (CDC, 2010a).

National Association for Sport and Physical Education (NASPE) Standards: A document that presents content standards for what a student should know and be able to do as a result of a quality physical education program (NASPE, 2004).

Physical activity: Any bodily movement produced by skeletal muscles that results in an expenditure of energy (CDC, 2010a).

Physical fitness: A set of attributes with regard to a person's ability to perform physical activities that require aerobic fitness, endurance, strength, or flexibility that is determined by a combination of regular activity and genetically inherited ability (CDC, 2010a).

Relatedness: Refers to a sense of connection with others that includes a feeling of being included and cared for by others within the domain of action (Ryan et al., 2009).

Vigorous physical activity: Physical activity that expends more energy or is performed at a higher intensity than brisk walking. On an absolute scale, physical

activity that is done at 6.0 or more times mets. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0 to 10, rating of perceived exertion (CDC, 2010a).

Assumptions and Limitations

Students at the participating schools are given iPads to use during the school day; the iPads are individually assigned to a student at the beginning of the day and collected at the end of each day. Wireless services are provided for all students throughout the school. Students are not permitted to bring their iPads home, which limits the scope of M-learning. Upon entering the school, students in the study needed to adjust their iPad apps to the previous day so they could record nutrition and physical activity data from the prior evening. Students were required to self-report their information and there were limited checks on the accuracy of this information. The duration of the study was 4 weeks and students were excited to use the new app related to the study. Assumptions were made that the students would fill out the information correctly and accurately. Teachers would use the lesson plans provided and hold an interest in using the mobile devices during class. Students would use the mobile devices during class as well as throughout the school day and have an interest in the material.

Summary

This chapter described the national obesity epidemic and the need to explore the use of technology in interventions. The hypotheses of the study, research questions, and importance of the study using mobile devices and motivational concepts were discussed.

Chapter 2 will review the literature related to the study, which includes the theoretical framework, adolescent development, motivational strategies, and the importance of technology for today's students. Chapter 3 focuses on the methodology, including sample size, research design, app development using SDT, data collection, validity and reliability, and quantitative and qualitative data analyses. Chapter 4 presents the findings and answers the research questions. Chapter 5 includes a discussion of the results and implications for future research.

Chapter Two

Review of Literature

The purpose of this study was to record changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and to report perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. The four research questions that guided this study were:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

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Overview of Obesity

Inactivity and poor diet are responsible for roughly 400,000 annual deaths and may soon be the leading cause of death in the United States (Gordon-Larsen, Nelson, & Popkin, 2004). The Centers for Disease Control and Prevention (2008) showed the increase in obesity that has occurred from 1976-1980 to 2007-2008. Among preschool children aged 2 to 5 years, obesity increased from 5.0% to 10.4%. Among 6 to 11-year-olds, the obesity increase went from 6.5% to 19.6%. Among adolescents aged 12 to 19 years, obesity increased from 5.0% to 18.1% during the same period (See Table 1).

Table 1

Prevalence of Obesity Among U.S. Children and Adolescents Aged 2-19, for Years 1971-1974 Through 2007-2008

Age in years	1971-1974	1976-1980	1988-1994	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
2-5	5.0	5.5	10.0	13.9	15.4	17.1	15.5	16.9
6-11	4.0	6.5	11.3	15.1	16.3	18.8	15.1	19.6
12-19	6.1	5.0	10.5	14.8	16.7	17.4	17.8	18.1

Centers for Disease Control and Prevention (2008)

Increasing physical activity in adolescents is now becoming the target for health promotion (Mhurchu et al., 2008). Observations in the physical education classroom of random middle schools revealed that students engage in moderate to vigorous physical activity for 16.1% of class time, or about 10 minutes (Simons-Morton, Taylor, Snyder, Huang, & Fulton, 1994). Guidelines for current adolescent activity are listed as moderate to vigorous physical activity (MVPA) for 60 minutes per day (Nader et al., 2008). In a large-scale study by Nader et al. (2008), the amount of MVPA activity engaged in by students aged 9 to 15 years was monitored. Using the guidelines for 60 minutes of MVPA a day, a sample of 1,032 students was observed and studied. Their physical

activity was measured by accelerometers (which record minute by minute activity) at ages 9, 11, 12, and 15 years. At age 9, almost all children were above the 60 minutes recommended for both weekdays and weekends. At age 15, adolescents were only engaged in activity for 49 minutes per weekday and 35 minutes on the weekend. Only 31% of the boys and 17% of the girls meet the recommendations at age 15. Differences for income, body mass index (BMI), and geographic region were also analyzed and translated into only a small effect size. The results showed a statistically significant decrease in activity in adolescents from ages 9 to 15. These findings showed a decrease in activity with each year of an adolescent's life. These finding also referred to the lack of activity seen in adults and the trend beginning from the adolescent years (Nader et al., 2008).

Consistent with the previous study, Allison, Adlaf, Dwyer, Lysy, and Irving (2007) found a statistically significant decline in physical activity in both males and females from the ages of 14 to 18 years and an age linear model decrease of .16 days with each increase in aged year. Many of the causes of adult health problems begin in the adolescent years (Berensen & Epstein, 1983).

Background of Adolescent Needs

In a study by Hausenblas and Fallon (2002), the barriers for self-efficacy were examined in young adolescents. Using the Transtheoretical Model and stages of changes, 387 students were examined based on their activity levels. Results found that the majority of middle school students were classified as regularly active, but that rate of activity declined from ages 13 to 18 years of age. This decline was greater for males than

females with other significances found in fitness testing and flexibility in the later stages of adolescence. Pros and cons of physical activity were not noted in the middle school years, which help to indicate that physical activity is expected in the middle school years but is lost in the later stages of adolescents. The study highlighted the stages of changes that adolescents go through and the importance of maintaining the self-efficacy of physical activity. In comparing the results to young adults, there is a significant change in attitude on physical activity and the amount of time spent engaging in said activity.

Another example of studying the needs of today's adolescents was done with an American and English perspective. In a study by Smith and St. Pierre (2009), secondary students from an American and an English school were studied to determine what factors they felt were important in physical education. Using the sport enjoyment model as a conceptual framework, the researchers interviewed the students regarding characteristics of enjoyment. They found that students did not perceive winning or competition as high attributes, but rather the interaction of their peers and teachers were determinant factors. The results suggested the teacher's ability to care, relate to, and understand students impacted whether the students enjoyed or hated physical education. The other two factors discussed were the activities of the students and the environment of the program. The activities can be beneficial if set up to increase the intrinsic motivation of each student. This way each student can be successful regardless of the game's outcome. The environment of the program had much the same feeling, with teamwork and cooperation being the strongest factors in positive feelings. By determining the needs of today's adolescents, teacher and student interaction can be increased and create a better link to the student's enjoyment of a healthy lifestyle.

Middle School Physical Education Standards

According to Graber, Woods, and Castelli (2007), only recently have physical educators had the benefit of referring to national standards to assist them in developing age-appropriate lessons and units. Previously, physical educators had to rely on what they had learned in teacher education and what they read in textbooks, and by what they encountered themselves while receiving physical education in public schools (Graber et al., 2007). Not until 1995 did the NASPE initially publish standards for physical education that were then updated 9 years later in 2004. The national standards provide the framework for a quality physical education program and develop a physically educated individual who has the knowledge, skills, and confidence to enjoy a healthy lifestyle (NASPE, 2004). These national standards are to be represented in lesson plans with objectives that meet these standards and proper assessment of the objectives.

Along with the national standards, each state has the ability to implement state standards with each grade level. In Florida, the latest standards are called the Next Generation Sunshine State Standards (NGSSS; FDOE, 2008). The standards were updated in 2008 and have benchmarks for each grade. The benchmarks for middle school students are under strands of movement competencies, cognitive abilities, lifetime fitness, and responsible behaviors and values. Some of the changes to the new benchmarks include using resources, including technology to assess, design, and evaluate personal physical activity, plan and prepare logs noting the food intake, calories consumed, and energy expended through physical activity (FDOE, 2008). Another important benchmark is the collaboration with a teacher to achieve and maintain a health-

enhancing level of personal fitness by creating, implementing, and assessing a personal fitness program (FDOE, 2008).

Middle School Physical Education Motivation

Several models have been studied in middle school physical education. Smith and St. Pierre (2009) used the sport enjoyment model as a framework and found that a gap existed between what current physical education teachers taught and what students reported to be important attributes. Students referred to a positive relationship with teachers and peers and perceived confidence as their main goals. The students wanted experiences that increased their self-confidence and enjoyment of an activity, which had a direct relation to strong self-efficacy beliefs. Legault, Green-Demers, and Pelletier (2006) found that during the adolescent period there were four main factors that affected achievement in the classroom. The ability beliefs, effort beliefs, valued placed on tasks, and characteristics of the task can either motivate or amotivate the individual. These components of extrinsic and intrinsic motivation are relied on heavily during the adolescent developmental period. Gallahue (1996) found that unless a teacher can develop a program in which the students have at least a general interest and activities that they have a specific interest, there is little chance that they will remain active. Student trends indicate that today's adolescents have gone away from team sport activities and have evolved into social activities related to fitness (Mears, 2008). These changes in activities are related to the motivation of today's adolescent.

Motivation takes on an overall general perspective on the individual, but specific attributes need to be addressed for a motivational theory to exist and work (See Figure 1).

Key ingredients of the motivation and regulation process of human beings are amotivation, intrinsic motivation, and extrinsic motivation (Ryan & Deci, 2002).

Amotivation			Extrinsic Motivation		Intrinsic Motivation
Non-Regulation	External Regulation	Introjected Regulation	Identified Regulation	Integrated Regulation	Intrinsic Regulation
	Other-determined Extrinsic Motivation		Self-determined Extrinsic Motivation		

Figure 1. The self-determination continuum (Ryan & Deci, 2002, p. 16).

Amotivation can be defined as a state in which an individual is neither intrinsically nor extrinsically motivated. It occurs when an individual does not value the activity, the activity is not relevant to the individual, or the individual lacks competence in the activity (Ryan & Deci, 2000). Extrinsic motivation refers to a motivational state that is regulated by external contingencies such as rewards or punishments that will be received for the activity or behavior (Ryan & Deci, 2000). Intrinsic motivation is defined by the state of motivation that drives an individual to engage in the activity or behavior for the inherent interest or enjoyment of the activity or behavior without attaining external contingencies (Ryan & Deci, 2000). "Creating positive fitness experiences, coupled with efforts by teachers to hold them accountable during that time, are a means by which health can be promoted and habits can be formed for patterns of life-long activity" (Schuldheisz & van der Mars, 2001, p. 76).

Self-Determination Theory (SDT)

SDT is a theory that explains motivation by focusing on the importance of humans' inner needs for development and behavior regulation associated with external control (Ryan & Deci, 2000). SDT encourages the use of motivation in the regulatory process of behavior change and has increasingly become a basis for interventions in areas of health and physical activity (Ryan et al., 2009). According to Deci and Ryan (1985, 1991), the innate physiological needs of autonomy, competence, and relatedness underpin self-determination motivation with research supporting the autonomy-supportive environment as opposed to the controlling situations to facilitate self-motivation. This self-motivation is the key ingredient for a teaching method that will help produce a student who will actively engage in his or her own learning and become motivated to continue a healthy lifestyle. The SDT model of health behavior change suggests that an individual's motivation to change the direction of his or her health is heavily influenced by the experiences of autonomy, competence, and relatedness during the phases of changes (Ryan et al., 2009). These basic tenets of the need for competence, autonomy, and relatedness are located in a sub theory under SDT, called the BPNT (Ryan & Deci, 2000) and are essential elements for supporting motivation and wellness (Deci & Ryan, 2000).

Autonomy can be defined as the extent to which instigation and direction of actions comes from within the self (Grolnick, Ryan, & Deci, 1991). This discovering of one's self is very evident in the adolescent years and important to the maturation of the individual. Reeve (2002) described the autonomy support to the events and environments that provide choice and opportunity for self-direction with a minimal amount of pressured

evaluations, imposed goals, and demands. Deci and Ryan (1991, 2000) believed that the innate psychological needs of autonomy are the origin and regulator of individual actions. When individuals feel that their opinions are valued, their feelings are taken into account, and they have the opportunity to make choices and be self-managers, autonomy is enhanced (Deci & Ryan, 2000).

Competence, or "effective-focused motivation," is based on the need to have an impact on surroundings, which manifest in significant results in the environment (Deci & Ryan, 2000). SDT proposes that the feelings of competence can be nurtured in any endeavor, provided the focus is on personal improvement and mastering a task, rather than on a social comparison (Ntoumanis, 2001). Such social contextual events as feedback, communications, and rewards during an action can enhance the feelings of competence (Ryan & Deci, 2000).

Relatedness is characterized by a state of loving and caring for others, with the reciprocal being true, where love and care are also received by the individual (Deci & Ryan, 2000). This need to develop and secure a connection between others is very powerful in the motivation of an individual. Shahar, Henrich, Blatt, Ryan, and Little (2003) found that a close, stable, secure, and nurturing relationship with significant authority figures, such as teachers, is a critical factor for children's and adolescents' development. Relatedness can be associated with extrinsic values where motivation can come from positive rewards. By incorporating relatedness to the self-determination theory, a teacher is able to include all intrinsic and extrinsic motivators for the students in his or her classroom (Deci & Ryan, 2000).

Incorporating Technology

Mohnsen (2004) defined technology as computers, software, or the world wide web, which can be used to help achieve a practical purpose. Mohnsen went on to say that in physical education, this technology can be used to help students improve their physical performance, social interaction, or cognitive understanding of physical education concepts. Technology can offer a possible solution to enhance and extend physical educators' instructional practices and help address the childhood overweight and obesity issue in the United States (Ince, Goodway, Ward, & Lee, 2006). In a recent study of families with children between ages 6 and 13, the average family had four televisions, 99% had a DVD player or VCR, 88% had a video game console, and 85% had a computer with half of those families having Internet access (NASPE, 2004).

While integrating technology into lessons there is also evidence that teachers will need more training to use technology related to teaching methods to improve the performance of their students (Ince et al., 2006). Martin, McCaughtry, Kulinna, Cothran, and Faust (2008) examined the impact of mentoring physical education teachers through their use of pedometers to improve their instruction and reduce their computer anxiety. The purpose of the study was to determine the effectiveness of a year-long professional development program to enhance teacher efficacy at incorporating technology (i.e., computers and pedometers) into their teaching practices. They found that using professional development helped teachers to have longer lasting effects from the training using the technology versus other training methods.

Research is starting to show that mobile devices are a promising technology that can be used to support learning (Hoppe, Joiner, Milrad, & Sharples, 2003). Classrooms

are outfitted with computers, Smartboards, and projectors. In an effort to improve student learning and better prepare them for the future workforce, almost every school has Internet access and about one computer for every four students (Bausell, 2008). All these devices help classroom curriculum, but the next generation will have all these devices in a hand-held model and gather and use information anywhere.

Students today do not know a world where high speed Internet is not available. "Just as we don't think about the existence of air, kids don't question the existence of technology and media" (Rosen, 2011, p. 13) and they will spend nearly all their waking hours using media and technology. Although this high volume of use has been named a contributing factor to obesity, it also indicates that children are accustomed to and familiar with technology as primary tool for information (NASPE, 2004). With the abundance of use of mobile technology with students, a new term has evolved in the use of these devices in education. Mobile leaning (M-leaning), as defined by Keegan (2005), is the provision of education and training on PDAs/palmtops/handhelds, Smartphones, or mobile phones. Mobile devices enable a teacher and student to use computer power anytime and anywhere, while the Internet and wireless technologies enable mobile devices to interconnect seamlessly (Liu et al., 2003).

As students become more adept with using technology, it becomes important to increase the efficacy of teachers. A 2009 report on U.S. trends revealed that only 20% of states require technology training or testing for recertification or participation in technology-related professional development (Hightower, 2009). A study conducted in 2000 by the National Center for Education Statistics revealed that only 23% of 1,674 surveyed teachers felt prepared to integrate technology in their instruction. These

numbers and attitudes have evolved with a more recent study by the NCES (2010), showing 61% of the 4,133 teacher sampled felt that having current training with technology in professional development classes prepared them for classroom integration.

In a pilot study on a college campus (Swabe & Goth, 2005) a hand-held game was created that worked as a campus orientation tour. Students were given tasks to complete around campus, which included finding buildings and exchanging information with specific professors, as they avoided being caught by trailing teams and tried to catch the leading team. General comments were recorded from the students with the second highest reporting that the game added value to the activity as opposed to a traditional college tour. "With the new mobile technology it is now possible to situate problems in their natural context without losing the motivational benefits of the games" (Swabe & Goth, 2005, p. 205). This study helped show the link between intrinsic values and learning potential in M-learning.

Lastly, in an experiment to assess student performance in secondary and tertiary education, research was conducted by means of M-learning on three groups of students (De-Marcos et al., 2010). One hundred and twenty-six students ranging from 14 to 21 years of age and were located in a middle school, high school, and a college setting. The aim was to assess improvements in academic achievement and motivation in adolescents and young adults. Results showed that this tool helped improve academic achievement for adolescents, but did not provide statistical improvement for the high school or college students versus the control group. The attitudinal survey showed that all the students rated the M-learning as a very positive tool for learning. The teachers also rated the teaching tool as positive and having little impact on the changing of current teaching. "In

the field of teaching and learning, the expected benefits of this new mobility include, among others, more efficient instruction together with an improvement in learning outcomes" (De-Marcos et al., 2010, p.1069).

Logic Model

This study would be classified under the Institute of Education Sciences (IES) as a goal two research study. The IES recognizes five research goals. Goal one is exploratory while goal two is development and innovation. Currently, about 50% of studies from the National Center for Educational Research (NCER) and 57% of studies from the National Center for Specialized Research (NCSER) fall under this research goal (Albro, 2010). Under the level two guidelines, a pilot study should be administered and a logic model should be constructed.

According to Taylor-Powell, Steele, and Douglah (1996), a logic model displays the sequence of actions that describe what the program is and will do – how investments link to results. Taylor et al. included five core components in this depiction of the program action (See Figure 2):

1. Inputs: resources, contributions, investments that go into the program
2. Outputs: activities, services, events and products that reach people who participate or who are targeted
3. Outcomes: results or changes for individuals, groups, communities, organizations, communities, or systems
4. Assumptions: the beliefs we have about the program, the people involved, and the context and the way we think the program will work
5. External factors: the environment in which the program exists includes a variety of external factors that interact with and influence the program action. (p. 4).

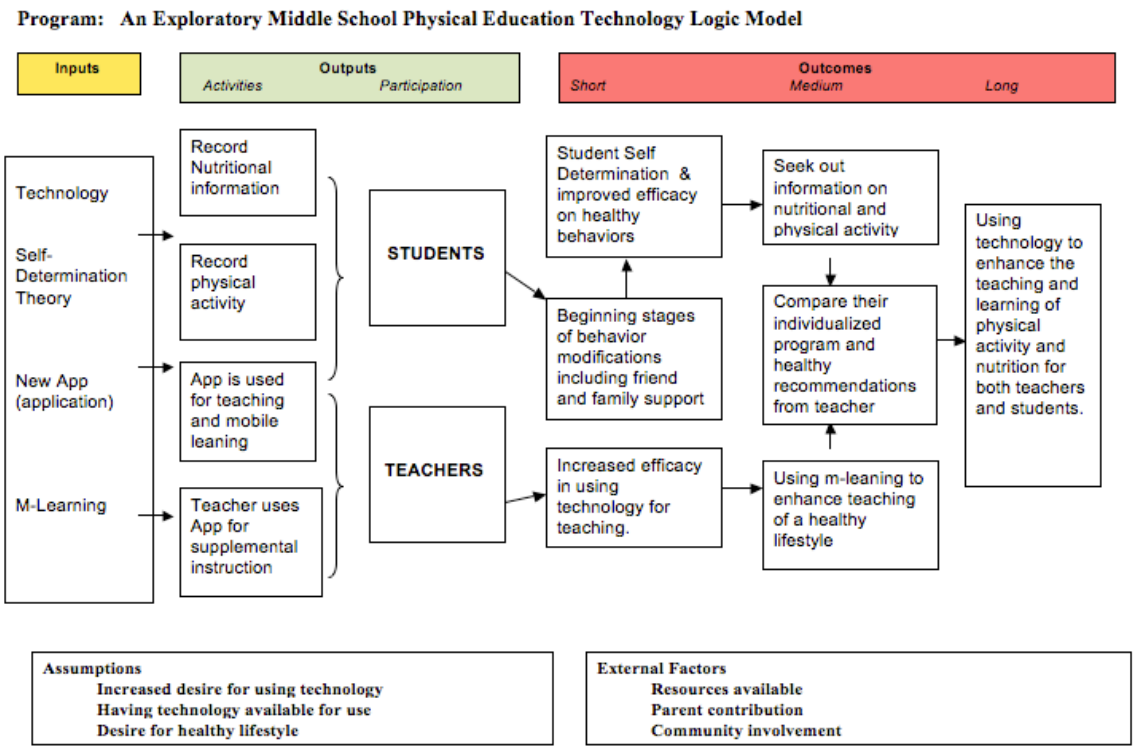

Figure 2. A logic model for the exploratory design of using technology in a middle school physical education program.

