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A Critical Examination Of An in Class Tabata Based Physical Fitness Protocol on Student Engagement Levels in a Sixth Grade Math Class

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A CRITICAL EXAMINATION OF AN IN CLASS TABATA BASED PHYSICAL FITNESS PROTOCOL ON STUDENT ENGAGEMENT LEVELS IN A SIXTH GRADE MATH CLASS

by

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DEDICATION

To my wife who supported and encouraged me throughout this entire process, I would not have been able to do this had it not been for your support.

To my four beautiful daughters who did not always understand why Daddy had to be in the office so much, I hope that someday my journey inspires you to reach for your goals.

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ABSTRACT

The purpose of this study was to evaluate the effectiveness of a Tabata Based Physical Fitness Intervention (TBPFI) on measures of student engagement in a middle school mathematics class. Student engagement was measured with the Student Engagement in Mathematics Scale (SEMS) which a Likert style scale. The results of this survey supplied a numerical rating for the social, emotional, and cognitive engagement of each student-participant in the study on days when a TBPFI was implemented and on days when it was not implemented. Additionally, pre- and post-interviews were conducted with the student-participants and the teacher-participant. Finally, researcher observations and rating scales were used to evaluate student engagement with the implementation of a TBPFI. Over the course of six weeks, five students and one classroom teacher participated in the study. The results of the study suggest that the use a TBPFI in a middle school mathematics class can improve the engagement levels of some students but not for all students and it may be dependent on current physical activity levels. The results of the study were used to develop an action plan that identifies the appropriate use if a TBPFI in a classroom setting for a middle school in an effort to engage more students in the classroom setting.

Keywords: Student Engagement in Mathematics Survey, Tabata Based Physical Fitness Intervention, physical activity, Physical education

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LIST OF ABBREVIATIONS

CDC ..... Centers for Disease Control and Prevention

CSPAP ..... Comprehensive School Physical Activity Program

SEMS ..... Student Engagement in Mathematics Survey

TBPFI..... Tabata Based Physical Fitness Intervention

WSCC ..... Whole School, Whole Community, Whole Child

CHAPTER ONE: INTRODUCTION

Improving wellness has a positive impact on student growth, development, and academic progress, and is an instrumental piece in educating the whole child (Bramante et al., 2007; Care et al., 2020; Slade & Griffith, 2013). As a result, the ASCD developed the Whole School, Whole Community, Whole Child (WSCC) model of education as a method to improve not only student wellness, but also educational outcomes (Bramante et al., 2007). Since its origination in 2007, the WSCC model has been refined into 10 components that provide the framework for improving student achievement. These 10 areas serve as the foundation for schools to develop programs, policies, and procedures from which student achievement can occur through social, emotional, physical, and cognitive improvements (Care et al., 2020). Three of these components; social, emotional, and cognitive, are referred to collectively as student engagement and serve as an underlying factor in determining student success in school (Baroody et al., 2016). The final component, the physical aspect, is a contributing factor to student engagement through physiological improvements, primarily in cardiovascular fitness, that enhance the neurological conditions needed to drive improvements in cognition, executive function, behavior and self-esteem (Calfas & Taylor, 1994; Hillman et al., 2014)

Physical Activity, Fitness, and Student Engagement

Researchers have demonstrated that physical activity can influence the cognitive aspect of student engagement through enhanced cognitive processing and executive

functioning abilities and that these abilities seem to be greater with higher levels of fitness (Hillman et al., 2014; Scudder et al., 2014); that is, as fitness improves, so do measures of cognition, executive function, and academic performance (Grisson, 2005; Hillman et al., 2014; Scudder et al., 2014). Furthermore, Calfas and Taylor (1994) explain that participation in physical activity can improve the emotional aspects of student engagement through increased self-esteem and reductions in stress and anxiety. Finally, the social aspect of student engagement is enhanced through improved classroom behavior and mental focus with participation in physical activity (Pontifex et al., 2013).

As a result of the link between physical activity, fitness, and student engagement, the Centers for Disease Control and Prevention (CDC) developed the Comprehensive School Physical Activity Program (CSPAP) as a guide to increase opportunities for physical activity and fitness throughout the school day (CDC, 2019). Consequently, health and physical education has been identified as a primary avenue for physical activity opportunities and physical fitness improvements in a school-based setting. To help achieve this goal, the Society for Health and Physical Education (SHAPE) recommends that students in elementary school receive 150 minutes per week of physical education and students in middle and high schools receive 225 minutes per week of physical education (SHAPE America, n.d.). However, according to Kulik et al. (2015), most physical education programs fall short of meeting this goal which appears to be due to the negative perception of physical education as a content area.

Physical Education Perceptions and Time Allocation

Despite the evidence and recommendations to support improving physical activity and fitness as a means to enhanced student engagement, physical education is often

viewed as less important than other subject areas, typically those that involve state and federal testing requirements (Barney & Deutsch, 2009). While many educators broadly agree that health and fitness is important for the overall development of a student, they do not view physical education as important as other subjects and the content learned is perceived as less applicable to future life (Barney & Deutsch, 2009; Laureano et al., 2014). Consequently, school entities prioritize the importance of reading, writing, mathematics, and science as a pathway to lifetime success and tend to marginalize areas related to health and wellness. As a result, subject areas such as English, math, and science are not tasked with justifying their importance for future success or relevancy within a school, yet physical education has struggled to remain equally relevant. In fact, since the start of the century physical education has been reduced or eliminated in many schools across the country because it is viewed as less important than other content areas (Pate et al., 2006). As a consequence, the recommended allocation of time allocation for physical education has been reduced, shortchanging the opportunity for students to gain the benefit of improved fitness and wellness (Kulik et al., 2015).

Statement of Problem of Practice

For the better part of two decades, I have devoted my career to enhancing the health and fitness of adolescent populations. Over the last decade, I have implemented numerous initiatives to bolster student health and fitness to assist in improving academic results. A few examples include a walking program prior to the administration of state standardized testing designed to enhance test outcomes, a before-school physical activity program aimed at improving fitness and also bolstering reading scores, and an in-class physical activity program tied to the curriculum to provide additional opportunities for

daily activity. However, due to time constraints and funding, these initiatives are not offered anymore. Additionally, the increasing pressure to improve academics, and the perception that physical education, fitness, and wellness are less important than tested content areas, has led to a current situation where the requirement for physical education has been altered to allow more time for direct instruction in tested areas.

At the elementary level, students are removed from physical education to participate in targeted tutoring sessions to address deficiencies in math and English language arts. At the middle school level in our district, students are offered physical education for only a single nine-week grading period each year. And finally, high school students are offered an "accelerated" physical education option in the summer that requires nothing more than self-reporting of completed physical activity for physical education credit. The consequence of these practices at the elementary and secondary levels is a minimization of opportunities to participate in physical activity during the school day and throughout the school year.

Based on what has transpired over the last decade in my current setting, the problem that has developed is one of an inequality of available time for physical education and physical activity relative to tested content areas during the school year. This minimization of time for physical education and physical activity has hindered students' ability to gain the documented benefits of improved physical fitness on student engagement and academic outcomes (Care et al. 2020; Hillman et al., 2014). As a result, a reimagined role for physical education that seeks new methods and procedures to offer physical activity opportunities to enhance physical fitness is needed.

Specifically, seeking methods that have the potential to improve not only physical activity and fitness but also have an impact on student engagement in a general classroom setting could contribute to the overall goal of both physical education as well as tested content areas. Consequently, physical activity and fitness improvement methods that can be assimilated quickly and easily into a typical school day are warranted. A potential option is the Tabata fitness protocol that was developed to provide similar results to traditional fitness practices, but in much less time (Tabata, 1997).