Using the logic model designed for this exploratory study (See Figure 2), short-term outcomes were specifically studied. The model used the inputs of technology and components of the SDT as applied in the AFIT app. These components included student autonomy, competence, and the relatedness to the teacher. Goals of a health modification program using input from teachers, technology, and the community are medium to long-term. Teacher efficacy in using technology with student mobile learning is a medium to long-term goal for the teacher.

Other important aspects of the logic model are the assumptions and external factors. Assumptions of increased use of technology in the future and the desire for a healthy lifestyle are reasonable assumptions for adolescents in today's society. The

external factors are items for future research in determining whether outside influences can affect the outcomes of this model.

Psychosocial Influences

"The focus on adolescent psychosocial health is particularly salient, because during the middle school years girls and boys experience many physical, emotional, social, and educational changes that can be challenging to navigate and may negatively influence how they feel about themselves and their bodies" (Greenleaf, Petrie, & Martin, 2010, p. S65). The term *psychosocial* is used quite frequently in the literature in connection with health outcomes, but is an umbrella term in which diverse research about health can be carried out (Martikainen, Bartley, & Lahelma, 2002).

Greenleaf et al. (2010) studied 1,022 middle school students regarding the psychosocial variables of self-esteem, depression, physical self-concept, and body composition as compared in relation to students being labeled in the healthy fitness zone (HFZ) or in the needs improvement zone (NIZ). Findings indicated that after controlling for socioeconomic status (SES), middle school girls that were in the HFZ had higher levels of self-esteem and body satisfaction and rated themselves as stronger, having greater endurance, and having lower levels of depression than the NIZ female students. The middle school boys that were in the HFZ group reported being stronger, having greater endurance, and being more satisfied with their body image than the NIZ group of boys.

In another study, Hoyt, Chase-Lansdale, McDade, and Adam (2012) used a sample of 10,147 adolescents and found that psychosocial influences and positive well-

being in adolescents were significantly associated with reporting better perceived health in young adulthood. This study was unique in that it focused on positive psychosocial influences instead of negative influences and was able to predicted fewer risky behaviors in young adulthood from positive influences.

These psychosocial variables, when placed in context of health, can be seen as mediating the effects of social factors on health outcomes and modified by the social structures in which they exist (Martikainen et al., 2002). Leaving more evidence to suggest that behaviors can be changed through an intervention program by understanding how variables affect the outcome (Baranowski, Lin, Wester, Resnicow, & Hearn, 1997). These variables can come from the umbrella of psychosocial variable research.

Summary

This study was to recorded changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and reported perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. The literature review presented background information about the obesity epidemic and current middle school physical education standards and motivation. The theories of SDT (Deci & Ryan, 1985, 1991) and BPNT (Ryan & Deci, 2000) were used as theoretical frameworks for the study. Recent literature supports incorporating technology into the classroom and the use of psychosocial measurements for changes in adolescent physical activity and nutritional attributes. This study explored the perceptions of teachers and students using mobile technology in the form of an app in a middle school physical education class.

Chapter Three

Methods

This exploratory study recorded changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and reported perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. The AFIT app was created for this study to collect data on nutrition and physical activity and provide an additional resource for teaching nutrition and physical activity. The theoretical framework of Self Determination Theory (SDT) outlined the motivational strategy employed in the app, using the components of autonomy, competence, and relatedness. A pretest versus posttest *t*-test statistical analysis was used to compare the psychosocial measures of fruits and vegetable and physical activity (confidence, family support, and friend support) of the students. Student and teacher journals, interviews, and lesson and lunchroom observations provided qualitative data regarding the processes and perceptions of using the new technology in the teaching and learning of nutrition and physical activity content. This chapter includes a discussion of the research design, purpose of the study, research questions, participants and setting, and methods of data collection and analysis. In addition, the AFIT app and lesson plans are described.

Research Design

The mixed methods approach was chosen due to a growing consensus among researchers that quantitative and qualitative research can complement each other. Using a combination of data collection approaches can provide richer insights and raise more interesting questions for future research than if only one type is used (Gall, Gall, & Borg, 2007). There are three advantages to using this research design: (a) obtaining the convergence and integration of findings to enhance or expand the research, (b) shrinkage of other possible explanations for conclusions made from the data, and (c) elucidating different aspects of the phenomenon under investigation (Johnson & Turner, 2003). For this study, the mixed methods approach allowed the quantitative methods to answer or test hypotheses, while the qualitative measures uncovered additional constructs that were relevant to the study's goals (Gall et al., 2007).

Purpose

This mixed methods study recorded changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and reported perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. The theoretical framework of SDT (Deci & Ryan, 1985) was used to describe the motivational strategies of autonomy, competence, and relatedness employed in developing an iPad app. A pretest versus posttest statistical analysis was used to compare the psychosocial measures, while interviews, journals, and observations gathered qualitative data about teachers' and students' perceptions of their use of the app. The psychosocial measures were fruits and

vegetable and physical activity (confidence, family support, and friend support) and were derived from the PACE (2001) instrument. The scores were based on the average of the questions asked for each section as they related to each participant's ability to engage in behaviors that support meeting recommended daily requirements in eating fruits and vegetables and exercising daily with and without barriers in place (See Appendix A).

Research Questions

The following research questions were addressed in this study:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

1b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for behaviors that would result in eating more fruits and vegetables?

1c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for behaviors that would result in eating more fruits and vegetables?

2) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity

(confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

2a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for engaging in behaviors that would result in the meeting the daily recommended requirements for physical activity?

3) How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

4) How do middle school teachers perceive using the AFIT app for teaching nutritional and physical activity content in their physical education classes?

Participants and Setting

Data were collected from 140 participating middle school students and four physical education teachers at two magnet schools. The students were intact groups that were assigned by the school at the beginning of the year to each physical education class.

A power analysis was performed to determine the appropriate sample size. Setting the alpha at .05 and estimating a medium effect size (due to the limited time in the study) with a statistical power at .7, an estimated sample of 100 was given (Gall et al., 2007). To accommodate the sample size, four teachers were recruited from two different schools and the minimum number was exceeded for this study.

The researcher gained permission from the school district for the lesson plans to meet the national and state requirements, thus allowing every student to use the app regardless of participation in the research study. The teachers were then able to have all students participate in the activities using the supplied lesson plans that incorporated the AFIT app, while teaching content about fruits, vegetables, and physical activity (See Appendices D, E, & F). In the week prior to the study, the researcher met with the IT person for each school and downloaded the newly created app to every student's iPad individually, which totaled almost 600 total downloads.

The two magnet schools were selected based on their initiatives to provide all students with iPads for the current school year. The two middle schools were separated by gender (i.e., single sex school) and were located in an urban part of a large metropolitan school district. Based on data from the Florida Department of Education in 2008 and the demographic pre survey, the demographics for the two schools were as listed in Tables 2 and 3.

Table 2

School & Participant Demographics

Student Characteristic	Participants	State Average*
White	30%	46%
African American	35.7%	23%
Asian	2.1%	2%
American Indian	2.9%	2%
Other	29.3%	NA
Free or Reduced Lunch*	>80%	46%

Note. n=140, *Source: FDOE (2008)

Table 3

Demographic Data of Student Participants

Demographic	School 1	School 2	Percent
Age			
11	06	13	13.6
12	23	36	42.1
13	12	22	24.3
14	07	15	15.7
15	00	06	04.3
Grade			
6	29	53	58.6
7	08	23	22.1
8	11	16	19.3

Note. n=140

AFIT App Development & Theory

The AFIT app that was used in this study was created by the researcher in consultation with an app designer who had recent experience designing healthy apps for

the iPad devices. A new app was needed that would address both nutritional and physical activity content and provide a process for data collection that the middle school physical education teachers could access. As part of the AFIT app, a database at www.afitmodel.com housed the students' self-reported information. The physical educator, upon accessing the app, could retrieve this information and use it during lessons.

Over the past year, the AFIT app was constructed in several phases. Step one involved the initial drawing of the app with a rough outline of the motivational components that it would employ. Step two included the initial trials and testing of the preliminary design. In step three, some of the components were redesigned to have a better flow. Next, in step four, the app was beta tested with college students. Based on these results, the app was again redesigned. In step six, the AFIT app was pilot tested with middle school students. After the pilot study, features identified by the middle school students were added (See Appendix L). Lastly, in step eight, the AFIT app was placed in the app store for easy downloading.

All components of the app incorporate motivational strategies from Self-Determination Theory (SDT; Deci & Ryan, 1985) and a second sub theory, Basic Psychological Needs Theory (BPNT; Deci & Ryan, 1985, 2000). BPNT uses the specific components of autonomy, competence, and relatedness as motivators in SDT. These were used as guides in the design of the AFIT app relative to intrinsic and extrinsic motivation for a healthy lifestyle.

Autonomy refers to the regulation of self when a person can experience his or her behavior as self-organized or endorsed (Ryan et al., 2009). The student version of the

app was designed so students would have full control of the information that they reported. In each of the student components of the app, they self-reported information on their personal behavior. This process allowed them to be in charge of the information and the values they placed on the information. The logs served as reminders of what students reported. Therefore, the app was designed to support the students' need for autonomy as identified in SDT.

The app was also specifically designed to incorporate competence into the students' needs. Competence, or efficacy, is related to a student's ability or skill. For habit changing to take place, a connection to the social environment needs to be present (Ryan et al., 2009). Students born between 1980 and 2000 have an innate ability to use technology; they are comfortable multitasking while using a diverse range of digital media and literally demand interactivity as they construct knowledge (Schooley, 2005). This innate confidence in technology and using the app offered an easier medium for the students to self-report their information. Incorporating the features of an app allowed for access of information in the social environment. Students could access the app and self-report their information while eating with their friends or food shopping with their parents. The app was created to increase students' confidence in choosing a healthy lifestyle outside the classroom and in their social environment.

The final component for the BPNT was the relatedness component of the app. Relatedness refers to a sense of connection with others, a sense that includes caring and support from others (Ryan et al., 2009). The school setting with the teacher and student relationship lends itself to a strong relatedness component and could be obtained by providing a database for the teacher to use to access the student information. This

connection made the students accountable to the teacher and allowed the teacher to see the students' acquisition of knowledge outside the classroom.

AFIT App Components

The AFIT app contains eight main components: (a) the new food plate (USDA, 2011); (b) points and stars; (c) the nutritional log; (d) water consumption; (e) steps acquired; (f) moderate to vigorous activity; (g) the activity log; and (h) the teacher retrieval function.

Food plate. As can be seen in Figure 3, the first component of the app contained the new food plate (U.S. Department of Agriculture, 2011) in outline form.

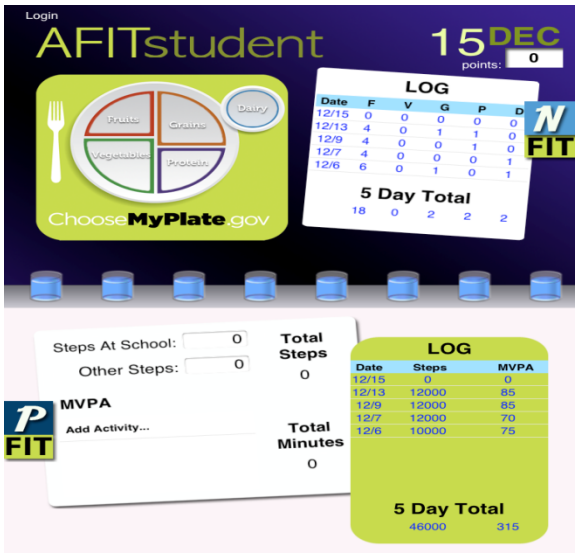

Figure 3. AFIT app at the start of each day.

As students pressed sections of the plate, the app provided food or drink choices (See Figure 4) in a drop-down menu. Students could select the items they consumed. For example, when a student touched the fruits section of the food plate, a list of fruits

appeared and the student could touch the specific food he or she consumed. After selecting the fruit, that section of the food plate started to fill (See Figure 4). The visual display of the food plate could motivate students to complete their plate designs each day.

Figure 4. AFIT app with the fruits tab selected.

Points, stars, and nutritional log. At the top of the student app, points were awarded for any food intake and stars were awarded when the student met recommended daily intake (RDI) goals. The corresponding nutritional log indicated the choices that were made and gave a visual log of the self-reported information. This visual display of information was used as an immediate reinforcement for the student's actions.

Water consumption. The water glasses were used as a divider between the nutritional and physical activity information and for motivation for consuming water. Each glass started out full at the beginning of the day and went empty as it was touched. Points were awarded for the number of glasses consumed and a star was awarded for meeting the RDI of water consumption, which was drinking all eight glasses.

Steps and MVPA. The bottom part of the app contained the physical activity content. Students wore pedometers throughout the study and self-recorded their steps in and out of school. Below the step input was a category for Moderate to Vigorous Physical Activity (MVPA) minutes. The student touched the "Add Activity" link and a drop-down menu appeared (See Figure 5).

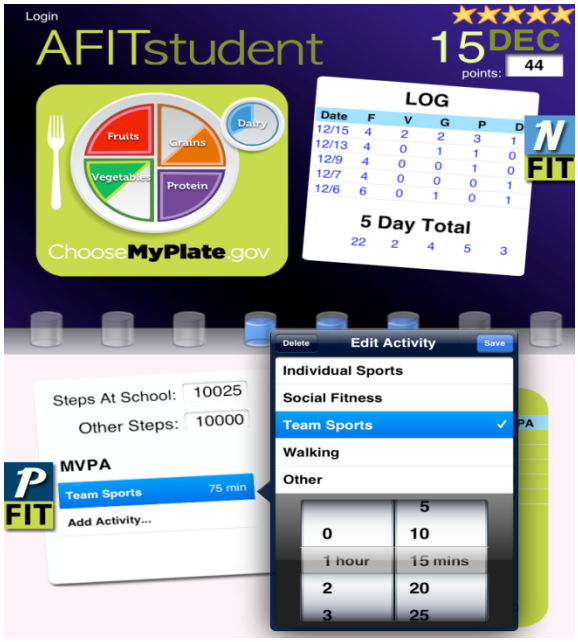

Figure 5. AFIT app with MVPA tab selected.

The activity choices were individual sports, social fitness, team sports, walking, or other. A roll bar was used to input minutes. The student received a star only if he or she matched or exceeded 10,000 steps for the day and another star for every 60 minutes of MVPA. The design of the app and its content were aligned with activities and games in which adolescents engage and used the motivation of points and stars awarded for each activity achieved.

Activity log. The activity log gave daily totals of activity achieved in steps acquired and MVPA minutes. The log also provided a 5-day total at the bottom, which allowed the students to see how they were doing in physical activity for the last 5 days. This information allowed for high input days to offset low input days and gave the students a better picture of their average activity achievements.

Teacher retrieval. The teacher app was set up to be a retrieval system. To enhance security of information, the teacher accessed his or her app by inputting a specific code. The teacher's app design consisted of columns of information for all students (See Figure 6). The teacher's visual display included the date and class period on the top, the student's name, his or her corresponding logs for nutrition and physical activity, and the points and stars that the student received for the day in review.

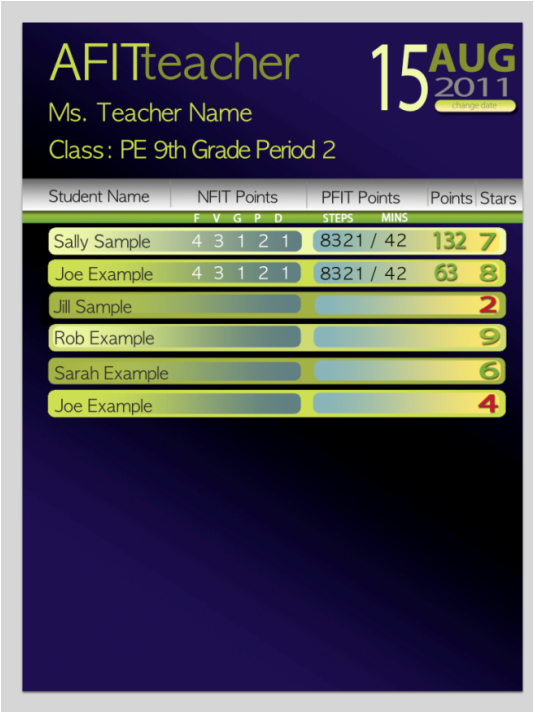

Figure 6. Teacher's version of the AFIT app.

All information was presented in an easy to read format to provide the teacher with a quick summary of each student's self-reported information. This information enhanced the connection between the student and the teacher. The AFIT app provided the intrinsic motivation of the information on the student's app and the extrinsic motivation that could be provided by the teacher's app.

Lesson Plans with the AFIT App

The cornerstone of a comprehensive school effort to increase the physical activity levels in students is a good physical education program (Rink, Hall, & Williams, 2010). In a position statement from the NASPE (2004), the education of the whole child in a physical education class has been termed critical:

> A high-quality physical education program offers a student more than just skill development and physical activity; it emphasizes student learning in all three domains (psychomotor, cognitive and affective). While the psychomotor domain is the most obvious domain of focus in a high quality physical education setting, purposeful instruction in the cognitive and affective domains also enhances student development and fosters a healthy, physically active lifestyle.
>
> Students who are unhealthy, are inactive and lack good nutrition often are unmotivated to learn in the classroom, and that presents a barrier to a complete education. NASPE's position is that a high-quality physical education program, supported by the school and community, is vital to providing students with the education they need and deserve, and is critical to a complete education and development of the whole child. (pp. 6-7)

The position statement highlights the importance of physical activity and nutrition while also emphasizing the appropriate learning domains that need to be covered in an effective lesson plan. According to Rink (2006), student performance standards can define what a student can achieve as a result of an entire program, while instructional objectives can describe what a student will achieve during a single lesson. The

components of the psychomotor domain (i.e., skills and fitness outcomes), affective domain (i.e., feelings, attitudes, and social behavior), and the cognitive domain (i.e., knowledge and strategies) have a responsibility in the lesson plan for enhancing student learning (Rink, 2006).

Three lesson plans were designed for teachers in the research project. These plans were developed using appropriate practices for middle school students as defined by NASPE (2004) standards and Next Generation Sunshine State Standards (FDOE, 2008). They also provided objectives and assessments for all three domains of learning (See Appendices D, E, & F).

The teachers used one lesson plan each week to facilitate the students' use of the app and their continued mobile learning outside the physical education classroom. All four teachers had students in the classroom on Mondays for physical education class. The teachers used the lesson plans on fruits, vegetables, and physical activity in weeks 2, 3, and 4, respectively. The lesson plans were tested and refined by a physical education teacher and the researcher during the pilot study. The researcher, who has been a teacher for over 10 years, reviewed the lesson plans and format with the four participating teachers before the study began.

PACE Instrument

The quantitative instrument used was the Patient-Centered Assessment and Counseling for Exercise (PACE, 2001) psychosocial measures. The questionnaire assesses specific nutritional aspects, including fruit and vegetable consumption, confidence, friend and family support, and stage of change for the adolescent. The

questionnaire also assesses physical activity, including confidence, family and friend support, environmental factors, and stage of change for the adolescent. As a result of the findings during the pilot study, the number of items in this study was limited to pre and post testing of confidence, family support, and friend support for both nutrition and physical activity (See Appendix A). In all surveys, multiple-choice answers and a 5-point autonomy, competence, and relatedness scale ranging from 1 (*never*) to 5 (*always*) asked students about their participation in nutritional and physical activity and influences of associated behaviors.