Originally developed on a cycle ergometer to improve cardiovascular fitness in cycle endurance athletes, the Tabata fitness protocol has since evolved into a multifaceted fitness protocol that utilizes varying modalities of exercise such as bodyweight movements and running, all of which is explained in more detail in Chapter Two (Viana et al., 2020). Utilizing this protocol within a classroom setting could serve to improve academic achievement through enhanced student engagement as a result of participation in cardiovascular fitness enhancing physical activity (CDC, 2019; Hillman et al., 2014).

Research Question

What impact does an in-class Tabata based physical fitness protocol have on student engagement levels in a sixth-grade math class?

Purpose of the Study

The purpose of the study is to examine the impact of a Tabata fitness routine on the engagement level of students in a sixth-grade math class. For the purposes of this study, a Tabata fitness routine is a planned warmup of bodyweight exercises performed for a specific time interval not to exceed 4 minutes prior to the start of a typical sixth-grade math class. Moreover, for the purposes of this study, student engagement is defined

as “a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and the drive to learn more” (Abla & Fraumeni, 2019, p. 2).

Theoretical Framework

According to Grant and Osanloo (2014), the development of a blueprint from which the details of a research study can develop is essential for success. Once developed, this blueprint serves as the overall guide for the research. The blueprint for this project has been developed through the lens of a whole school, the WSCC model, the comprehensive school physical activity plan (CSPAP), and inquiry as stance (Care et al., 2020; Dana, 2015). The combination of these frameworks provides a guide to understand and expand my professional teaching practice through an ongoing process to develop and implement an educational model.

Whole School, Whole Community, Whole Child

The primary goal of this project is to provide students with the opportunity to experience not only academic success, but also social, emotional, and physical success through the theory of a WSCC educational model. A guiding principle of the WSCC model is the whole child education and is defined as “the development of children who are healthy, safe, engaged, supported, and challenged within a sustainable approach to education and community engagement” (Bramante et al., 2007, p. 3). This definition, which outlines an educational approach, was developed using Maslow’s (1943) Hierarchy of Needs as the overarching theory described by Slade and Griffith (2013) as follows:

> When students’ basic physiological and psychological needs (safety, belonging, autonomy, and competence) are satisfied, they are more likely to become engaged in school, act in accord with school goals and values, develop social skills and understanding, contribute to the school and community, and achieve

> academically. Further, when schools fail to meet those needs, students are more likely to become less motivated, more alienated, and poorer academic performers. (p. 26)

While the WSCC model serves as the primary theory for this research, a more specific aspect of this model, the Comprehensive School Physical Activity Plan (CSPAP) provides the guidance and motivation as it is the physical activity portion of the WSCC model (CDC, 2019). The primary goal of the CSPAP is to develop and implement opportunities for physical activity throughout the school day as a pathway to improved student engagement. The implementation of a CSPAP is the continual improvement process needed to create change through the whole child model and warrants an open-ended view of change rather than a closed end project.

Inquiry as Stance

Practitioner inquiry, or action research, is typically viewed as a process that produces change to immediate practice. Generally, "immediate practice" is thought to be a classroom setting and working with students directly. In this type of practitioner inquiry, inquiry as project, teachers may view it as a linear process that is separate from practice and has a defined end point. Upon completion, the new information is assimilated into practice and then the teacher returns to "business as usual" (Dana, 2015, p. 163).

Inquiry as stance views practitioner inquiry as professional stance "where questioning, systematically studying, and subsequently improving one's own practice becomes a necessary and natural part of a teachers work" (Dana, 2015, p. 164). Inquiry as stance puts "inquiry" at the forefront of the teacher's role as an educator as a way to best

improve practice. Cochran-Smith and Lytle (2009) best defines inquiry when they state that inquiry is

> a way of knowing and being in the world of educational practice that carries across educational contexts and various points in one's professional career and that links individuals to larger groups, and social movements intended to challenge the inequities perpetuated by the educational status quo. (p. vii)

In the case of this research, my immediate practice is the professional capacity with which I perform my job and the ability to function as a contributing member of the educational team to implement a whole child educational model. In this representation, I attempt to link my practice to larger groups and challenge the inequities perpetuated by the educational status (Cochran-Smith and Lytle, 2009).

Methodology

This mixed methods research study was conducted during the Spring 2022 semester at ABCDE middle school in Pennsylvania with an enrollment of 303 students in sixth through eighth grade. The participants of the study were five students and one educator of a sixth-grade mathematics class. Participants were chosen from a math class within the building in which the researcher was employed and that which matched the researchers available schedule. A brief biographical description of the student-participants and educator participant are discussed in Chapter Three.

Over the course of six weeks, student-participants completed two consecutive days of no in class physical activity followed by two consecutive days of in class physical activity. The in class physical activity consisted of a bodyweight Tabata fitness protocol that included eight exercises performed each performed for 20 seconds followed by a 10-second break. Data collection methods included a non-activity day Student Engagement in Mathematics Scale (SEMS) and an activity days SEMS each week, a pre- and post-

structured interview for student and educator participants, and finally, observations and field notes from the teacher-researcher twice per week, which was once on an activity day and once on a non-activity day. These data sets were used to gauge the impact of an in class Tabata fitness protocol on overall student engagement in a sixth-grade math class.

Significance of the Study

The fitness levels of students have been correlated to academic achievement (Grisson, 2005). Likewise, overall student health and wellness has been linked to academic achievement in a variety of categories (Care et al., 2020). A key component to enhance academic achievement is student engagement during the school day (Baroody et al., 2016; Lee, 2013). In a school-based setting, physical education has been identified as a primary avenue for delivery of services to enhance student health, fitness and wellness and a pathway to improve student engagement (CDC, 2019). However, recommendations for physical education time allocation are rarely met due to perceptions that other content areas are more important (Kulik et al., 2015; Laureano et al., 2014). This study sought to demonstrate that alternative methods of including physical education-based content to promote physical activity and fitness during the typical school day in a classroom-based setting can improve student engagement levels and thus enhance academic outcomes.

Summary of the Findings

The findings of this study indicated that a Tabata based fitness protocol during a sixth-grade math class can yield positive results for some students but not for all students. Likewise, the perceptions of the teacher-participant and the researcher indicated that many students' engagement levels are perceived to be improved based on researcher and

teacher observations. Finally, the inclusion of physical fitness activities in a classroom setting is perceived as a positive and welcomed by the students as a positive addition to a class.

Positionality

As indicated by Herr and Anderson (2015), positionality refers to whether the researcher is an insider or an outsider in relationship to the research. In the case of this research, I served as both because I was the physical education teacher and the researcher. However, it should be noted that near the end of the study design, my positionality changed due to a change in teaching assignment. Originally, this study was to be completed in an elementary setting; however, a few months prior to data collection, I was reassigned as a middle high school teacher in a different building. While the problem of practice remained the same, the location and intended participants had to change. While this did present challenges, I remained an active participant who served as the teacher leader and also as an outsider to view the results of the data sets. This positionality placed my ethics at a premium because if I was not steadfast with my implementation, the results of the study could be deemed to be bias or manipulated by me to reveal a positive association. In addition, Efron and Ravid (2013) indicated that ethical considerations surrounding the safety, confidentiality and well-being of study participants should be taken to protect their interests. Transparency was important so that any questions about methods or tactics were easily disseminated to questioning parties.

As an outsider, I was interested in observing student engagement levels in a mathematics class after participating in a series of in-class fitness experiences. In this position, I recorded students' activities with respect to their participation, attitudes, and

perceptions about math class after participating in a series of in-class fitness experiences. As an insider, even though it was a relatively new setting, I was a colleague of the educator participant and as a result, I was viewed as an equal rather than a researcher or authority figure. Specifically, I served as a teacher leader to implement a variation of a current curriculum model. In this role, I served as a content expert but also as an equally contributing member of the educational team to improve educational outcomes.