The PACE instrument has been used with the Centers for Disease Control and Prevention and the National Institutes of Health Resources and Services Administration:

> The instrument was created in 1990 and now is in use with more than 40 professionals with expertise in multiple fields including preventive medicine, health psychology, exercise sciences, behavioral medicine, nutrition, experimental psychology, computer sciences and engineering, media technology and graphic arts, health promotion, pediatrics, internal medicine and family medicine. (PACE, 2007a)

> Current projects of the PACE team are involving exploring how to improve lifestyle behaviors such as physical activity, diet and dietary behaviors in adolescents and adults. Based on evidence from the clinical and behavioral sciences, our focus is on exploring how web, telephone, cell phone and wireless technologies can be used to extend the reach and impact of these interventions. (PACE, 2007b)

In supporting the validity and reliability of the instrument, Zabinski et al. (2006) used the psychosocial measures with adolescent boys and girls to examine the attributes of behavior change (i.e., family/peer influence, pros, cons, self-efficacy, parent/child change strategies, and household eating rules). In this study, 878 adolescents with a mean age of 12.8 years and an age range from 11 to 15 years were given the psychosocial variables questionnaire through a computer program. The results indicated that changes

in behavior, family influences, and household rules were related to daily servings of fruit and vegetables and more of the correlates were found as the children aged. The Cronbach's alpha was tested on the original questionnaire and the retest of the participants. In the fruits and vegetables section, the pros (benefits of eating fruits an vegetables) had .75 on the test and .85 on the retest, the cons (barriers to eating fruits and vegetables) had .85 and .84, respectively, and self-efficacy on fruits and vegetable consumption had .81 and .90, respectively. In the child change strategy (feelings on eating fruits and vegetables), the alpha was .91 on the test and .76 on the retest. This research points to intervention strategies for psychosocial variables and helps support the validity and reliability of the psychosocial variables.

Another supporting study compared the psychosocial measures from a paper test versus a computer-based test with the hypothesis that both measurements would demonstrate adequate scale reliability (Hagler, Norman, Radick, Calfas, & Sallis, 2005). Seventy-six adolescents between the ages of 11 and 15 were selected for this test and retest study. Each subject took three tests and was randomly assigned to paper and computer-based questions. The results supported the hypothesis that there would be no statistical significant difference between the two formats of the test. The Cronbach's alpha for the fruit and vegetable variables of change strategies, self-efficacy, and pros and cons in the paper test ranged from .72 to .86 for the test and from .74 to .89 for the retest. The computer-based test's alpha ranged from .82 to .91 and the retest ranged from .88 to .96 for the same variables. These results supported the reliability of both the paper and computer assessments for psychosocial measurements and pointed to the need for interventions using these measurements. The studies supported the use of the PACE

(2001) instrument with adolescent research in the recording of psychosocial changes in fruits, vegetables, and physical activity. Cronbach's alpha were calculated in the pretest and posttest (See Table 4) and were consistent with previous studies.

Table 4

Cronbach's Alpha on the Pre and Posttest Surveys

Survey	# Items	Cronbach's Alpha Pretest	Cronbach's Alpha Posttest
FV Confidence	7	.76	.81
FV Family Support	4	.79	.82
FV Friend Support	3	.71	.69
PA Confidence	6	.83	.83
PA Family Support	4	.79	.84
PA Friend Support	5	.70	.73

Note. FV = Fruits and Vegetables, PA = Physical Activity

Quantitative Data Collection

Data management. Quantitative data were collected from 140 students over a 4-week period. The data came from a demographic survey that was given on day 1 and a PACE (2001) survey that was given at weeks 1 and 4. All surveys were placed in separate folders and kept in a locked file cabinet in the researcher's office. Data from the surveys were transferred to an Excel spreadsheet on the researcher's computer and the students were given numbers and all names were removed. The spreadsheets were backed up on a 8GB thumb drive and kept in the same locked file cabinet.

All surveys are now being kept in a folder and will be stored for 5 years in a locked file cabinet. All quantitative data on the researcher's computer have been backed up on a 8GB thumb drive and will be stored in the same locked file cabinet for 5 years. After 5 years, the 8GB thumb drive will be erased and all surveys contained in the file

will be shredded. This data storage procedure is repeated for each piece of data collected from the students and teachers.

PACE survey. On Monday of the study's first week, the pretest PACE survey (PACE, 2001) was administered to participating students in their physical education classes by the researcher. The surveys were then given again on Friday of week 4 (posttest) by the researcher. During each administration, the surveys were given at the beginning of the class to ensure ample time was allowed to finish the survey. Students answered each question individually and the researcher was present to answer any questions from the students. As noted in the pilot study, the survey took approximately 10 to 15 minutes to complete and the researcher collected the surveys and placed each class in a separate folder. The students wrote their names on the survey and the researcher created a number for each student. The surveys were transferred, by student number, to the researcher's computer in an Excel spreadsheet for later analysis. The Principal Investigator was the only person who had the list of numbers that corresponded to the student names.

Qualitative Data Collection

Qualitative data were collected from both students and teachers over a 4-week period. The qualitative data came from student and teacher semi-structured interviews at weeks 2 and 4; student and teacher journal entries at weeks 2, 3, and 4; and lesson plan and informal observations during weeks 2, 3, and 4. All written documents collected were placed in separate folders and will be kept in a locked file cabinet in the researcher's

office and will be stored for 5 years. Student and teacher interview transcriptions were placed on the researcher's computer and backed up on a 8GB thumb drive. The Principal Investigator was the only person who transcribed all voice recordings to the researcher's computer.

Student journals. During weeks 2, 3, and 4, each student participating in the research study was given time during his or her physical education class to answer journal prompt questions (See Appendix I). An example of a journal prompt is, "How did the teacher being able to see what you reported make you feel? In your response explain why you felt that way."

The researcher provided a card stock piece of paper that listed the journal prompts. Students were asked to answer the prompts and all papers were collected at the end of the class period. The researcher was present at the writing sessions to oversee the process and record any questions or comments from the students or teachers. The prompts were collected by the researcher and separated for each teacher and each class period. Each student was identified using the same numbering method employed for the PACE (2001) survey. Using responses from the first prompt, several changes were made for the subsequent writing prompts to further explore students' previous responses.

Teacher journals. The first journal response included demographic information to describe each teacher's background followed by the research journal prompts. Teachers were asked to describe their personal demographics and other items such as their experience teaching physical education, teaching experience at the selected school,

and previous experience using technology in physical education (See Appendix G). This journal entry was collected at the beginning of the study.

The following journal entries were completed after each lesson plan on Mondays (weeks 2, 3, and 4) with the four participating teachers responding to specific journal prompts (See Appendix G). An example of a teacher prompt was, "What are your thoughts on using the app for instruction today?" The journal prompts were on a yellow card stock piece of paper, which allowed for easy distinction from the students' journals. The prompts were collected and transcribed on the researcher's computer.

Student interviews. Participating students had small group interviews during the physical education class on Thursday of week 3 at school one and Friday of week 3 at the second school. The selection of students for the small group interview came from individual usage of the AFIT app in the previous week. Three students who used the AFIT app the most in the previous week and three students who used the AFIT app the least were selected to be interviewed at the end of their respective classes. There were more than three students who were equal on the high and low participant list, so a random selection of the three was conducted. Each of the schools had a small group interview with high and low participants. Each group was separated from the rest of the physical education class and interviewed in a quiet classroom. Students were asked to verbally consent to being audio recorded before the session began. The verbal consent was documented for each student by the researcher and marked down in the researcher's notepad before every interview session. No students chose not to be recorded in the group interviews and the students were recorded using a Sony digital recorder.

The student interviews followed a semi-structured format (See Appendix J) and lasted approximately 20 to 30 minutes. The questions in a semi-structured interview are pre-formulated, but the answers are open-ended and can be fully expanded at the discretion of the interviewer and the interviewee and enhanced by probes (Schensul, Schensul, & LeCompte, 1999). Semi-structured interviews play an important role in the development of exploratory models and the preparation of more systematic modes of investigation (Weller, 1998). The recorded interviews were transcribed on the researcher's computer with each student being given a pseudonym. The researcher had a master list that connected the pseudonyms with each student interviewed. After transcription, the digital recording was transferred to a 8GB thumb drive and locked in a secure file cabinet at the researcher's office.

Teacher interviews. The required teacher interviews took place on Thursday of weeks 2 and 3 at school one and Friday of weeks 2 and 3 at the second school. The time of the interviews depended on the teachers' schedules with each session lasting approximately 30 minutes. The interviews took place in a secluded office or classroom to limit distraction during the interviews and were with both teachers at a time. The interview guide used a semi-structured format (See Appendix H). Interviews allow researchers maximum flexibility in exploring any topic in depth and the ability to cover new topics as they arise (Schensul et al., 1999). Both teachers at each school were given a separate folder on the audio recording device and the recoding was transcribed on the researcher's computer using a pseudonym established for each teacher.

Lesson plan and informal observations. During the study, the researcher observed each teacher during one of the lesson plans provided. During these observations, the researcher verified that the lesson plan was being implemented as designed and that the objectives and assessments for each of the three domains were being addressed. In addition, the lesson plans had specific activities where the students generated lists about fruits, vegetables, and physical activity. These lists were collected by the researcher to help verify that the content that was covered in the lesson.

In supporting data for the lesson plan observations, field notes were taken by the researcher. The researcher took on the role of a passive participant (Spradley, 1980) and had limited interaction with the teacher or class during observations. Three main points of interest were noted for the observations. First was the focus on the lesson plan and the implementation of activities by the teacher. Second, the strategies used by the teacher for student and teacher engagement, and finally, the actual interaction between the teacher and student.

In addition to the lesson plan observation, informal observations were conducted. The researcher had a notebook with him at all times and documented classroom activities, teacher and student comments, and distant observations. These forms of observations helped in guiding future journal prompts and interview follow-ups. Each school had a dedicated notebook and the content is now being kept in a locked cabinet at the researcher's office.

Research Procedures

All physical education students in the two schools received the same lesson plans and app technology for the instruction on fruits, vegetables, and physical activity. IRB approval was obtained from the University of South Florida before conducting any research within the schools. The principals, teachers, and the District's Research Division also provide approval for the study and for placing the AFIT app on school property (i.e., iPads). The steps in the 4-week research study are provided in Table 5.

Table 5

Steps in the Research Process

	Daily Schedule				
WEEKS	Monday	Tuesday	Wednesday	Thursday	Friday
1	PACE Survey given to students AFIT app downloaded	Acclimate to AFIT app			
2	Fruits lesson plan taught Student & Teacher journal entries	Students continue to enter information into AFIT app		School 1 Teacher interviews and student small group interviews	School 2 Teacher interviews and student small group interviews
3	Vegetable Lesson plan taught Student & Teacher journal entries	Students continue to enter information into AFIT app			
4	Physical Activity lesson plan Student & Teacher journal entries	Students continue to enter information into AFIT app		School 1 Teacher interviews and student small group interviews	PACE Survey School 2 Teacher interviews and student small group interviews

Data Analysis

Data related to the four research questions were analyzed using different methods. Questions one and two were analyzed using quantitative data analysis that came from a pre versus posttest data collection. Questions were as follows:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

1b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for behaviors that would result in eating more fruits and vegetables?

1c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for behaviors that would result in eating more fruits and vegetables?

2) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

2a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging

in behaviors that would result in meeting the daily recommended requirements for physical activity?

2b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for engaging in behaviors that would result in the meeting the daily recommended requirements for physical activity?

The statistical analysis used a one group pretest-posttest design. The research participants were not randomly assigned and stayed in their intact classrooms that were assigned at the beginning of the school year. Statistical significance for all tests was set at $p < .05$. Demographics for all participants were obtained and used for a profile of the participants (See Appendix M).

For research questions 1 and 2, descriptive statistics were calculated and included the mean, standard deviation, skewness, and kurtosis values. Using the pretest versus posttest design, a two-tailed *t*-test was conducted in the Statistical Package for the Social Sciences (SPSS) computer software (version 20). The reason for using a two-tailed test was to allow for significant changes in the means in a positive or negative direction. For research question 1, the comparisons of the fruit and vegetable self-efficacy, family support, and friend support were calculated using the generated mean from each section.

For research question 2, the comparisons of the physical activity self-efficacy, family support, and friend support were calculated using the generated mean from each section.

Questions 3 and 4 utilized qualitative analysis. Data came from student and teacher interviews, lesson observations, and field notes. Questions were as follows:

3) How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

4) How do middle school teachers perceive using the AFIT app for teaching nutritional and physical activity content in their physical education classes?

The teachers and students in the participating classes expressed their personal attitudes and feelings about the AFIT app as it was introduced in the physical education classroom in journal responses and during interviews.

At the end of each week, the teachers' and students' qualitative data were transcribed. After transcription, data were first read for accuracy. After checking for accuracy, data were preliminarily coded and categorized. Coding notes and responses from interviews and journals allowed distinct concepts to be noted (LeCompte & Schensul, 1999) and also helped determine significance of events in subsequent data collection (Patton, 2002). Data were given preliminary categories that supported follow-up probes in future journal prompts and interview sessions and allowed for confirming or disconfirming support for each theme noted.

The collected data from the teacher interviews were transcribed and coded for common themes to provide insight into the teachers' perceptions about using the technology in the classroom for instruction and having access to the students' out of class self-reported data. The student data were also analyzed for themes and subthemes that

helped reveal their feelings about using the AFIT app both inside and outside of physical education.

All data were analyzed using constant comparison and inductive analysis (Corbin & Strauss, 2008; LeCompte & Schensul, 1999) to identify relationships and themes. Using constant comparison, behavior or language can be separated into discrete concepts, which then can be "chunked" into categories (LeCompte & Schensul, 1999, p. 77).

The information was also shared with a peer de-briefer at the university who had expertise in qualitative research methods and had worked in urban school settings. A peer de-briefer should be someone who does not have a vested interest in the research project and will ask searching questions and present other viewpoints (Lincoln & Guba, 1985). The peer de-briefer was able to pick up on themes that were not easily found by the researcher, while the researcher read the transcriptions. Having an outside entity listen to the researcher's comments and also see the data collected gave new insight into a larger theme that was explored by the researcher. On the following Monday (after a Friday interview), a member check was conducted with the teachers about their responses to substantiate preliminary findings.

At the end of the data collection, interpretations for research questions 3 and 4 were conducted using a triangulation approach. Triangulation involves conforming or cross checking the accuracy of data obtained from one source with collected data from another source (Denzin, 1978). By utilizing all the transcriptions from the collected journal responses, interview sessions for both the teachers and students, supporting data from the observed teacher lessons, and the peer de-briefer's input, a more complete picture was achieved.

Ethical Issues

To address an ethical issue related to this research project, a decision was made to include all the physical education classes in the use of the new technology. The researcher wrote lesson plans that were appropriate for national and state standards and was given permission from the district Physical Education supervisor to allow all students (almost 600) to participate in all activities related to this study. Only those students who returned the permission slips were included in the actual study, even though everyone downloaded the app and was given a pedometer for the complete duration of the study. Several students lost their pedometers during the study, but only those students who were actively participating in the study were given a replacement. These extra measures allowed the teachers to use the lesson plans and activities in all classes, which helped remove barriers between participating classes and non-participating classes. This helped provide a more normal teaching routine throughout the day for the teachers and students.

Regarding my involvement in middle school physical education, as the researcher, I had been going to one of the participating schools for several months as an internship supervisor for the university. Therefore, the students and teachers were familiar to me. I was not as well known in the second setting. Even so, I had been a school physical education teacher for over 10 years and understood the normal proceedings of school activities in physical education. I believe my comfort with middle school physical education helped when conducting interviews with both students and teachers in the study.

I, along with a software programmer for iPad apps, developed the AFIT app used in this study. My interest in the app was grounded in my personal beliefs that technology

has great potential in motivating students and helping teachers communicate content in interesting ways. I kept an open mind throughout the research while exploring the app's usefulness.

Finally, no students were subjected to any physical or mental harm during the research project. The self-reported information contained in the database generated by the AFIT app was secure and teachers were only able to access the data for their classes. Students had access to their self-reported information and I was the only person who had access to all the students' information. At the end of the 4-week study, the students and teachers chose to continue using the app for the rest of the school year. There was no additional grading associated with the project and all students received the same information and technology regardless of whether they were enrolled in the participating research classes.

Summary

The aim of this study was to record changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and report perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. Students were given a pre and posttest on psychosocial measures of fruits and vegetables, and physical activity. Small group interviews with high and low AFIT app participants gave an objective point of view with supporting data coming from the student journals about the app. Teacher interviews after teaching the supplied lesson plans gave insight into how

teachers felt about using the AFIT app. Quantitative and qualitative data were analyzed to answer the research questions of this study.

Chapter Four

Results

The purpose of this study was to record changes in adolescents' behaviors related to meeting recommended daily requirements in physical activity and nutrition as measured by a psychosocial instrument and report perceptions from teachers and students about using the AFIT app in and out of the physical education classroom. The four research questions that guided this study were:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

1b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for behaviors that would result in eating more fruits and vegetables?

1c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for behaviors that would result in eating more fruits and vegetables?

2) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

2a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for engaging in behaviors that would result in the meeting the daily recommended requirements for physical activity?

3) How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

4) How do middle school teachers perceive using the AFIT app for teaching nutritional and physical activity content in their physical education classes?

This chapter presents the results in three different sections. Section one reports the quantitative data that were recorded to evaluate questions 1 and 2. Section two

contains information on the schools' environments and teachers' backgrounds. Section three contains an analysis of the qualitative data to evaluate questions 3 and 4.

Participants and Pre Survey

A total of 140 students and four teachers participated in the study. On the first day of the study, a home survey was given that included a demographic sheet and questions relating to the students' home environment with regard to nutrition and physical activity.

Questions 1 and 2 from the home survey were related to the students' nutritional background. The first question on the survey was; how many times in a week do you bring your lunch to school? The students were given four choices: 0 times per week, 1 to 2 times per week, 3 to 4 times per week, and almost every day. Just under 70% of the study participants said they never brought their lunch to school (See Figure 7). From the data gathered from the FDOE (2008), over 80% of students at the participating schools receive free or reduced lunch, which substantiates the self-reported values in question 1.

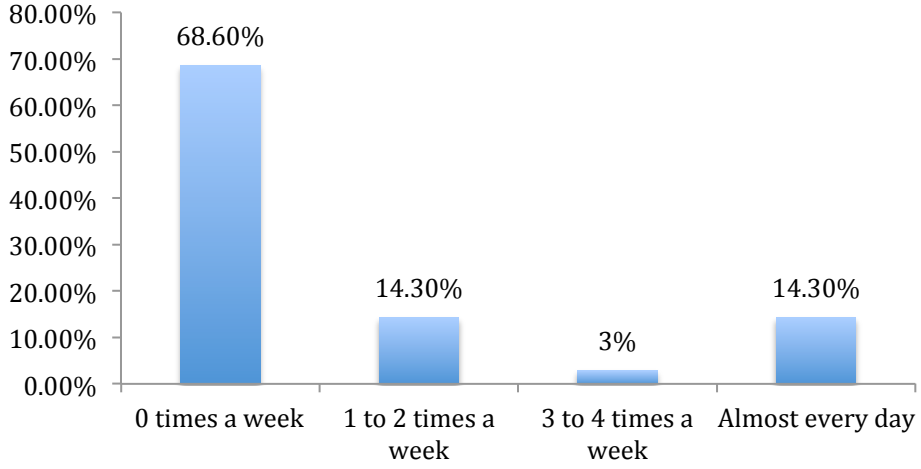

Figure 7. Percent of students who bring their lunch to school in a week.

Figure 8 displays the results from question 2 of the survey, how much do you notice what your friends eat for lunch? Nearly 90% of the students reported noticing what their friends ate for lunch.

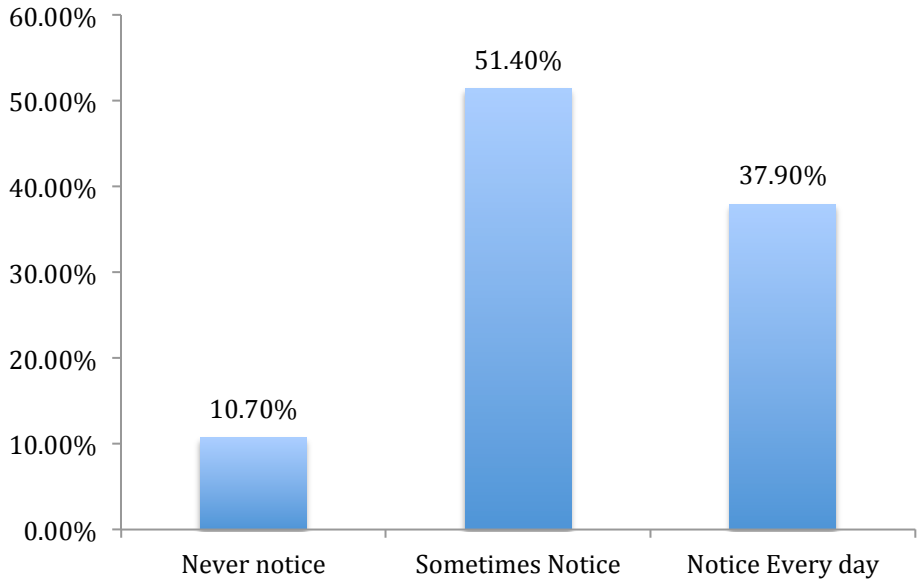

Figure 8. Percent of students who notice what their friends eat for lunch.

Questions 3 and 4 from the home survey were related to the students' household experiences in daily exercise and family involvement in food store shopping. Figure 9 shows the results from question 3, which asked, on average how much do adults in your household exercise, including weekends?

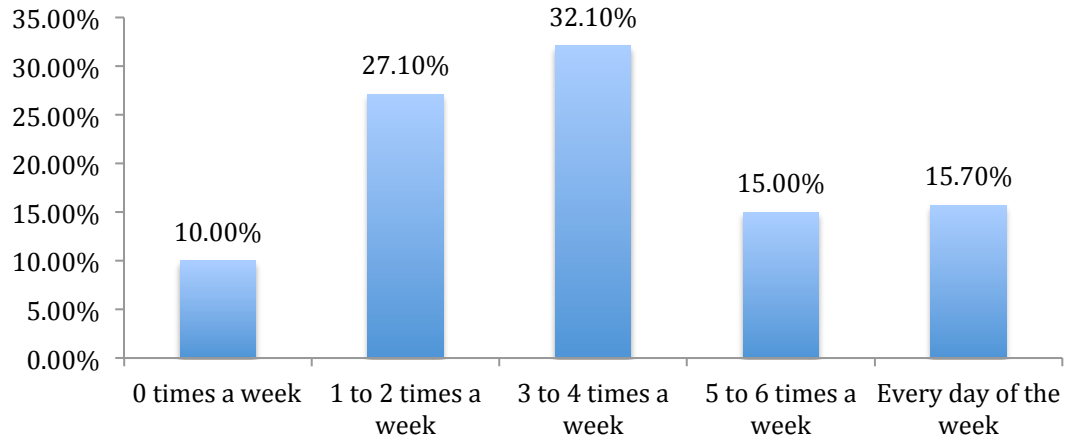

Figure 9. Percent of adults in the student's household that exercise per week.

Figure 9 shows that most students reported that adult members of their household exercised 3 to 4 times a week. Also noted in the figure is that over 37% of the household adults exercised on average 0 to 2 times per week, well below the recommended minimum for adults.

Figure 10 depicts the results of question 4, which asked, how often do you go to the store to help with the household food shopping? Ninety-seven percent of the students reported they went to the store to help with food shopping, with less than 3% saying they never went to the store.

The home survey revealed that a majority of the participants (69%) did not bring their lunch to school on a daily basis but most (90%) noticed what their friends ate for lunch. Most of the household adults exercised 3 to 4 times a week, with small numbers above and below that figure. Almost all of the participating students (97%) went to the store with a family member when buying groceries.

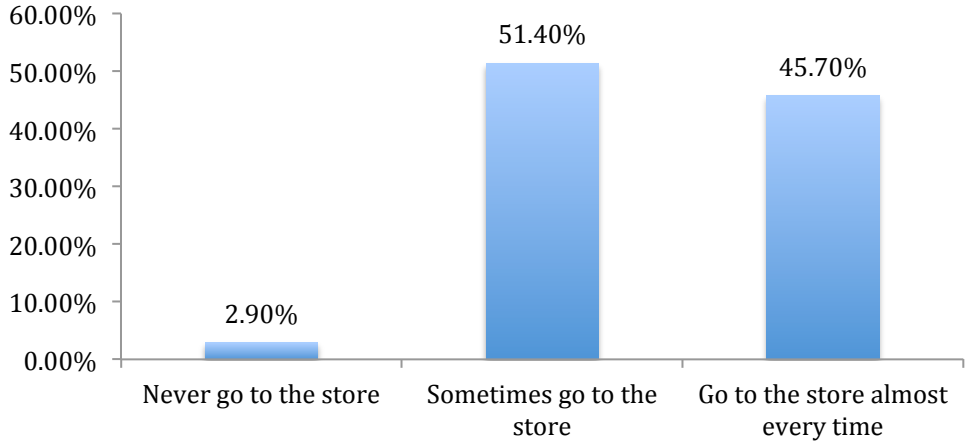

Figure 10. Percent of students who go with a family member for food shopping.

Section One: Quantitative Results

Question 1. Research question 1 asked whether there was a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class. Fruits and vegetable confidence related to the participants' confidence in engaging in behaviors that would result in eating more fruits and vegetables (e.g., I eat five servings of fruits and vegetables a day and I eat fruits and vegetables when out at a restaurant, etc.) and the choices ranged from "I'm sure I can't" to "I'm sure I can." Fruits and vegetable family support and fruits and vegetable friend support asked questions of supporting behaviors to meet daily recommended requirements in eating fruits and vegetables (e.g., encourage

you to eat fruits and vegetables and eat fruits and vegetables with you, etc.) and the answer choices ranged from "never" to "every day." Psychosocial measures were tested at two points during the study—one on the first day of the study and the second on the final day of the study, 4 weeks later. The instrument that was used was the PACE (2001) survey, which consists of five main sections and several subsections. Using the information gathered from a pilot study, the instrument was reduced to three sections for the fruits and vegetables psychosocial measurements (i.e., fruits & vegetables confidence, family support, and friend support) to fit the class time and cognitive constraints of the middle school population.

One hundred and fifty-one students participated in the initial PACE instrument (2001) pretest, which also included the home survey information. Of the 151 students, four of the questionnaires were not completed correctly and were removed from the study. On the final day of the study, two of the students did not fill out the form completely and five of the students were not present, reducing the total participants to 140 students.

For question 1, results were analyzed for fruits and vegetable confidence, fruits and vegetable family support, and fruits and vegetables friend support in a two-tailed paired samples *t*-test. The two-tailed test was used to look for significant mean change in a positive or negative direction. Table 6 presents the descriptive statistics for the fruits and vegetables pre and posttest results. The corresponding mean score is relative to the choices of answers for each section. For fruits and vegetables confidence, the scale scores were as follows: 1 (*I'm sure I can't*), 2 (*I probably can't*), 3 (*neutral*), 4 (*I probably can*), and 5 (*I'm sure I can*; See Appendix A). Mean representation for fruits

and vegetables family and friend support was as follows: 1 (*never*), 2 (*1-2 days*), 3 (*3-4 days*), 4 (*5-6 days*), and 5 (*every day*; See Appendix A).

Table 6

Descriptive Statistics for the Average Pre Versus Posttest on Fruits & Vegetable Confidence, Family Support, and Friend Support

Test		Mean	Min	Max	*SD*	Skewness	Kurtosis	*t*
Fruits & Vegetables Confidence								
	Pretest	3.90	1.00	5.00	0.74	-0.80	0.98	
	Posttest	3.43	1.14	4.29	0.67	-0.69	0.23	9.18**
Fruits & Vegetables Family Support								
	Pretest	3.38	1.00	5.00	1.09	-0.11	-1.03	
	Posttest	3.38	1.25	5.00	1.14	-0.12	-1.03	-0.04
Fruits & Vegetables Friend Support								
	Pretest	3.00	1.67	5.00	0.79	1.01	0.36	
	Posttest	3.10	1.33	5.00	0.90	0.53	-0.48	-1.99

Note. n=140: analysis used a paired t-test
**p<.001

Results from the paired samples t-test between pre and post fruits and vegetables confidence yielded a significant result at an alpha set at .05, $t(139) = 9.182$, $p < .001$. The two-tailed t-test showed a statistically significant change in score, but looking at the means the scores went from 3.90 on the pretest to 3.43 on the posttest. This decline in score was statistically significant, and was represented in the posttest confidence score with the mean being closer to "neutral" than the original "I probably can" pretest score. Each teacher's class was found to have significance in the change in mean score (See Table 7). This breakdown of teachers' scores was used to compare each teacher's class averages and to rule out any outlier teachers using the AFIT app. Each teacher had a decline in score average, which was statistically significant; these results helped to rule

out one specific teacher or class as an outlier that brought down the rest of the class average.

Table 7

Paired T-Test Results for Each Teacher on Fruits & Vegetable Confidence

Teacher	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
1	21	4.25 (.60)	3.63 (.54)	4.07*	.25
2	27	3.97 (.65)	3.42 (.75)	5.32*	.71
3	51	3.81 (.79)	3.52 (.66)	3.06*	.56
4	41	3.78 (.76)	3.22 (.65)	8.15*	.82

Note. Potential range of scores was from 1 to 5.
*p<.01

Results from the paired samples *t*-test between pre and post fruits and vegetable family support and fruits and vegetable friend support did not yield a significant result at an alpha set at .05, $t(139) = -.039$, $p = .969$, and $t(139) = -1.403$, $p = .163$, respectively. No significance was found when the classes were divided between sixth, seventh, and eighth graders as well (See Table 8).

Table 8

T-Test Results for Sixth, Seventh, and Eighth Grade Students on Fruits & Vegetable Family Support

Grade Level	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
6	82	3.54 (1.04)	3.46 (1.19)	0.71	.60
7	31	3.05 (1.09)	3.15 (1.12)	-0.55	.54
8	27	3.28 (1.20)	3.42 (1.01)	-0.55	.30

Note. Potential range of scores was from 1 to 5.

Even though no statistical significance was found, comparing the mean results indicated that the mean for fruits and vegetable family support was greater during seventh and eighth grade, but declined during sixth grade. This is further explored in Chapter 5. The mean results were also analyzed for fruits and vegetable friend support (See Table 9).

Table 9

T-Test Results for Sixth, Seventh, and Eighth Grade Students on Fruits & Vegetable Friend Support

Grade Level	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
6	82	2.99 (.78)	3.16 (.91)	-1.75	.46
7	31	2.84 (.67)	2.96 (.69)	-0.86	.36
8	27	3.20 (.92)	3.11 (1.07)	0.38	.31

Note. Potential range of scores was from 1 to 5.

Results from the different grade levels for fruits and vegetable friend support indicated a higher mean in sixth and seventh grade posttest, but a decrease in mean during eighth grade posttest. This is further explored in Chapter 5.

Question 2. Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class? Physical activity confidence relates to the participants' confidence in engaging in behaviors that would result in meeting the daily recommended requirements for physical activity on a set of questions (e.g., set aside time to do physical activity and do physical activity even when

you have a lot of schoolwork, etc.) and the choices ranged from "I'm sure I can't" to "I'm sure I can."

Physical activity family and physical activity friend support asked questions about support with regard to engaging in behaviors that would increase meeting daily recommended requirements of physical activity (e.g., encourage you to do sports and physical activity and accompany you while doing sports and physical activities, etc.) and the answer choices ranged from "never" to "every day." Psychosocial measures were tested at the same two points as previously mentioned—on the first day of the study and the follow-up on the last day of the study, 4 weeks later. The section for physical activity was also reduced to the measurements analyzing physical activity confidence, physical activity family support, and physical activity friend support. Descriptive statistics are given for the three sections tested (See Table 10).

Table 10

Descriptive Statistics for the Average Pre Versus Posttest on Physical Activity Confidence, Family Support, and Friend Support

Test	Mean	Min	Max	*SD*	Skewness	Kurtosis	*t*
Physical Activity Confidence							
Pretest	3.47	1.00	5.00	1.01	-0.23	-0.73	
Posttest	3.70	1.50	5.00	0.99	-0.43	-0.87	-2.52*
Physical Activity family support							
Pretest	3.54	1.00	5.00	1.09	-0.26	-0.82	
Posttest	3.58	1.00	5.00	1.16	-0.51	-0.79	-0.41
Physical Activity friend support							
Pretest	3.29	1.40	5.00	0.90	0.10	-0.88	
Posttest	3.45	1.00	5.00	0.92	-1.53	-0.66	-1.99*

Note. n=140, *p<.05

The corresponding mean score is relative to the choices of answers for each section. For physical activity confidence: 1 (*I'm sure I can't*), 2 (*I probably can't*), 3 (*neutral*), 4 (*I probably can*), and 5 (*I'm sure I can*; See Appendix A). Mean representation for physical activity family and physical activity friend support was as follows: 1 (*never*), 2 (*1-2 days*), 3 (*3-4 days*), 4 (*5-6 days*), and 5 (*every day*; See Appendix A).

Results from the paired samples *t*-test between pre and post physical activity confidence yielded a significant result at an alpha set at .05, $t(139) = -2.524$, $p = .013$. Using the two-tailed *t*-test showed a statistically significant increase in score from a pretest mean of 3.47 to a posttest score 3.70. This significant result was broken down by teachers and class grade (See Table 11).

Table 11

T-Test Results for Each Teacher on Physical Activity Confidence

Teacher	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
1	21	3.56 (1.06)	3.86 (.99)	-1.31	.51
2	27	3.40 (.86)	3.67 (1.04)	-1.83	.70
3	51	3.55 (.99)	3.80 (.95)	-1.70	.37
4	41	3.39 (1.12)	3.50 (.99)	-0.60	.40

Note. Potential range of scores was from 1 to 5.

Results indicated an increase in mean change from the pretest to the posttest in all of the four teachers' classes and also when the classes were broken down by grades (See Table 12).

Table 12

T-Test Results for Sixth, Seventh, and Eighth Grade Students on Physical Activity Confidence

Grade Level	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
6	82	3.48 (1.01)	3.75 (.95)	-2.23*	.39
7	31	3.39 (1.00)	3.43 (1.07)	-0.21	.55
8	27	3.54 (1.05)	3.83 (.98)	-1.59	.55

Note. Potential range of scores was from 1 to 5.
*p<.05

Results from the paired samples *t*-test between pre and post physical activity family support did not yield a significant result at an alpha set at .05, $t(139) = -.408$, $p = .684$.

Results from the paired samples *t*-test between pre and post physical activity friend support did yield a significant result at an alpha set at .05, $t(139) = -1.990$, $p = .049$. Using the two-tailed *t*-test showed a statistically significant change in score from a pretest mean of 3.29 to a posttest score 3.45. This significant result was broken down by teachers and class grade (See Table 13).

Table 13

T-Test Results for Each Teacher on Physical Activity Friend Support

Teacher	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
1	21	3.20 (.98)	3.74 (.91)	-2.23*	.31
2	27	3.24 (.88)	3.41 (.77)	-0.99	.41
3	51	3.33 (.97)	3.32 (.97)	0.11	.45
4	41	3.30 (.80)	3.50 (.95)	-1.36	.43

Note. Potential range of scores was from 1 to 5.
*p<.05

Results noted an increase in mean from the pretest to posttest for three of the four teachers and for all grades when analyzed individually. This breakdown of results for teachers and class grades was used to look for any unusual circumstances in the results reported and found none were present (See Table 14).

Table 14

T-Test Results for Sixth, Seventh, and Eighth Grade Students on Physical Activity Friend Support

Grade Level	*n*	Pretest Mean (*SD*)	Posttest Mean (*SD*)	*t*	correlation
6	82	3.38 (.92)	3.50 (.92)	-1.02	.36
7	31	2.98 (.88)	3.33 (.86)	-2.06	.40
8	27	3.36 (.80)	3.46 (.99)	-0.60	.52

Note. Potential range of scores was from 1 to 5.

Table 15 presents a summary chart and lists the results from the six psychosocial measurements with the mean differential given. Only one of the six tests resulted in a negative mean differential. This test also resulted in the largest calculated effect size, a medium effect by Cohen's d classifications (Cohen, 1988). The effect size was calculated using the formula for dependent measures $d=tc[2(1-r)/n]m$, where r is the correlation across pairs of measures (Dunlap, Cortina, Vaslow, & Burke, 1996). Cohen (1988) defined effect sizes as "small d =.2, medium d=.5, and large d=.8" (p. 25) and indicated they are commonly used to measure the magnitude of the treatment effect. The effect sizes and relevance will be further discussed in Chapter 5.

Table 15

Results Summary Chart for Psychosocial Measurements

Test	Pretest Mean	Posttest Mean	Mean Differential	*t*	Cohen's d Effect size
Fruits & Vegetables					
Confidence	3.90	3.43	-0.56	9.18**	.69
Family Support	3.38	3.38	0.00	-0.04	.00
Friend Support	3.00	3.10	0.10	-1.40	.16
Physical Activity					
Confidence	3.47	3.70	0.23	-2.52*	.27
Family Support	3.54	3.58	0.04	-0.41	.05
Friend Support	3.29	3.45	0.16	-1.99*	.22

Note. n=140, *p<.05, **p<.001

Section Two: School Environment and Teacher Background

School environment at site one. School site one is an all-girls school located in an urban setting in a large metropolitan city in the southeast United States. The school was changed from a co-ed school the previous year to a newly created girls academy that follows the ideas and philosophies of how young female adolescents thrive in a learning environment. The school's philosophy statement, as listed on the school's website is as follows:

> The (omitted) offers a college preparatory culture in a single gender environment. Students work in a technology rich learning environment where teachers guide instruction with Smartboards in every classroom and where students use iPads to participate in a rigorous curriculum. The focus on academic excellence promotes achievement, pre-AP readiness, professionalism, self-confidence and motivation in a stimulating atmosphere that prepares young women for success and allows them to grow as leaders while developing a positive self image. After school, students have the opportunity to extend their learning and expand their horizons through Enrichment Academies that include Debate, Model United Nations, Strategic Games, Golf, Academic Tutorials and other programs based on student interests. (School website, 2012)

This school was selected for the study due to its use of technology with middle school students. Each student is given an iPad at the beginning of the school day and it is collected at the end of each school day. The teachers adopted a philosophy to encourage technology use in the classroom with the addition of the tablets that were given to all students.

Teacher backgrounds at site one. Teacher 1 is a 36-year-old African American female with 13 years of teaching experience. She is "somewhat comfortable" using technology and has experience with Smartboards, laptops, Palm Pilots, iPads, and projectors in and out of the classroom (Teacher journal 1). When asked about the importance of using technology in a physical education classroom, she reported, "it is the way of the twenty-first century and students will use the technologies to become more creative in their learning" (Teacher journal 1). Her classroom is decorated with health-related materials (bulletin boards with health components), there is a Smartboard with a projector connected in front of the classroom, and the chairs and desks have health books set underneath for the students before class starts (Classroom observations).

Teacher 2 is a 32-year-old Caucasian female with 4 years of teaching experience. When asked about her comfort level with technology she responded by saying, "on a scale from 1 to 10 with 10 being the highest I would give myself an 8" and reported that she feels "comfortable using iPads, Smartboards, computers, apps, videos, Wii, etc." (Teacher journal 1). When asked about the importance of technology, she said "it provides engagement with all the students having an iPad, in which we can utilize in class and during group assignments" (Teacher journal 1). She also reported that "students can

use their personal devices to create presentations and then hook up to the Smartboard to display to the class" (Teacher interview 1). The class is set up much like that of Teacher 1, with the addition of bell work on the board as students enter the classroom. Students start their assignments by using the textbook under their seats or using their iPads to look up information for the day's class immediately after entering the classroom (Classroom observations).

School environment at site two. School 2 is an all-boys school located in an urban setting in a large metropolitan city in the southeast United States. The school was changed from a co-ed school the previous year to a newly created boys academy that follows the ideas and philosophies of how adolescent males thrive in a learning environment.

> In a single gender environment, we will deliver an education which will inspire and empower young men to master rigorous academic standards by instilling in them a strong work ethic and expecting them to model core values in both school and community. (School website, 2012).

The school is set up to facilitate healthy competition between classes and grades, which complements the tendencies of male adolescents. This philosophy became evident as the boys compared their points and stars using the AFIT app and Teachers 3 and 4 incorporated low pressure competition within their classes (Classroom observations).

The school was selected due to its use of iPads with middle school students and faculty. The two school sites are partner schools and the local school district wanted the same resources to be used at both locations and was a conditional requirement for any study to be conducted at these locations. This allowed for an increase in student and teacher participants and helped to increase the strength of the study.

Teacher backgrounds at site two. Teacher 3 is a 35-year-old Caucasian male with 9 years of teaching experience. This was his second year at this school and he gave himself a "6.5 on a scale of 1 to 10" for comfort level in technology (Teacher journal 1). He reported that he "frequently uses the computer, iPad, and the Smartboard for researching information and utilizing in various ways in the classroom" (Teacher journal 1). When asked why he felt it is important to include technology in the classroom, he explained that "it is where everything is heading and the students really enjoy it" (Teacher interview 1). The classroom is set up with round tables on the sides and rows of desks in the middle, which allows him to have both group work stations and individual work desks (Classroom observations).

Teacher 4 is a 38-year-old Caucasian male with 3 years of teaching experience. He felt "somewhat" comfortable using technology in the classroom and has had experience in Wii-fit, BMI measuring, and using videos in the classroom (Teacher journal 1). When asked about his use of technology, he explained that he "likes using technology that will give a visual example of the content being covered, which helps the students connect to the material in a different way then [*sic*] a book would" (Teacher interview 1). The classroom is located behind Teacher 3's classroom and is a large resource room that can handle a variety of activities. There are large rectangular tables, smaller round tables, and there is an area on the side that can hold a mock jury trial. Teacher 4 uses the small tables for his class activities, which are located in front of the Smartboard and projector with a connecting podium (Classroom observations).

Section Three: Qualitative Data Analysis

This section describes teachers' and students' perceptions of the benefits and obstacles related to their use of the AFIT app. Notations for data and triangulations are as follows: TI = teacher interview (See Appendix H), SI = student interview (See Appendix J), TJ = teacher journal (See Appendix G), and SJ = student journal (See Appendix I). Students were also given a code that consists of the teacher (1-4), class period (1-7), and individual student number on their roster (1-36) for easy referencing. For example, a quote followed by (SJ2,3,4,12) is a reference to the second student journal from teacher number three's fourth period class written by the twelfth person on the class roster provided to the researcher.

For 4 weeks, the students and teachers interacted with the AFIT app and participated in lessons using the app. After each lesson, teachers were given journal prompts to capture their perceptions about using the app for instruction purposes. The students were also given journal prompts that contained several open-ended questions related to their enjoyment and use of the mobile technology outside the classroom (See Appendix I). Weekly interviews were conducted with each teacher and small groups of students to gather their perceptions of using the AFIT app in and out of the classroom (See Appendix J). In the small group interviews there were six students selected in two separate groups, one group included three students who were using the AFIT app every day, while the second group contained three students who did not use the AFIT app the previous week. These six students were given pseudonyms for reporting purposes and were interviewed at weeks two and four. Several classroom observations were conducted to study the interactions between the teachers and students while using the AFIT app.

The following sections will be used to answer research question 3: How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

Benefits to students. Students found the AFIT app to be personally motivating and empowering both in and out of the physical education classroom. They conveyed these ideas to their family members and noted them in their weekly journal responses and small group interviews. In the first interview, Desi said "I have been telling my family about the app and they want to download it to their phones so they can keep track of their eating as well" (SI1), while Trevonte commented that "I was talking to my little brother and sister about the app because they found my pedometer and think it is cool" (SI1). Sam said, "I told them it [the pedometer] actually encourages me to walk and not just sit down and be lazy" (SI1). "My dad downloaded on his iPad and I showed him how to enter stuff, I am going to see how many stars he can get" (SJ1,4,4,6) and "my mom said it was a good idea and will download it on her iPad so she can see what she can eat" (SJ1,1,3,17) were examples of how student motivation continued outside of class. One student described taking her "iPad to Walmart to pick more fruits and vegetables off the list" and continued by expressing her parents "were excited that I was eating healthy" (SJ2,2,2,12).

Examples of motivation that came with the using the AFIT app within the schools were seen in the classroom and lunchroom observations as well as journal responses. In a journal response, one student said that "at lunch I used to take the meal, juice and chips, but now since I have been using AFIT, I take the meal, juice, and a fruit or vegetable"

(SJ2,3,1,11). These ideas were reinforced during observations in the lunchroom, as students were excited to show me, the researcher, what they were eating at lunch and I sat and talked to several of them during the lunch period. They pointed out fruits and vegetables, or in some cases were desperately trying to convince me about the fruits or vegetables they had eaten before I arrived (Observation 3).

Some additional examples of motivation from the journals included, "it motivated me to eat more healthy" (SJ1,4,6,9) and "I have been trying to add more healthy stuff to my plate" (SJ2,3,2,3). The students had become focused on eating more vegetables and fruits after the first two lessons and were finding it difficult to meet the RDI of those categories. Students were journaling that they had been trying to "eat more fruits and vegetables" (SJ2,1,3,9) and "it keeps me healthy, but it is hard to fill up [the food plate]" (SJ1,4,3,14).

Other indications of motivators were captured by the AFIT app's reward system. Responses included "it makes me feel good when you get a star and it lets me know what foods are better than what I eat" (SJ2,4,5,5), "I like the way it encourages you when you do something good, it makes me want to be healthier" (SJ2,2,2,6), and finally, "I like the encouragement it gives me to be healthy" (SJ2,3,2,1). Another form of motivation and empowerment came through a reported behavioral change, as indicated in journal responses such as "I eat breakfast everyday [*sic*] now that I use the AFIT, but before I didn't" (SJ2,1,2,9) and "I normally eat junk food after school but I have cut back a little" (SJ2,2,5,12). During the interview, in referring to the AFIT app, Sam said "I was actually thinking finally something awesome to do on the iPad and it actually encourages me to do good things at home like I usually want to eat more good things instead of the

bad stuff with sugar and stuff" (SI2). Another student commented, "I think this will help me be healthy, by me changing" (SJ1,1,3,7) and "it helps me with my daily life and it makes me want to exercise more and eat healthier" (SJ1,1,7,7), exemplifying student motivation and empowerment.

In designing the AFIT app, specific attention was given to the extrinsic motivators and those reward choices were captured in journal responses, small group interviews, and classroom observations. "I like that I get points for everything I do, plus you get a gold star for a certain amount" (SJ2,1,3,4) and "it tells me how many points I get for eating right, drinking water, and the steps I took" (SJ2,4,4,6) were some journal examples. The points the students were referring to were the values that were given for each food item and physical activity reported and the stars were earned for meeting the RDI of a food choice or physical activity. In the small group interviews the students reinforced their perceptions of the rewards system and the AFIT app's ability to provide feedback. "I like that the app gives points for everything" (SI1) said Sasha and "I like the crunching sounds with eating and the running sound with my steps" (SI1) added Tori.

In the interview with the daily users, the first question asked was, "What do you think about the AFIT app?" (See Appendix J). Henry thought "it was very cool how I can track what I eat and my steps and get points for everything" (SI1). Trevonte liked the graphics and also how it "basically reminded me to maintain my diet and how much I exercise" (SI1). Some of the journal responses about the AFIT app elicited comments such as, "I thought this could really help me as it keeps track of what I eat and lets me know how healthy I am" (SJ1,2,6,2). Another student commented "that it lets me keep

track of my record of my lifestyle" (SJ1,3,4,6), while another student pointed out that "that app made me happy that I could see how fit I was becoming" (SJ1,3,7,8).

The majority of comments reflected how the app increased students' motivation in achieving a healthy lifestyle. Responses such as "it helps me keep track of my nutrition and it keeps me get organized on what I eat" (SJ2,2,5,29) show the empowerment that students felt while using the app. The students continued to reflect on how the app helped them and what changes it could make for their health. A student commented in his journal that "I feel more successful when I achieve a star and makes me eat healthier" (SJ2,2,4,5), while another noted that "it changed the way I eat" (SJ2,2,1,9). A final student suggested that "the app gave me more courage to exercise and to try and eat better" (SJ2,2,1,9). These comments were highly reflective of the personal achievements that students were gaining from the rewards system in the app and how it translated into improvements in their lifestyle.

Finally, beneficial applications of the app could be seen in how the students were engaged while using the app. In classroom observation 3, a teacher used the AFIT app to create a tri-fold handout about fruits and vegetables. The students worked in small groups and created the information that was placed in the pamphlet that was to be sent home (See Appendix N). Every student was engaged in the activity and the teacher was able to walk around the room and observe the creations from the students. Teacher 2 commented that "these are the type of activities that I like to do the most; the students create the content themselves and can take it home to show their parents" (Observation 3). The motivation was in the activity and within the class. I asked another student after a classroom activity whether he liked using the AFIT app during the PE class. He

commented, “I think it is cool that we can use our iPads in class, it is much better than reading from a book” (Observation 2).

Obstacles for students. The AFIT app did not resonate with every student during the study and several found little to no positives when using the new app. In a question about the reasons students did not like using the app, one student commented, “mainly because it was not my thing and because it was not that exciting” (SJ2,4,2,15). Two students commented about time constraints and how they affected their app use: “It is a lot of work to do everyday [*sic*]” (SJ2,1,3,16) and “it was hard to do daily and time consuming” (SJ2,2,3,19). Other students commented that they kept forgetting to input their numbers each day. This led to another problem with the anxiety some students felt about the information being seen daily by the teacher.

During the small group interview with the non-users, I asked, “how does that make you feel about the teacher seeing your daily information?” Sasha said, “well sometimes when you forget to do it they will announce your name out loud and it is kind of embarrassing because everyone does it but you forget too” (SI2). Desi responded with, “I am okay with the teacher seeing it, but just like Sasha said sometimes I forget to update it” (SI2). The most compelling comment came from Shantel after the same question, “sometimes I forget to update so then if coach will see I did nothing this week and she will think I am a lazy person, and I am not a lazy person. So basically like forgetting to put in anything will make a bad impression” (SI2). Using this app had its advantages, but at the same time this could lead to an increase in anxiety and remorse if improperly displayed.

Even though the app was used as a supplemental teaching and learning tool, some students felt it increased their schoolwork and responsibility. During a small group interview, Tori expressed that she did "not use the app, because I forget to do it and I am usually busy" (SI2). Several students wrote in their journals that they were busy with other class work and did not use the app outside of PE class and would forget when at home. In classroom observation 2, I noticed that the students were checking their pedometers and asked whether they were inputting their numbers at night or in the morning. This group suggested that they did not enter in their numbers into the app (Observation 2) and when asked why not, there was no specific reason given—the students just shrugged their shoulders and one said, "I don't bother to log my numbers in, I just check the numbers myself" (Observation 2). "Several students had lost or damaged their pedometers and stopped using the app" said Teacher 4 (Observation 2). Another student commented in his journal that "I prefer not to use it, because I never have time and it just shows what is wrong with what I ate" (SJ2,1,3,18).

During the 4 weeks of the study, teachers were asked to use the specific lesson plans to teach about fruits, vegetables, and physical activity. The lesson plans supported the newly created AFIT app and made a connection with the teachers and students using the mobile technology. Teachers were interviewed, given weekly journal prompts, and observed to triangulate the their perspectives using the AFIT app for supplemental teaching. The following sections will be used to answer research question 4: How do middle school teachers perceive using the AFIT app for teaching nutrition and physical activity content in their physical education classes?

Benefits to teachers. The teachers believed the AFIT app enhanced their programs in several ways. Teacher 3 discussed the increased attention his class received from other teachers and administration. My first question in the teacher interview (See Appendix H) was, "describe your experience with the AFIT app so far"(TI1). Teacher 3 described his experience with the app by stating, "I am truly excited that other teachers and administrators were talking about my class and the importance of the content" (TI1), and other teachers were pleased with the effect the app had on their instruction. Teacher 4 described it as a "very useful source of information, which allows for interactive learning with students" (TI1). Teacher 1 echoed this idea during the interview. She said she "simply love(s) the idea of using the app for instruction and it's a great supplement to get students more involved in the lesson by serving another avenue to enhance learning. I think the AFIT app is an amazing tool that can be used by teachers and students to become more aware about their own nutrition and physical wellness" (TI1). Teacher 2 agreed that "the students immediately took to the lesson and were fully engaged while using the app" (TI1).

During an observation, Teacher 2 expressed that she was happy that "there is finally an app for us." She continued to talk about how most of the teachers were using different apps and specific iPad tools in their classrooms because they were in a technology-focused school, but she felt that Physical Education had not been involved in those conversations until now. She believed "people would not think that technology can be used in Physical Education classes, but there are more health-related apps out there than probably any other category" (TJ2). Even at the end of the study, three teachers continued to feel increased recognition and support for their program as indicated by

Teacher 3's last journal where he stated that, "the people I spoke to wanted to know what we were doing with the pedometers and thought it was a great idea and wanted to do this with the faculty" (TJ3). Teacher 4 and Teacher 1 also noted continued recognition of the app by others in their schools.

> I have heard some faculty state that they love the idea of using apps to enhance the students learning experience. Some even stated that they wish they had access to some new innovative apps like the AFIT, because they have noticed that it has captured the attention of their students (TJ3). (Teacher 4).
>
> I have heard how the teachers and administration love the app. It is increasing student motivation to be more physically active and make healthy food choices during the school day. I have also experienced parents asking about the app and how to get it! I feel that the app is contagious and will help sweep the student and adult populations into a health and wellness craze! (TJ3). (Teacher 1).

Even though teachers recognized that the app had brought more recognition to their program and involved them more fully in the technological focus of the school, they still varied in their own personal excitement relative to using the app. Most expressed excitement with the app because they could see the excitement in their students. The teachers discussed ways in which they believed the students were enjoying the app. They had observed them using it during "their downtime" (Teacher 4, interview 2), creating "friendly competitions with each other" (Teacher 3, TJ2; Teacher 4, TJ2), or "to socialize with their friends" (Teacher 4, TJ2). Teacher 2 was excited to see how the "students especially enjoy the app as it provides them with some immediate positive feedback" (i.e., points adding up and/or accumulating stars; TJ2). In Teacher 1's final journal (TJ3) when asked, "please add any comments you have about this being the final week of the study" she commented, "I do not want the study to stop this has been exciting for both the students and myself."

Obstacles for teachers. The teachers did not always have a high level of excitement with using new technology in an already very busy curriculum. One of the obstacles to implementation of the app included downloading problems. The sixth grade classes were using iPads during the install morning, so they had to be downloaded a few days later. Because the app could not be downloaded in all classes immediately, Teacher 2 felt as if she had started behind for this class. In addition, during the first observation, she indicated that several students had "already lost their pedometers before they even can start." All students in the school, regardless of participation in the study, were given pedometers. These devices were to be used with the app for students to self-report the number of steps they took in a day. Teacher 1 and Teacher 4 mentioned occasional problems with the Internet connection at their respective schools. There were several other complaints from teachers about the pedometers being lost, students forgetting their usernames and passwords, and students forgetting their iPads and having to use a loaner version that did not have the AFIT app installed—these obstacles were noted during observations 1 and 2 and in journal responses. These problems led to some frustration with using the AFIT app and diminished the teachers' level of excitement with this innovation.

Immediately after teaching the first lesson plan, the teachers seemed to realize they were not fully prepared to implement the new curriculum using the AFIT app. Teacher 4 stated that "he would like more tutorials in using the app and also thought it would be effective to use with the entire faculty and train the teachers on how to use this prior to the school year" (TJ1). At the same time, Teacher 3 wrote that he felt "it is

important for the teacher to have a knowledgeable understanding of the app in case of potential questions or concerns that may occur" (TJ2). He continued by saying, "I feel the students would benefit more if I had covered the material more effectively" (TJ3). Teacher 2 suggested that they "spend a little more time on how to use the information in the app, it seems like the students and myself are still learning the technology" (TJ2). During the first class observation, limited content was covered as both the teachers and students were focused on learning how to use the app (Observation 1).

Although the teachers seemed unprepared the first week, by the second week they were much more confident and were beginning to think about how they could modify the lessons for their own classes. Teacher 4 asked, "can I change the lesson plan you have for us to teach in a little different way?" and Teacher 2 indicated that she had "another idea for a lesson." By the end of the study, several teachers had created new ways to cover the information (Observation 3). Teacher 1 created a lesson in which the students made tri-fold handouts that contained all the information that was to be covered that day using the AFIT app (Observation 3; See Appendix N). They were able to take the pamphlets home to educate their parents about proper food choices for the fruits and vegetable category. Teacher 4 had the students make a short video presentation on the material and displayed the videos at the end of the class for each group (Observation 3).

Summary

This chapter contained a description of the student participants, including demographics and an overview about their home nutrition and activity levels. The chapter also described the teacher participants in terms of their demographics, technology comfort, and classroom environments. The four main research questions were answered

with the data collected from journal entries, student and teacher interviews, classroom observations, and a student pretest and posttest survey. One of the three psychosocial tests given for fruits and vegetables (i.e., confidence, family support, and friend support) was found to be statistically significant (fruits and vegetables confidence), but had a negative mean change. Two of the three psychosocial tests given for physical activity (i.e., confidence, family and friend support) were found to be statistically significant (physical activity confidence & physical activity friend support) with a positive mean change. Beneficial impacts for using the AFIT app were captured for both teachers and students, while obstacles for using the AFIT app were also present in journal responses, interviews, and classroom observations. Students found empowerment in using the AFIT app, presenting intrinsic, extrinsic, and amotivation characteristics. Teachers found excitement using the app through the eyes of the students, with autonomy, competence, and relatedness components. Chapter 5 will discuss the results specific to current research and theories of motivation and draw conclusions and future implications.

Chapter Five

Discussion

This chapter discusses the key findings from Chapter 4, including general conclusions that can be made from the results and recommendations for further research related to the impact of using mobile technology in the physical education environment. The following questions were used to guide the study:

1) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in nutritional components of fruits and vegetables (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

1a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in eating more fruits and vegetables?

1b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for behaviors that would result in eating more fruits and vegetables?

1c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for behaviors that would result in eating more fruits and vegetables?

2) Is there a significant improvement in psychosocial measurements of behaviors related to meeting recommended daily requirements in components of physical activity (confidence, family support, & friend support) when using the AFIT app for supplemental instruction in a middle school physical education class?

2a) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased confidence in engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2b) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased family support for engaging in behaviors that would result in meeting the daily recommended requirements for physical activity?

2c) Do middle school students who use the AFIT app as a supplement to instruction in a physical education class report increased friend support for engaging in behaviors that would result in the meeting the daily recommended requirements for physical activity?

3) How do middle school students perceive using the AFIT app while learning about nutrition and physical activity in their physical education classes?

4) How do middle school teachers perceive using the AFIT app for teaching nutritional and physical activity content in their physical education classes?

Healthy Behaviors Mirrored in School and at Home

At the start of the study, participants filled out a brief questionnaire (See Appendix M) about their age, ethnicity, and a home survey of nutrition and exercise behaviors. Questions asked students about bringing their lunch to school, noticing what their friends ate for lunch, exercise habits of the adults living in their household, and grocery store trip frequency. These brief background questions supported the idea of students' behaviors being mirrored at school and at home.

Results from the home survey indicated that almost 70% of the students did not bring their lunch to school on a daily basis and a research observation was made that a large majority of the students came to school, some more than an hour early, and were given free breakfast. The students noted that almost 70% of the adults in their households exercised fewer than five times per week, thus not meeting the RDI for adults. Combining the home survey nutrition and physical activity information supported the need for increased education within schools regarding the importance of fruits and vegetables and physical activity in and out of school. It has been suggested that a physically active lifestyle in adulthood may originate from an active lifestyle in the adolescent years (Shephard & Trudeau, 2000). This information needs to be addressed for students and their parents to understand the importance of modeling a healthy lifestyle in and out of school.

The home survey indicated that 97% of students went to the store with members of their household. Having students give input into their food choices can have a dramatic effect on their diets, if done correctly. The National Cancer Institute (1991) suggested that a diet rich in fruits and vegetables and low in fat has been shown to

improve overall health. Using mobile technologies can help students make appropriate choices outside of the class by giving feedback on appropriate and inappropriate choices. As one student noted in the study, "I went with my mom to Walmart and I opened the AFIT app and we picked vegetables that were on the list, so I could get more points and stars next week." Hoppe et al. (2003) showed that mobile devices are a promising technology that can be used to support learning. These findings were supported by the results from the current study, which indicated that by adding appropriate lessons teachers can help reinforce positive attributes with healthy living and establish the importance of a healthy home environment.

In summary of the initial home survey, several observations are noteworthy. In this study, 90% of the students noticed what their friends ate for lunch. Peer pressure has an impact on adolescent behavior and noticing what friends eat for lunch will have an effect on food choices. This is consistent with R. Larson and Richards' (1991) study, which noted that peer pressure was a hallmark of adolescent development and then followed up by Zabinski et al.'s study (2006) which examined fruits and vegetable variables in a sample of adolescent boys and girls and concluded that measurements of peer pressure influence the needs of fruits and vegetable intakes. Data collected from the home survey also revealed that the participants' household adults were not meeting the recommendations for daily exercise and might not have been providing appropriate opportunities for the adolescents to meet their recommendations as reflected in the physical activity family support pre and posttest. Finally, most of the students in the study went to the store with family members; this information could allow for mobile technologies that concentrate on positive food choices to help students and adults in their

decisions for healthy foods. Woodward et al. (1996) found that consumption of particular foods among 12 to 15-year-olds is significantly related to parents' and friends' consumption of food. Increasing home involvement into the education of diets rich in fruits and vegetables and physical activity can have a positive effect on the obesity epidemic.

Nutrition Enlightenment with Mobile Devices

During the 4 weeks of the study, participants used the AFIT app in and out of the classroom. While the students were in the physical education classroom, the teachers used specific lesson plans that engaged the students in using the AFIT app and its concentration on fruits, vegetables, and physical activity content. The basis of the lesson plans and the motivational strategies in the AFIT app were intended to influence behavioral change with the students during the study and the PACE (2001) survey was then used to measure those changes. The scores indicated that students became empowered and enlightened (i.e., finding and learning for their personal growth) by the activities planned with the AFIT app and the encouragement found by the mobile device. Statistical significance was found in the students' ability to engage in behaviors that increased their confidence in meeting recommended daily requirements in physical activity and they had increased friend support in meeting those requirements. Statistical significance was also found in the decrease in mean change for students' ability to engage in behaviors that would result in eating more fruits and vegetables.

The PACE (2001) survey, which included questions about fruits and vegetables and physical activity (confidence, family support, & friend support), was given on the

first day of the study to students as the AFIT app was being downloaded to their personal iPads. The test was then re-administered with all the same questions on the final day of the study, 4 weeks from the previous test. When examining the results between the pretest and posttest, a two tailed paired samples *t*-test was used. The importance of the two-tailed test is its ability to detect significance in a positive or negative direction. Listed below are the questions from the fruits and vegetable confidence test.

Questions from the Fruits and Vegetable Confidence were as follows:

1) Eat 5 servings of fruits and vegetables everyday.

2) Ask someone in your family to buy your favorite fruit or vegetable?

3) Ask for fruits and vegetables with your lunch?

4) Drink 100% fruit juice instead of fruit punch or soda

5) Eat fruits and vegetables for a snack instead of chips or candy?

6) Ask someone in your family to include fruits and vegetables with dinner?

7) Eat fruits & vegetables when eating out at a restaurant?

Answers could range from 1 (*I'm sure I can't*), 2 (*I probably can't*), 3 (*neutral*), 4 (*I probably can*), to 5 (*I'm sure I can*; See Appendix A).

In looking at the results from the fruits and vegetables part of the test, significance was found, $t(139) = 9.182$, $p < .001$, in the change in confidence. The mean change was from a 3.90 on the pretest to a 3.43 on the posttest, indicating the questions for engaging in behaviors for eating more fruits and vegetables were initially scored toward the "I probably can" answer, but by the end of the study the students realized that their individual score was closer to "neutral" response which was just above the "I probably can't" response. These results indicate that enlightenment came from students' use of the

AFIT app and the difficulties associated with engaging in behaviors for increasing their fruit and vegetable intake on a daily basis. One of the participating teachers indicated that she was also using the AFIT app and discovered how hard it was to meet the RDI for fruits and vegetables (Observation 2). Based on the significance of the *t*-test, a paired data effect size was calculated with the results showing a moderate effect size (d= 0.69). A moderate effect size is stating the magnitude of the difference, without relying on statistical significance and would warrant follow up research.

The other two psychosocial measurements under fruits and vegetables on the PACE (2001) survey were related to family and friend support. These questions related to the encouragement received from family members and friends about engaging in behaviors that would encourage eating fruits and vegetables. Both measures did not result in a significant change in means with fruits and vegetable family support (p=.97) and fruits and vegetable friend support (p=.16). Even though there was no statistically significant change on fruits and vegetables family and fruits and vegetable friend support, the mean difference for fruits and vegetables family support did increase during the seventh and eighth graders but declined for the sixth grade population in this study. Also noted was that fruits and vegetables friend support, which had an increased in mean from the pretest to the posttest in the sixth and seventh grades, but a decline in mean difference for the eighth grade students. A larger sample would be advised in follow-up studies to include the transitional years of fifth and ninth grade.

In summary of the nutritional enlightenment (i.e., finding and learning for personal growth) from using a mobile device, a major observation can be made about fruit and vegetable confidence in this study. The hypothesis of an increase in confidence

in engaging in behaviors that would result in eating more fruits and vegetable was not only disproved, but a significant decrease was observed. At the beginning of the study the students felt they could meet the RDI of servings of fruits and vegetables, ask for fruits and vegetables at lunch, and eat them in restaurants. After 4 weeks of using the AFIT app on a mobile device, which helped track their fruit and vegetable consumption, a realization of how hard it was to meet the RDI of fruits and vegetables servings and the other attributes measured by the questionnaire was recorded on their posttest and journals. An effect size was calculated after the statistical significance was found to measure the strength of the difference. This decline in confidence score was large enough to warrant a medium effect score, highlighting the importance of these data and the need for follow-up studies.

Physical Activity Confidence Increased When Using a Mobile Device

In the data collection for assessing students' change in behaviors for physical activity confidence as well as family support and friend support, the quantitative results were complemented by qualitative observations and interviews. In the section below, field notes from my visit help describe the scenario found at both schools at the beginning of the study, and the quantitative results that follow show the pre to posttest scores on physical activity significantly increased the participants' confidence in engaging in behaviors to meet the recommended daily requirements of physical activity and had increased friend support for engaging in those behaviors during the 4-week study using a mobile device.

> As I walk into the school, I proceed to main office to have my ID scanned and sign in to where I am going for the day. This is the same routine I have done for

days now and I am excited to interview the teachers for the first time. Right when I get into the office the front staff asks when they can get pedometers for them to use. I am caught off guard and they both stop what they are doing and inform me that they do a lot of walking and could easily get 10,000 steps a day and they want to log their numbers. I told them where I bought the pedometers and then they follow-up by asking if they can use the AFIT app as well. I told them it is in the app store and it is free to download, and please tell me what you think about it. At that time the Principal hears me talking and comes out of his office and asks, if the faculty are using the app how many steps are they (adults) supposed to get, I let him know it is the same 10,000 steps even as you get older, but the moderate to vigorous activities change a little. He walks me out of the office and says how much he likes the faculty taking notice of the kids doing activity. He tells me that he has heard that a few teachers are allowing the students to walk/pace in between class activities because they were low on their steps and that he likes all this new excitement in the school. (Classroom observation 1)

I leave the office and the bell rings and the students flood the hall before I can get to the PE classroom. "Hey Mr. (AFIT), look how many steps I have already. I went over 11,000 yesterday and today I am going to beat that" (Classroom observation 1). This activity of showing me how many steps each student has, continues all the way to the PE classroom by numerous students. I entered the PE classroom to interview teachers 3 & 4 and describe the activity from the front office to the classroom and immediately notice the teachers are not surprised. As I start the first teacher interview, teacher 4 tells me "that everyone has noticed the new app and especially the wearing of pedometers and other teachers have been asking and emailing him to ask if they can use the app during their class as well" (Teacher interview 1). This same situation presents itself at the other school during the first teacher interviews.

The questionnaire measuring students' confidence in their ability to meet recommended daily requirements for engaging in physical activity was given on the first day of the study and then re administered 4 weeks later on the final day of the study. The mean on the first test for the students was 3.47 and increased to 3.70 out of a possible 5 on the final test. Below are the questions associated with the physical activity confidence score. This change in means was statistically significant, $t(139) = -2.524$, $p = .013$, and had a 0.27 effect size (Cohen, 1988) which is considered to be a small effect size.

Questions from the Physical Activity Confidence were as follows:

1) Do physical activity even when you feel sad or stressed?

2) Set aside time for physical activity on most days of the week?

3) Do physical activity even when your family or friends want you to do something else?

4) Get up early, even on weekends, to do physical activity?

5) Do physical activity even when you have a lot of schoolwork?

6) Do physical activity even when it is raining or really hot outside?

Answers range from 1 (*I'm sure I can't*), 2 (*I probably can't*), 3 (*neutral*), 4 (*I probably can*), to 5 (*I'm sure I can*; See Appendix A).

This test result indicated that students increased their confidence (or their ability) to engage in behaviors to meet the recommended daily requirements to be physical active and thus meeting the goals of the AFIT app on most days of the week. The physical activity goals that were recorded on the AFIT app were to meet or exceed 10,000 steps a day, which was recorded on their pedometers, and to meet or exceed 60 minutes of moderate to vigorous physical activity (MVPA), which was self-reported by the students using the AFIT app. Students' confidence in their ability to meet these goals increased from the beginning to the end of the 4-week study. These results counter the findings in earlier studies that showed a decrease in monitored activity during the adolescent years (Allison et al., 2008) and the trend of adult's inactivity (Nader et al., 2008) and health problems (Berensen & Epstein, 1983) starting in the adolescent years. In looking at each of the physical activity confidence mean changes for both individual teachers and grade levels, all mean scores increased from the pretest to the posttest. These results ruled out outliers that affected the overall mean scores and reinforced the concept that students

increased their confidence on engaging in behaviors to meet physical activity daily requirements while using the mobile device and specifically the AFIT app.

The other two psychosocial variables that were tested were physical activity family support and physical activity friend support for engaging in behaviors for meeting recommended daily requirements in physical activity. Physical activity family support did not yield a statistically significant result, $t(139) = -.408$, $p = .68$. This result was supported by the home survey, which suggested adolescents might not be receiving encouragement, transportation to, or other support from family members when participating in physical activity at the home environment. In conjunction with these results schools are reducing the amount of time that students are engaged in physical activity. According to the Institute of Medicine (2005) only 6.4% of middle and junior high school students are provided daily physical education.

Result from physical activity friend support did yield a significant result, $t(139) = -1.990$, $p = .049$. The students had increased support from their friends in engaging in behaviors that supported meeting the requirements for daily physical activity.

Questions from the Physical Activity Friend Support were as follows:

1) Do your friends encourage you to do sports or physical activities?
2) Do your friends do physical activity or play sports with you?
3) Do your friends or classmates tease you about not being good at physical activities or sports?*
4) Do your friends ask you to walk or bike to school or to a friend's house?
5) Do your friends tell you that you are doing well in physical activities or sports?

Answers 1 (*never*), 2 (*1-2 days*), 3 (*3-4 days*), 4 (*5-6 days*), and 5 (*every day*; See Appendix A). *Reversed score

Though parents did not increase their physical activity support during the study, the students' peers did. These results indicate that students supported their peers' behaviors for meeting recommended daily requirements and encouraged each other in physical activities. These results were observed during the previously mentioned classroom observation in which the students were eager to show their step totals and later during the teacher reinforcement from the AFIT app.

In summary, the participants' physical activity confidence of engaging in behaviors that meet daily requirements of physical activity increased while they were using the mobile devices. There has been little research on the use of mobile devices and their connection to physical activity, but in this study the students felt that using the AFIT app, which tracked physical activity amounts, increased their confidence for behaviors in meeting the RDI of physical activity. This confidence was complemented by the significant increase in friend support and encouragement of physical activity. Having increased confidence in one's ability to meet physical activity needs as well as being supported by one's peers in that effort was a significant finding from this study and supported the use of mobile learning for increasing physical activity.

Adolescent Motivators are Highlighted Using a Mobile Device

Self Determination Theory (SDT; Ryan & Deci, 2002) suggests attributes of extrinsic motivation, intrinsic motivation, and amotivation are prevalent during adolescent development. Extrinsically motivated behaviors refer to behaviors in which

an external controlling variable can be readily identified. Adolescent behavioral changes are highly motivated by extrinsic factors. These are the factors that students see in everyday activities, where rewards are based on the student's actions and end products drive motivation. These end products, or accomplishments, were specifically designed in the AFIT development and separated this mobile app from the vast numbers of health and nutrition apps that are currently in use. The components of the app that were related to extrinsic motivators (See Figure 11) were: Component 1, the new food plate; Component 2, points and stars; Component 4, water glasses; Component 5, steps recorded; Component 6, moderate to vigorous activity recorded; and Component 8, the teacher retrieval system.

Figure 11. Components labeled on the AFIT app.

Component 1, the new food plate (USDA, 2011), is an interactive food plate that fills in as the students enter data; the goal is to have a full food plate at the end of the day and to receive a star for meeting the RDI for each section of the plate. In Component 2, points and stars are continually added as users track their consumption and physical activity. Users of the AFIT app can accumulate up to 10 stars in a day; however, the points possible are unlimited. If a student is able to earn the full 10 stars, then the stars change from gold to blue. In Component 4, the water glasses start each day filled up and empty as the students consume water throughout the day; the end goal is for all of the water glasses to be empty and to receive a star for that accomplishment. For Component 5, the steps recorded, each student was given a pedometer at the beginning of the study. Students were not told how many steps they needed to get in a day and were dependent on self-guided discovery to find out how many steps were needed to receive a star for that input. The students quickly found that 10,000 steps were needed for the RDI of that section. The use of the pedometer and the constant reminder of how many steps were needed became a motivating factor due to the added device and its visual presence. This end product of 10,000 steps became a challenge for many students and they had to figure out ways to accumulate that step total in and out of school. Component 6, the moderate to vigorous activity recorded, was much like the steps needed, but the choices of individual sports, team sports, social fitness, walking, and other as categories were a teaching tool in themselves allowing students to experience activities that cross over from young student activities into common adult activities. The end product for MVPA was meeting the 60 minutes needed and receiving a star; another motivator was the cheering sound that resulted from meeting the RDI of this category.

Finally, Component 8 had a dual role of both extrinsic and intrinsic motivation. The extrinsic motivator in the app was the teacher retrieval system. This component allowed the teacher to see how the students were doing on their AFIT app in real time, the relatedness attribute of SDT (Ryan & Deci, 2000). The external motivation of having a teacher, a person who cares for the student, make a connection to the students through the AFIT app was a main reason that a new app was created for this study. Relatedness is supported by the warmth, care, and involvement of others (Ryan, Williams, Patrick, & Deci, 2009) and making the connection to the teacher satisfied this connection. A study by Gagne, Ryan, and Bargmann (2003) revealed that with the relatedness component to the coach their subjects had increased motivation as opposed to not having this connection. This feature integrated SDT into the motivating design and helped ensure extrinsic motivators were found by the students using the AFIT app during the study. The end product for this motivator was the verbal feedback received from the teacher on a daily basis and the personal satisfaction with the AFIT's feedback system. The more extrinsic motivators that are integrated in the design, the more autonomous the participants will be, and in turn will predict both a positive experience and better maintenance among them (Ryan et al., 2009).

Intrinsically motivated behaviors are those for which there is no apparent reward except the activity itself (Deci, 1975). Students who exhibited this type of motivation discussed sharing the app with others and their enthusiasm about changing their activity and eating behaviors. The intrinsic components that were infused into the AFIT were: Component 3, the nutrition log; Component 7, the physical activity log; and Component 8 that housed the options of the app (See Figure 11).

Components 3 and 7, the daily logs, were constant reminders to the students of their weekly inputs. The logs had a 5-day total on the bottom and could be used by the students to self-check their goals and to see patterns in their eating and physical activity. The logs were not visible to the teacher so the motivation was internal. This intrinsic value becomes more apparent as students age and is the dominating motivator in the adult lifestyle. As students travel along the self-determination continuum (Ryan & Deci, 2002) intrinsic motivation represents the behaviors that are performed for the inherent pleasure of the activity as opposed to the extrinsic motivation that is governed by rewards, threats, or payments (Standage, Duda, & Ntoumanis, 2003). The AFIT app included both motivators with the idea of adolescents leaning more toward the extrinsic motivators, but starting to experience some of the intrinsic values of healthy living.

Component 8, the intrinsic motivator of the dual component, was the options choice where the students had control over the sounds the app gave as personal feedback and also allowed reminders to be set for each student's schedule. Students were able to have the app give a sound reminder at different times of the day to help them remember to enter their personal data. Both of these features were specifically designed to increase student autonomy and competence by allowing the students to choose the types of feedback they enjoyed. This ingredient is an import aspect in changing a behavior under SDT (Ryan & Deci, 2000) and it directly relates to student autonomy and competence in BPNT (Ryan & Deci, 2000).

Amotivation, as defined earlier, is a state in which an individual is neither intrinsically nor extrinsically motivated. It occurs when an individual does not value the activity, the activity is not relevant to the individual, or the individual lacks competence

in the activity (Ryan & Deci, 2000). This attribute was well noted by the students in their journals, interviews, and classroom observations. Any new activity is not going to work for all students and barriers among the adolescent population using SDT (Ryan & Deci, 2000) were expected as seen in previous studies (Deci, 1975; Ryan, 1995; Ryan & Deci, 2000). During the interview with the students who were not using the app the previous week, several reasons for amotivation were apparent. To some students the app was another activity that needed to be done in an already busy curriculum, and to some students the app's motivation design did not work and was found to be boring or uninteresting. Finally, the relatedness component that allowed the teacher to see each student's information was found to be disturbing to some and annoying to others. The negative feedback related to the AFIT app and its theory need to be further explored in future studies by increasing the small group interviews with the amotivated participants.

In summary, the design of the AFIT app and the use of a mobile leaning device encompassed the three motivational strategies for adolescent behavioral change (Ryan & Deci, 2002). Students reported feelings representing intrinsic, extrinsic, and amotivation with regard to using the app and the connection it made to the teacher. A majority of the students embraced the rewards given by the app, the personal satisfaction of healthy living, and the connection it created with the teacher. When individuals feel that their opinions are valued, their feelings are taken into account, and they have the opportunity to make choices and be self-managers, their autonomy is enhanced (Deci & Ryan, 2002). The amotivated group increased the awareness of negative situations that need to be addressed when introducing mobile learning into the curriculum. As adolescent overweight is the best predictor of adulthood overweight (Field, Cook, & Gillman, 2005),

results from this study suggest that new motivational strategies that focus on adolescent interventions should be initiated in today's physical education curriculum.

Training is Paramount for Teachers to Use Mobile Technology

Analysis of the teacher journals, small group interviews, and observations suggested the need for increased teacher training. The teachers asked for more time to learn how to use the AFIT app and how to integrate the lessons into their personal teaching styles. Data supported the need for increased teacher education when using new technology and for new instructional concepts to be incorporated with individual teaching styles. Results from the teacher survey indicated that their comfort levels with technology ranged from "somewhat" comfortable to 8 out of 10 on a comfort scale, but all teachers agreed it was the future of teaching and very important for education. Ince et al. (2006) found that integrating technology into lessons could improve student performance. The increased daily use of technology in schools, combined with the already high use of mobile technology by the iGeneration, reveals that a significant effort for technology integration in-services is needed to reduce the gap between adults and adolescents in mobile technology efficacy.

A classroom observation was made while one teacher was in the middle of the first lesson (See Appendix D) on fruits and vegetables. The teacher was at the front of the classroom with the AFIT app on the Smartboard with all the students logged onto their accounts. The teacher had already asked the students in small groups to write down as many fruits and vegetables as they could think of and they were discussing their lists. One student responded that a tomato was a fruit while another argued that it was a

vegetable. The class continued in this debate for another minute before a student involved in the argument asked the teacher for help. The teacher, who was ready for this question because of its common place in this topic, told the class to use their resources (pointing to the iPad) to find a definition "not on Wikipedia" to make the argument for it being a fruit or a vegetable (Classroom observation 1). The class immediately looked for resources to back their arguments and the teacher glanced over at me with a smile, knowing the students would find information indicating that tomatoes are both a fruit and a vegetable. In school settings, classroom engagement functions as a behavioral pathway by which students' motivational processes contribute to their learning and development (Wellborn, 1991).

For the teacher to get to this level of comfort using the technology and engagement from the students, several methods of adult learning were considered—the app was given to the teachers a month before the study started to acclimate them to its features, a lesson plan was scripted word for word and given to the teachers 2 weeks before the study started, and a demonstration of the first lesson plan was conducted for the teachers using the AFIT app a week before the study started. These considerations allowed the teachers to increase their efficacy with the AFIT app before the study. Common barriers of the technology gap between students and adults were present at the beginning of the study (observation 1), but slowly declined by the end of the 4 weeks (observation 3). These findings support the differences between generations, as the iGeneration has become accustomed to new technology while the adult population still needs specific support and in-service training to feel comfortable introducing and using new technology in the classroom.

Differences were also noted in the teaching styles of the teachers during interviews, journal responses, and classroom observations. Some were very direct in their instruction while others used more of a guided discovery with their classes, but overall there was a constant change in the teachers' self-efficacy with using the technology for their personal style. Adults have different learning styles than students. Heimstra and Sisco (1990) suggested a situation in which andragogy is a model of instruction to improve teaching of adults. They went on to add that mature adults are increasingly independent and responsible for their own actions and learn by the desire to solve immediate problems, something that the pedagogy model does not account for. The research suggests that there is a difference between pedagogy and the andragogy learning cycle, with students learning in certain ways and teachers needing a different set of values for the learning of technology to take place. Tough (1971) described adults using "learning projects" to continue their education outside of schools and institutions. A learning project is defined as a series of related episodes, with each episode pertaining to a motivation to produce some lasting change (Tough, 1971). These ideas became evident with the teachers in this research study and how they took to learning the new technology. The teachers expressed a desire for more in-service learning time with the AFIT app's features, a better understanding of how the app worked and possible problems that could arise, and finally lesson plans that worked with their teaching styles.

In summary, there is a need for in-service training for teachers to integrate technology into the curriculum. The divide between teachers and student efficacy in using technology became apparent in this study. Teachers found multiple advantages for using technology in their curriculum and noted that it was the future of education. With

that being said, the teachers still found frustrations with implementing the use of the mobile devices and its dependency on an efficient wireless system. Teachers need specific support in problem solving with technology and how to incorporate their specific teaching styles into using mobile devices for their students.

A Descriptive Logic Model of Research Conducted using the AFIT App

Using the exploratory middle school physical education model that was created before the study and presented in Chapter 3, a new model of the integration of mobile technology resulted from the findings (See Figure 12).

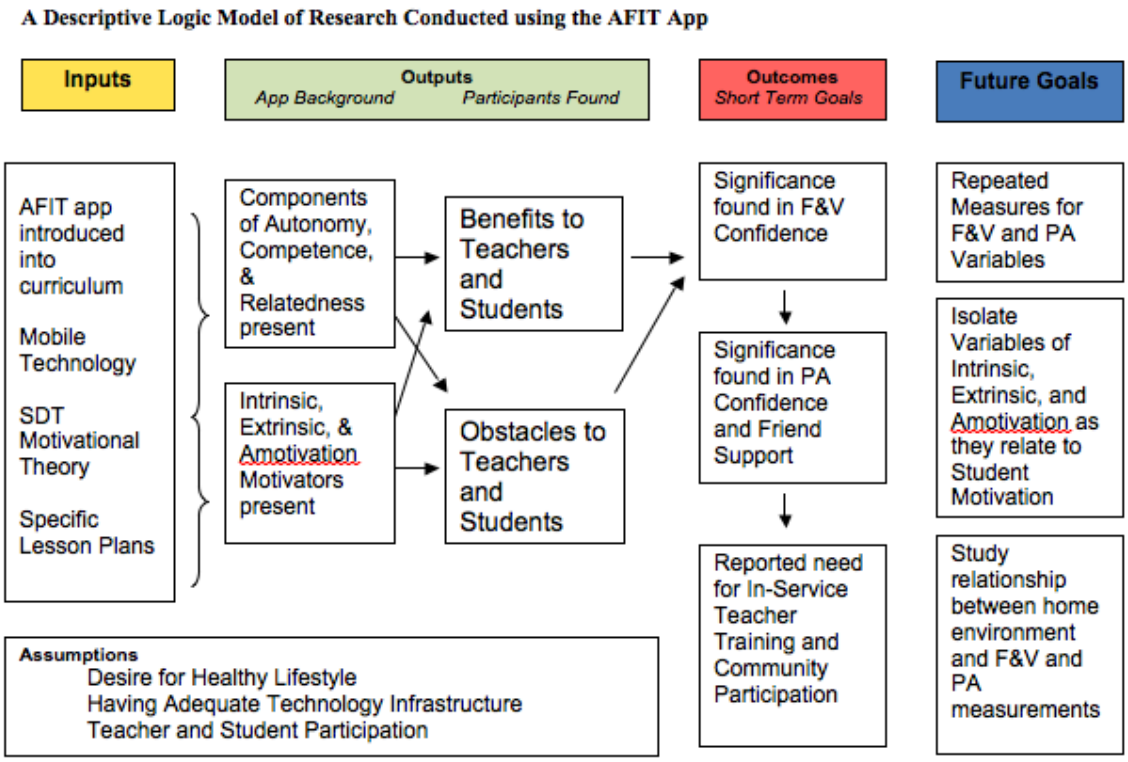

Figure 12. A descriptive logic model of research conducted using the AFIT app.

The components of the AFIT app, such as BPNT (Ryan & Deci, 2000), which is under the motivational umbrella of SDT (Deci & Ryan, 1985, 1991), required the needs of autonomy (the belief of the self being the regulator of an individual's actions), competence (the belief that individuals can impact their surroundings through personal improvement and mastering of a task), and finally relatedness (the development of a secure and connected relationship with a person who cares for the individual) to be met for all parts of the motivational theory to be effective. These specific attributes were infused in the development of the AFIT app and helped to make the connection of motivators and student/teacher accountability.

Using the framework of SDT (Deci & Ryan, 1985), adolescent motivators present in journals, interviews, and observations were: intrinsic motivation, highly autonomous behaviors that are a result of the fun, pleasure, and satisfaction that stemmed from participation in the activity (Deci & Ryan, 1985; Ryan & Deci, 2000); extrinsic motivation, defined as nonautonomous behaviors that are governed by externally controlled constraints, such as rewards, threats, and payments (Standage, Duda, & Ntoumanis, 2003); and amotivation, which refers to individuals who are neither intrinsically or extrinsically motivated and lack the intention to act (Ryan & Deci, 2000). The outcomes that came from the study were a significant decrease in mean change in confidence for behaviors that support meeting recommended daily requirements of eating fruits and vegetables, a significant increase in behaviors supporting meeting the daily requirements of physical activity, and a significant increase in friend support for meeting physical activity daily requirements. The final part of the model refers to how the results indicated future research goals in which there was an increased desire from the teachers

to have more in-service training and for an inclusion of the community into the application of the mobile technology.

Recommendation Summary for Future Research

The results of this study showed that using the AFIT app for supplemental instruction can highlight both positive and negative behaviors for fruits and vegetables and physical activity measurements. The pretest to posttest for fruits and vegetables revealed a decrease in confidence for behaviors that support meeting recommended daily requirements in eating fruits and vegetables. The pretest to posttest for physical activity revealed an increase in supporting behaviors for meeting the daily physical activity requirements, and an increase in friend support for meeting those daily physical activity requirements. These results suggest a need for the increased use of mobile technology in educating middle school children about physical activity and the need for increasing fruits and vegetable positive behaviors. The study also supported the use of the PACE (2001) survey and provided specific information on areas of concern related to fruits and vegetables intake and physical activity measurements. Finally, the study showed the importance of continued in-service training to teachers to help reduce the gap between student and adult technology efficacy.

Directions for future research in increasing healthy behaviors in school and at home should include a more thorough analysis of the home environment. Having a more detailed inventory for parents and children to fill out can better correlate to the results seen in the future studies. Potential facilitators and barriers to meeting recommended levels of activity and fruits and vegetables, such as family involvement and support, will

need to further studied. Increased or decreased family support might be directly related to the increase or decrease of fruits and vegetables that are purchased and physical activity performed by adults in the home.

Implications for future research on the enlightenment of using mobile devices would need to include a larger adolescent population and a longer study time frame. Future studies would be advised to have a repeated measures design that would include the fifth grade year to the ninth grade year. A repeated measure design would help differentiate the results that were indicated in the present study as perceived fruits and vegetable consumption at the beginning of the study to the end result of actualization of the difficulty of meeting the RDI of eating fruits and vegetables. A repeated measure then could test the actual implications of the lesson plans and motivational strategies employed in the AFIT app to determine whether a noticed change in learning takes place in future follow-up tests. A longitudinal design can also show benefits for tracking nutritional and physical activity behaviors in the full spectrum of the adolescence years.

Implications for future studies related to increasing physical activity confidence, family support, and friend support while using a mobile device should concentrate on the specific attributes of the mobile device. Knowing that physical activity confidence and friend support are increased with mobile technology, future studies should isolate the attributes of autonomy, competence, and relatedness. These components were specifically designed into the AFIT app and should be measured separately using both quantitative and qualitative means to discover whether one has a greater effect than another. Using an experimental design with random assignment of participants to the

AFIT app and control conditions should be proposed to test the effect of the AFIT app on physical activity and other health-related variables.

Future studies of adolescent motivators that are highlighted using a mobile device should focus on students in the amotivation classification and be critiqued in both quantitative and qualitative means to find the specific attributes that led them to be amotivated. Understanding these issues will go a long way in motivating all students in development of mobile technology and its incorporation into the schools.

Finally, future research on teacher training needs to focus on three aspects: what specifically needs to be covered during in-service training when using an app for teaching, how to troubleshoot problems associated with integrating technology into the classroom, and how to adapt lesson plans using different styles of teaching while implementing mobile technology into the curriculum.

Conclusions

In the latest report from the Robert Woods Foundation and Trust for America's Health (2012), obesity rates could exceed 60% in 13 states by 2030. These obesity rates will drastically affect health care costs, as they are associated with Type II diabetes, heart disease, hypertension, and other obesity-related diseases. The adults in 2030 are children and adolescents today and there needs to be an increase in action research studies targeting this population. The setting that has the most potential for having a public health impact is the schools as virtually all children can be reached in the schools (Sallis et al., 1992). There are several theories in the literature that can provide a strong framework for future studies, but motivational theories that speak to the students and

adults should be targeted for their positive results in behavioral changes associated with levels of motivation. The data from the PACE (2001) survey pretest given on day 1 of the study showed students reported that they felt confident in their ability to achieve the RDI of fruits and vegetables, but by the end of the study they realized how hard it was to actually meet these recommended intakes and on the final day of the study the scores reflected this lower confidence in behaviors for meeting the RDI of fruits and vegetables. Results suggest mobile devices can record actual intake and have a significant effect on what is perception and what is actual behavior. The high use of mobile devices has become normal in today's society due to decreases in costs and increases in wireless technology and can be used as supplemental teaching tools to give unique insight into what is actually being consumed versus a student's perception.

Data also suggested students increased their confidence in achieving behaviors for meeting the RDI of step counts and MVPA. Using the mobile devices for accurate accounts of activity in and out of the classroom may also be beneficial in giving a complete picture of the obesity epidemic. The energy balance formula of energy intake and physical activity expenditures is the basic understanding of a healthy lifestyle. Combining both aspects of nutrition and physical activity with the use of mobile learning as a supplemental teaching tool can be a possible solution to the obesity epidemic that is plaguing the country and world today.

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Appendices

Appendix A: PACE Instrument

Fruits & Vegetables Confidence

There are many things that can get in the way of eating fruits & vegetables.
Rate **HOW SURE** you are that you can do the following in each situation.
Please answer **ALL** questions.

PLEASE:

*** Fill in each circle completely.**

*** Erase all changes completely.**

	I'm sure I can't 1	I probably can't 2	Neutral 3	I probably can 4	I'm sure I can 5
1. Eat 5 servings of fruits & vegetables everyday.	O	O	O	O	O
2. Ask someone in your family to buy your favorite fruit or vegetable?	O	O	O	O	O
3. Ask for fruits & vegetables with your lunch?	O	O	O	O	O
4. Drink 100% fruit juice instead of fruit punch or soda?	O	O	O	O	O
5. Eat fruits or vegetables for a snack instead of chips or candy?	O	O	O	O	O
6. Ask someone in your family to include fruits or vegetables with dinner?	O	O	O	O	O
7. Eat fruits & vegetables when eating out at a restaurant?	O	O	O	O	O

Fruits & Vegetable Family Support

During a typical week, how often has a member of your household:
(For example, your father, mother, brother, sister, grandparent, or other relatives)

PLEASE:

*** Fill in each circle completely.**

*** Erase all changes completely.**

	Never 1	1-2 days 2	3-4 days 3	5-6 days 4	Every day 5
1. Encouraged you to eat fruits & vegetables?	O	O	O	O	O
2. Told you that you are doing a good job with eating fruits & vegetables?	O	O	O	O	O
3. Provided fruits & vegetables as a snack or part of a meal?	O	O	O	O	O
4. Eaten fruits & vegetable with you?	O	O	O	O	O

Fruits & Vegetable Friend Support

During a typical week, how often:

	Never 1	1-2 days 2	3-4 days 3	5-6 days 4	Every day 5
1. Do your friends encourage you to eat fruits & vegetables?	O	O	O	O	O
2. Do your friends eat fruits & vegetables with you?	O	O	O	O	O
3. Do other kids tease you for eating fruits & vegetables?	O	O	O	O	O

Physical Activity Confidence

There are many things that can get in the way of physical activity.
Rate **HOW SURE** you are that you can do physical activity in each situation.
Please answer **ALL** questions.

PLEASE:
*** Fill in each circle completely.**
*** Erase all changes completely.**

	I'm sure I can't 1	I probably can't 2	Neutral 3	I probably can 4	I'm sure I can 5
1. Do physical activity even when you feel sad or stressed?	○	○	○	○	○
2. Set aside time for physical activity on most days of the week?	○	○	○	○	○
3. Do physical activity even when your family or friends want you to do something else?	○	○	○	○	○
4. Get up early, even on weekends, to do physical activity?	○	○	○	○	○
5. Do physical activity even when you have a lot of schoolwork?	○	○	○	○	○
6. Do physical activity even when it is raining or really hot outside?	○	○	○	○	○

Physical Activity Family Support

During a typical week, how often has a member of your household: (For example, your father, mother, brother, sister, grandparent, or other relatives)

	Never 1	1-2 days 2	3-4 days 3	5-6 days 4	Every day 5
1. Watched you participate in physical activity or play sports?	○	○	○	○	○
2. Encouraged you to do sports or physical activity?	○	○	○	○	○
3. Provided transportation to a place where you can do physical activity or play sports?	○	○	○	○	○
4. Done a physical activity or played sports with you?	○	○	○	○	○

Physical Activity Friend Support

During a typical week, how often:

PLEASE:

*** Fill in each circle completely.**

*** Erase all changes completely.**

	Never 1	1-2 days 2	3-4 days 3	5-6 days 4	Every day 5
1. Do your friends encourage you to do sports or physical activities?	○	○	○	○	○
2. Do your friends do physical activity or play sports with you?	○	○	○	○	○
3. Do your friends or classmates tease you about not being good at physical activities or sports?	○	○	○	○	○
4. Do your friends ask you to walk or bike to school or to a friend's house?	○	○	○	○	○
5. Do your friends tell you that you are doing well in physical activities or sports?	○	○	○	○	○

Appendix B: Scoring for the PACE Instrument

Scoring Information for PACE Adolescent Psychosocial Measures

Physical Activity Measures

Stage of Change

Using the branching scheme:

If physically active 5 to 7 days a week:

Question 2:

1 = Action stage

2 = Maintenance stage.

If physically active 0 to 4 days a week:

Question 3:

1 = Precontemplation stage

2 = Contemplation stage

3 = Preparation stage

Physical Activity Change Strategies

Create a composite strategy score by computing the mean of items 1 to 15.

Physical Activity Pros & Cons

Pros of change scale = mean of items 2, 3, 5, 8, 9.

Cons of change scale = mean of items 1, 4, 6, 7, 10.

Physical Activity Confidence (Self-Efficacy)

Compute mean of items 1 to 6.

Physical Activity Family Support (Family Influences)

Compute mean of items 1 to 4.

Physical Activity Friend Support (Peer Influences)

Reverse code item 3, then compute mean of items 1 to 5.

Physical Activity Environmental Factors

Reverse code item 2, then compute mean of items 1 to 4.

Sedentary Behaviors

Stage of Change

NO, and I do NOT intend to in the next six months = Precontemplation

NO, but I intend to in the next six months. = Contemplation

NO, but I intend to in the next 30 days. = Preparation

YES, and I have been, but for LESS than 6 months. = Action

YES, and I have been for MORE than 6 months. = Maintenance

Sedentary Habits Change Strategies

Create a composite strategy score by computing the mean of items 1 to 15.

Sedentary Habits Pros & Cons
Pros of change scale = mean of items 1, 3, 4, 9.
Cons of change scale = mean of items 2, 5, 6, 10, 11, 12.
Note: Item 7 did not load on either factor (Norman et al., 2004).
Sedentary Habits Confidence (Self-Efficacy)
Compute mean of items 1 to 7.
Sedentary Habits Family Support (Family Influences)
Compute mean of items 1 to 4.
Sedentary Habits Friend Support (Peer Influences)
Reverse code item 3, then compute mean of items 1 to 3.

Fruit & Vegetable Consumption

Stage of Change

Using the branching scheme:
If 5 to 6 or more serving per day:
Question 2:
1 = Action stage
2 = Maintenance stage.
If 0 to 4 servings per day:
Question 3:
1 = Precontemplation stage
2 = Contemplation stage
3 = Preparation stage

Fruit & Vegetable Change Strategies
Create a composite strategy score by computing the mean of items 1 to 15.
Fruit & Vegetable Pros & Cons
Pros of change scale = mean of items 2, 3, 5, 7, 9.
Cons of change scale = mean of items 1, 4, 6, 8, 10.
Fruit & Vegetable Confidence (Self-Efficacy)
Compute mean of items 1 to 7.
Fruit & Vegetable Family Support (Family Influences)
Compute mean of items 1 to 4.
Fruit & Vegetable Friend Support (Peer Influences)
Reverse code item 3, then compute mean of items 1 to 4.

Dietary Fat

Stage of Change

NO, and I do NOT intend to in the next six months = Precontemplation
NO, but I intend to in the next six months. = Contemplation
NO, but I intend to in the next 30 days. = Preparation
YES, and I have been, but for LESS than 6 months. = Action
YES, and I have been for MORE than 6 months. = Maintenance

Dietary Fat Change Strategies
Create a composite strategy score by computing the mean of items 1 to 15.
Dietary Fat Pros & Cons
Pros of change scale = mean of items 1, 3, 7.
Cons of change scale = mean of items 2, 4, 5, 6, 8.
Dietary Fat Confidence (Self-Efficacy)
Compute mean of items 1 to 8.
Dietary Fat Family Support (Family Influences)
Compute mean of items 1 to 4.
Dietary Fat Friend Support (Peer Influences)
Reverse code item 4, then compute mean of items 1 to 4.

Appendix C: Permission to use Psychosocial Measurements

Norman, Gregory to me show details 12:20 AM (9 hours ago) Reply

Hi Tom,
Thanks for letting me know that you are using the measures. You officially have permission to use the psychosocial measures in your dissertation research. Please let me know if you have any questions about the measures. Best wishes to you in your research.
Greg

Greg Norman, Ph.D.
Department of Family and Preventive Medicine
University of California, San Diego
9500 Gilman Drive
La Jolla, CA 92093-0811
Phone: 858 534 9302

From: Thomas Watterson [twatters@mail.usf.edu]
Sent: Wednesday, October 12, 2011 1:11 PM
To: Norman, Gregory
Subject: Pace Measurements
- Hide quoted text -

Dr. Norman,
My name is Tom Watterson and I am currently working on my dissertation. I would like to ask permission to use your PACE Adolescent Psychosocial Measures.
I have downloaded them from your site, but wanted to ask officially if I can use your measurements for my research.

Thank you,
Tom Watterson

Appendix D: Fruit Lesson Plan

Fruit Lesson Plan
First Lesson Taught

Unit: Nutrition (fruits)
Research lesson #: 1 of 3

Lesson Objectives: (identify type & link to NASPE and NGSSS)

1. SWBAT (students will be able to) differentiate characteristics of a fruit, fruit choices and serving size. (Cognitive) NASPE # 4,6. NGSSS # PE.6. C.1.8, PE.7. L.2.3.
2. SWBAT work in a group setting for understanding of information with respect for each other and teacher. (Affective) NASPE # 5. NGSSS # PE.8.L.2.1
3. Psychomotor objective will be met by the activity planned for the remainder of the class by teacher. NASPE #1, 2, and 3, NGSSS # PE 6,7,8.M.1.

Lesson Assessments: (must match up with objectives)

1. Students will be assessed by open-ended questions asked from the teacher during the activities and at the end of the Fruits lesson.
2. Students will be assessed by the interaction of the group during the group activity.
3. Psychomotor objective met by teacher's lesson of the remaining days activity.

Equipment & Set-Up for Lesson: (provide diagram if necessary)
Can be taught in any location, preferably a quiet location with opportunity for writing/notes.

Risk Management/Safety:
Use the common practices for your school and location of instruction.

Lesson Preview:

1. Introduction – "Class today we are discussing nutrition and more specifically fruits. We will cover what is a fruit, how much is needed, and why we need them."
2. Assessments – "During the class, I will be asking questions about fruits and their importance and will be making sure everyone has contributed to the discussion."
3. Hook – "Can fruits prevent diseases? Can they help heal a wound? Can they help your teeth?" *Answer is yes to all three.*

Lesson Development:

1. Description of activity – The teacher will introduce the topic, with scripted material above. The teacher will define a fruit and ask for examples from the class. The teacher should have the students in small groups write down as many fruits as possible. Go around the groups and generate a list of all the fruits listed by the students.

2. At this time have the students click on the hyperlink under the food plate on the app (ChooseMyPlate.gov). Select the fruits group and check your list to the one provided as commonly eaten fruits. The missing fruit choices should be discussed and general comments about the student's favorites choices should be encouraged.

3. The next step for the teacher is to cover the material that pertains to how much fruit is needed for the specific age of the child and how much makes up a serving. These are the next two links on the webpage "how much is needed" and "what counts as a cup." Both pages give a chart that list the appropriate information for students.
   Examples of 1 cup of fruit – 1 banana, 32 grapes, or 8 large strawberries.

4. The final part of the lesson pertains to health benefits of fruits. Give examples from the webpage and associated benefits from individual fruits.

Lesson Review:

1. Have students demonstrate what they have learned, questions to be asked throughout the material. Assessment of knowledge should be performed for each child.
2. Preview next week's lesson on vegetables.

Appendix E: Vegetable Lesson Plan

Vegetable Lesson Plan
Second Lesson Taught

Unit: Nutrition (Vegetable)
Research lesson #: 2 of 3

Lesson Objectives: (identify type & link to NASPE & NGSSS)

1. SWBAT (students will be able to) differentiate characteristics of a Vegetable, categories of vegetables and serving size. (Cognitive) NASPE # 4,6 NGSSS PE 6 C.1 PE 8 L.2.
2. SWBAT work in a group setting for understanding of information with respect for each other and teacher. (Affective) NASPE # 5 NGSSS PE 6,7,8 R.1.
3. Psychomotor objective will be met by the activity planned for the remainder of the class by teacher. NASPE #1,2, and 3 NGSSS PE 6,7,8 M.1.

Lesson Assessments: (must match up with objectives)

1. Students will be assessed by open-ended questions asked from the teacher during and at the end of the Vegetable lesson. The lists generated during the activities will also assess students.
2. Students will be assessed by the interaction of the group during the group activity.
3. Psychomotor objective met by teacher's lesson of the day.

Equipment & Set-Up for Lesson: (provide diagram if necessary)
Can be taught in any location, preferably a quiet location with opportunity for writing/notes.

Risk Management/Safety:
Use the common practices for your school and location of instruction.

Lesson Preview:

1. Introduction – "Class today we move on to our second category of nutrition. We will be discussing vegetables. We will cover what is a vegetable, the four main categories of vegetables, and why we need them."
2. Assessments – "During the class I will be asking questions about vegetables and their importance and will be making sure everyone has contributed to the discussion."

3. Hook – "Can a vegetable have seeds? *Yes* "Which is not a vegetable – Pumpkin, Squash, Red Pepper, or a Green Banana? *Trick question - they all are vegetables, but sometimes they get confused as fruits.*

Lesson Development:

1. Description of activity – The teacher will introduce the topic, with scripted material above. The teacher will define a vegetable and ask for examples from the class. The teacher should have the students name as many vegetables as possible. In small groups try to classify their list into categories and see what they come up with. The missing vegetable choices will be discussed and general comments about the students' favorite choices should be encouraged. Use the hyper link (ChooseMyPlate.gov) to find the categories that the USGA provides and see if the students agree with their categories.
2. The next step is for the teacher to cover the material that pertains to how many vegetables are needed for the specific age of the child and how much makes up a serving. These items are found using the hyperlink and clicking the tabs "how much is needed," "what counts as a cup," and accessing the chart that pertains to both. Have students pick a favorite vegetable and describe what one serving is to the rest of the class.
3. The final part of the lesson pertains to health benefits of vegetables. Give examples from the website and list the associated benefits with each. Have students try to come up with ways to encourage vegetable consumption in their lunches and at home and discuss.

Lesson Review:

1. Have students demonstrate what they have learned, questions to be asked throughout the material. Assessment of knowledge should be performed for each child.
2. Preview next week's lesson on physical activity.

Appendix F: Physical Activity Lesson Plan

Physical Activity Lesson Plan
Third Lesson Taught

Unit: Physical Activity
Research lesson #: 3 of 3

Lesson Objectives: (identify type & link to NASPE & NGSSS)

1. SWBAT (students will be able to) differentiate characteristics of activities, moderate to vigorous and their importance. (Cognitive) NASPE # 2,3,4, & 6 NGSSS PE 6 M.1.1, PE 6,7,8 L.1
2. SWBAT work in a group setting and activities for understanding of information with respect for each other and teacher. (Affective) NASPE # 5 & 6 NGSSS PE 6,7,8 R.1
3. Psychomotor objective will be met by the activity planned for the remainder of the class by teacher. NASPE #1,2, 3 & 4 NGSSS 6,7,8 M.1.

Lesson Assessments: (must match up with objectives)

1. Students will be assessed by open-ended questions asked by the teacher during and at the end of the activity lesson. The lists generated during the activities will also assess students.
2. The teacher assesses students, as they interact in the group during the activity.
3. Psychomotor objective met by teacher's lesson.

Equipment & Set-Up for Lesson: (provide diagram if necessary)
Can be taught in any location, preferably a quiet location with opportunity for writing/notes.

Risk Management/Safety:
Use the common practices for your school and location of instruction.

Lesson Preview:

1. Introduction – "Class today we are discussing the importance of physical activity. We will cover what is physical activity, and why it is important."
2. Assessments – "During the class I will be asking questions about a variety of physical activities and their importance. I will also be making sure everyone has contributed to the discussion."

3. Hook – "What is your favorite activity to do outside of school", "Why is physical activity important and does it matter how hard or vigorous it is?" answer – *physical activity leads to long term health benefits and the harder the activity the greater the benefits.*

Lesson Development:

1. Description of activity – The teacher will introduce the topic, with scripted material above. The teacher will define activity and ask for examples from the class. The teacher should have the students name as many different activities as possible. The students then should divide the activities into moderate or vigorous activities. Use the hyper link (ChooseMyPlate.gov) to cover the lists that the USGA provides.

2. The next step is for the teacher to cover the material that pertains to why physical activity is important and how much is needed. Use the tabs "Why is it important" and "how much is needed" to cover the material on both topics. Describe the benefits of a healthy lifestyle and talk about the risks of not being physically active.

3. The teacher will talk about the current guidelines that require 10,000 steps per day and 60 minutes of moderate to vigorous activities. These items will relate to the app and the stars awarded for both categories.

4. The final part of the lesson will be to have the students engage in small group discussion on how they could reach those goals in out of school activities. Create a list of ways that someone can reach those goals without specifically playing a sport.

Lesson Review:

1. Have students demonstrate what they have learned, questions to be asked throughout the material. Assessment of knowledge should be performed for each child.
2. Tomorrow I will check your logs and see how you did on your step count and MVPA.

Appendix G: Teacher Journal Prompts

TEACHER
Reflections in journal prompts

Week 2 Monday
What are your thoughts on using the app for instruction today?
What did you find easy to use?
What did you find hard to use?
In teaching today, where you able to do anything different while using the AFIT app?
In teaching today, where there limitations from using the AFIT app in what you could do?
How would you have change things?

Week 3 Monday
Describe some feelings you had when using the app last week?
How did the seeing the student's information on a day to day basis make you feel? In your response explain why you felt that way.
Have you heard anything from other faculty members or administrators about the app or the research study? If so what was their impression.

Week 4 Monday
Describe your feelings with this being the last week of the study?
Would you recommend this approach to teaching to other physical educators?
Anything unexpected from the students about the app or the content covered?
What changes would you make to the app or content that was covered.
Please add any comments you have about this being the final week of the study?

Appendix H: Teacher Interview

Teacher
Week 2 Thursday/Friday
Describe your experience with using the app so far.

What did you enjoy about this app?
What did you least enjoy about this app?
How has it enhanced your teaching?
How has it limited your teaching?

What changes would you make for the content?
Did you notice any changes with the student's engagement from using the app?
Did you notice anything that was unexpected?
What changes would you make in using the app in PE class?

Week 4 Thursday/Friday
What are your feelings at the end of the study?
How was using the app for instruction, received by the students?
How did using the app for instruction make you feel?
What problems did you notice this week?
What overall changes would you make in using an app for PE classes?
Would you recommend this approach to teaching?
What was the hardest part of using the technology?
Any other comments about the AFIT or the study?

Appendix I: Student Journal Prompts

STUDENT
Reflections in journal prompts
Week 2 Monday
What was your first impression when seeing the app on your iPad?
What did you enjoy the most?
What did you enjoy the least?
What other feelings would you describe for the first week of the study? In your response explain why you felt the way you did.

Week 3 Monday
Please give a few reasons why you liked using the AFIT app.
Please give a few reasons why you did not like using the AFIT app.
Were you able to use the AFIT app outside of PE class? If so when and why.
How did the teacher being able to see what you reported make you feel? In your response explain why you felt that way.
What other comments do you have about the AFIT app?

Week 4 Monday
Circle how you feel about the AFIT app.

1	2	3	4	5	6	7	8	9	10
Very boring				So-So					Very Exciting

Have you discussed the AFIT app at home? What were your comments?
Did you change anything that you normally do because of the AFIT app?
What changes would you make to the app or content that was covered. In your response explain why you would make the changes.

Appendix J: Small Group Interview

Student
Small group interview - The students will be asked if they want to participate in the group interview. They will need to give a verbal indication if they want to participate and if they allow the session to be recorded. The verbal indication will be written down by the researcher, before the discussion is started and recorded.

Week 2 Thursday/Friday (High Participants)

Do you feel comfortable with using this type of technology? Why
How often have you used the AFIT app?
Are there any specific reasons why you have used the app so often?
How do you feel about using the app for your self-reported information?
Do you feel that you have control of what is reported?
How does the teacher seeing your information make you feel?
Has reporting your information changed your habits at all?
What changes would you make on the app?
What changes would you make on how the material is covered in class?

Week 2 Thursday/Friday (Low Participants)

Do you feel comfortable with using this type of technology? Why?
How often have you used the AFIT app?
Are there any specific reasons why you have not used the app so often?
How do you feel about using the app for your self-reported information?
Do you feel that you have control of what is reported?
How does the teacher seeing your information make you feel?
Has reporting your information changed your habits at all?
What changes would you make on the app?
What changes would you make on how the material is covered in class?

Week 4 Thursday/Friday (High Participants)

What did you enjoy the most with using the app during the study?
What did you enjoy least with using the app during the study?

What would you change if you were creating an app for nutrition and physical activity?
Did using an app in PE class change any of the material that was covered? If so how?
Would you recommend using this type of technology in teaching nutrition and physical activity?
Did having the teacher see your information change the way you felt about the information?
Are there specific reasons that you used the app so much during this study?

Week 4 Thursday/Friday (Low Participants)

What did you enjoy the most with using the app during the study?
What did you enjoy least with using the app during the study?
What would you change if you were creating an app for nutrition and physical activity?
Did using an app in PE class change any of the material that was covered? If so how?
Would you recommend using this type of technology in teaching nutrition and physical activity?
Did having the teacher see your information change the way you felt about the information?
Are there specific reasons that you used the app so little during this study?

Appendix K: Verbal Recruitment Procedure

Verbal Recruitment Procedure

" Hello class, I am a researcher from the University of South Florida. My name is Tom Watterson and I am the primary investigator for this study. My contact information is on the consent forms that I will distribute after I tell you about the study and answer any questions you might have at this time. If you or your parents have more questions later, please feel free to contact me with the information on the consent form."

1) The PI will inform the students about the study and show them the app on the iPad and the pedometers.
2) The PI will briefly discuss the study and answer questions from students and the teacher. Students will be informed that even if they are not in the study, they will receive the same material and participate in the same physical education class. There is no separation between participants and non participants.
3) The only students eligible for the research study are students in the selected classes, but all students will use the app and pedometers for their normal physical education experience.
4) If you are in a class that is not designated for the research study you will still download the app and use it during the four weeks, but your information will not used in the study.
5) If your class is asked to participate in the study, you will be asked to journal several times about your impressions and a few students will be asked to participate in a small group interview, in which I will ask questions about using the app. These interviews will be recorded so I can transcribe them later for analysis.
6) If you are in the selected class and decide to participate, a consent letter will need to be returned with your parents'/guardians' signatures. There is also an assent form that you will have to sign agreeing to participate. I have the consent and assent forms to distribute and my work phone number and email address is attached for your parents/guardians to ask me any questions.
7) The students will be informed that there is no incentive or grade attached with being part of this study and it is strictly voluntary. They will be told that they can withdraw at any time.

Appendix L: Pilot Study

A pilot study was conducted to evaluate the protocols needed for this study. The quantitative survey instrument, lesson plans for the teachers' physical education classes, and the application of the AFIT app, were the major foci for the pilot study. Based on the results of this study, several changes were made for this study.

Methods for the pilot study were conducted with one teacher and two middle school physical education classes. Day 1 introduced the app, gave out pedometers, and students sat in the gym and took the pre survey. The pre survey consisted of the long form of the Patient-Centered Assessments and Counseling for Exercise (PACE, 2001) instrument. The researcher was on hand and marked the each student's problems or questions about the survey. Time was also being observed to see the length of time the study would take and if the student's started to lose focus on the survey. Days one through ten, the students entered self reported data into the AFIT app and the teacher retrieved the information and discussed with the class each day. Day five consisted of the teacher using the pre scripted lesson plans and had a recorded interview with the researcher immediately following. Student journals were collected on day five and day ten of the study and a small group interview was conducted and recorded on day ten. All items were collected and the AFIT app was discontinued on day ten.

From the information gathered several procedures will be changed for the full study. The AFIT app, created for this research, has multiple layers of protection for the

students and teachers. These layers of protection for the students were found to be cumbersome for middle school students so downloading the app took longer than anticipated. These safeguards were addressed by now allowing students to sign in one time and remain signed in for the duration of the study. During the study, the researcher will be on site when the app is downloaded to help with any problems that occur. The app will now be placed in the iTunes app store, which will make downloading the app easier for the students and teachers and eliminate one of the steps needed in the pilot study.

The full version of the PACE (2001) instrument was too long for the attention span of the middle school students. They became overwhelmed and began to give up on the form. The instrument was reduced in size and several confusing pages were eliminated, which resulted in better concentration for a more specific test. This smaller version of the instrument was used as the posttest in the pilot and had better results. The items of self-efficacy, family and friend support for both physical activity and nutrition were not altered, ensuring the validity and reliability that have been previously established with the PACE instrument.

The pilot teacher found the lesson plans easy to use and indicated they held the students' attention. A change that was generated from using the lesson plans was to enlarge the window from the hyperlink on the app. The students and teachers visited www.ChooseMyPlate.gov during the classroom instruction. The previous window opened up to half the iPad screen size and was hard to read for the teacher and some students. This window was expanded to allow easier access to information for the teacher and students. The students also asked questions about the serving size and

physical activity that was to be recorded, which will be addressed earlier in the process of the study.

A quantitative analysis was unable to be done on the PACE (2001) instrument due to the students' lack of attention on the long version of the pretest. The posttest was done using different items from the PACE instrument and had no comparison to the original pretest, but succeeded in limiting confusing questions and retained the students' focus for the entire test.

The qualitative analysis of the pilot study gave insight for the students and teacher involved and helped with future journal prompt ideas. Students were asked to journal from some specific prompts that were provided. In a question about what they liked most of the app, one student reported: "I like this app because this made me more self-conscious about what I eat, that I may need to eat more vegetables or more dairy," while another student reported from this same question, "It does not criticize you." In a follow-up question about what changes they would make to the app, most students replied that they wanted to play a game when they reached a goal. Two students reported wanting more information about weight and calories burned during the activities they reported. These two students were involved in a self-motivation process for actively seeking out more information about a healthy lifestyle, which were medium to long term goals in the logic model.

Some of the best information came from the small group interview with the students and the final interview with the teacher. During the group interview with the students, a question that provided a great deal of feedback was "how did you feel about having the teacher see your app information?" Several students immediately said they

liked having the teacher see their information. They reported they were proud after having a high number of stars. Two other students said they did not like the teacher seeing their information. The researcher followed up by asking, "why did you not like (teacher name) seeing your app information?" One student responded that she forgot to enter anything in for dinner and her numbers were not accurate. This response led to another change in the app that will now allow students to change the day of their recordings, just in case they forget something or need to enter previous information. The other student's response to the question was, "I had a bad day and did not eat very well." This response lead to the rest of the group telling about their bad days and limited steps one day and no vegetables another day. During this part of the discussion one student offered something that highlighted the pilot study. This student described the scenario about her visit to the store with her mom and using the app to pick fruits and vegetables so she could "increase my numbers in the vegetable column." Using the app in the store with her parent is the ideal scenario for M-learning to take place and helped take the teacher's information about nutrition into the environment where the student reinforced the learning process.

In summary the pilot study was able to address some of the protocols needed for the full study. Modifying the pre and post survey information, refining the teacher lesson plans, and collecting data from journals and small group interviewing were all successfully attempted and modified accordingly.

Appendix M: Student Demographics

Pre Survey

Please read and answer each question as honestly and completely as you can.
The researcher will be the only person that sees this information.

Name: _____

1. How old are you today? ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐Other (specify) ___

2. What grade are you in ☐ 6 ☐ 7 ☐ 8

3. What is your race?
☐ White ☐African American ☐Asian ☐American Indian
☐Native Hawaiian ☐Other (please specify) _____

4. What is you ethnicity?
☐ Hispanic or Latino ☐ Non Hispanic or Non Latino

5. How many times in a week do you bring your lunch to school?
☐ 0 times a week
☐ 1 to 2 times a week
☐ 3 to 4 times a week
☐ Almost every day

6. How much do you notice what your friends eat for lunch?
☐ I never notice ☐ I sometimes notice ☐ I notice everyday

7. On average how much do adults in your household exercise, including weekends?
☐ 0 times a week
☐ 1 to 2 times a week
☐ 3 to 4 times a week
☐ 5 to 6 times a week
☐ Everyday of the week

8. How often do you go to the store to help with the household food shopping?

☐ I never go to the store

☐ I sometimes go to the store

☐ I go to the store almost every time

Appendix N: Teacher Demographics

Teacher Demographic information

What is your gender? □ Male □ Female
How old are you? _____

What is your race?
□ White □African American □Asian □American Indian
□Native Hawaiian □Other (please specify) _____

What is you ethnicity?
□ Hispanic or Latino □ Non Hispanic or Non Latino

How long have you been a MS PE teacher?

How long have you been at the current school?

How would you describe your comfort level with the technology?

What other technologies have you used in your classes?

What type of experiences did you have with those technologies?

What made you incorporate technology into your previous classes?

Appendix O: Tri-fold pamphlet

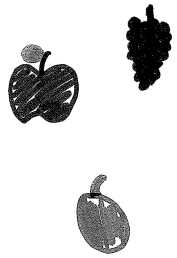
- Overall healthy diet!
- Protects cancer!
- Reduce risks for heart disease!
- Potassium; lower blood pressure!
- low fat, sodium, && calories!
- Vitamin C!
- Healthy blood pressure
- Form red blood cells.

AFit [&&) Fruits

Any fruit or 100% fruit juice counts as a part of the fruit group.

- cantaloupe
- honeydew
- watermelon
- strawberry
- orange
- cherry
- pears
- kiwi
- papaya
- nectorines

girls 9-13 need 1½ cups



Apple-1cup-1 small
Banana-1cup-1 long/large
Grapes-½ cup-32 seedless grapes
Oranges-½ cup 1 large
Peach-1 cup 2 halves
Pineapple-½ cup 1c chunks
Watermelon-1 cup 1 wedge (small)

Appendix P: IRB Approval

UNIVERSITY OF SOUTH FLORIDA

DIVISION OF RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-5618

March 13, 2012

Thomas Watterson

School of Physical Education & Exercise Science

RE: Expedited Approval for Initial Review IRB#: Pro00007359

Title: Impacts of a Teaching Innovation Featuring a Technology Application on Middle School Physical Education Teachers and Students

Dear Mr. Watterson: On 3/11/2012 the Institutional Review Board (IRB) reviewed and APPROVED the above referenced protocol. Please note that your approval for this study will expire on 3/11/2013.