Dissertation Overview

Chapter One serves as an overview of the research study. Chapter Two summarizes the current literature concerning the WSCC model, CSPAP, physical education, physical activity, physical fitness, and student engagement. Chapter Three offers a detailed methodology to answer the proposed research question. Chapter Four provides an analysis of the collected data and Chapter Five provides implications and recommendations for future action.

Definition of Terms

student engagement: "a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and the drive to learn more" (Abla & Fraumeni, 2019, p. 2).

Tabata fitness: fitness protocol that provides 20 seconds of activity followed by 10 seconds of rest and is repeated 8 consecutive times for a total of 4 minutes of activity (Viana et al., 2019).

perception: the ideas or thoughts someone has about a topic based on their experiences and understanding about the topic.

Comprehensive School Physical Activity Plan (CSPAP): "a framework for planning and organizing activities for school physical education and physical activity" (CDC, 2019, p. 2).

whole child education: "the development of children who are healthy, safe, engaged, supported, and challenged within a sustainable approach to education and community engagement" (Bramante et al., 2007, p. 3).

CHAPTER TWO: REVIEW OF LITERATURE

Improvements in physical abilities, fitness, and health can have a positive impact on student growth and development and are an incremental piece of the whole child model of education (ASCD, 2007, 2020). However, regardless of the evidence, this does not seem to produce an increase in physical fitness opportunities or physical education time for students in an educational setting (Kulik et al., 2015). In fact, it seems the opposite is happening as physical education classes are being reduced to increase time for instruction in content areas that require state mandated testing (Laureano et al., 2014). As a result, "We are narrowing the curriculum down to the basics in an over-tested atmosphere where everyone is relentlessly driving children upwards in a race to the top" (Care et al., 2020, p. 33).

Regardless of the discrepancy in time allocation, the positive research surrounding physical fitness and academics, as well as the understanding that health and wellness contribute to the successful development of a student, little change has occurred to include physical education and physical educator instructors as collaborators within a school system. Over time, the problem that has developed is one of inequity between physical education and other content areas. Specifically, this inequity has produced and inequality concerning the available time for physical fitness related activities, resources devoted to student health and wellness, and inclusion of physical education as an equally important content area for student growth and development based on the whole child model (Slade, 2013).

While physical activity in a classroom setting is common through normal movement patterns and class procedures, it differs from physical fitness and this difference is explained in more detail in this chapter (Braniff, 2011; Casperson et al., 1985). As a result, a potential solution could be the ability to demonstrate the practical impact classroom-based physical fitness routines can have on student engagement, and ultimately, academic improvement, within a classroom setting (Hillman et al., 2014). A pragmatic option to improve physical fitness may be the non-traditional use of physical education principles and practices by the physical education teacher.

To that end, this chapter is organized into the following sections: historical perspectives, theoretical framework, student health and wellness, educational inequities, and related research. Finally, the chapter concludes with a summary of the reviewed literature.

Historical Perspectives

The improvement of physical abilities through activities such as physical contests and tribal dances has been documented as part of ancient civilizations for much of the existence of the human race (Brewer, 1922). This is still part of the human race as evidenced by the value placed on professional athletes and the recognition that physical activity is an important aspect of overall health maintenance (World Health Organization, 2011). In a school-based setting, this recognition is manifested through the implementation of health and physical education classes, which have been part of the American education system for more than one hundred years (Brewer, 1922). While physical education has been part of the education system for more than a century, the implementation of standardized testing protocols for core subject areas has reduced the

importance of physical education and physical activity in favor of tested academic subjects (Institute of Medicine, 2013).

However, in an effort to reinforce the benefits of student health and wellness, the ASCD and the Centers for Disease Control and Prevention (CDC) have recently developed programs designed to improve physical fitness levels and physical activity participation as part of a complete education (Care et al., 2020; CDC, 2019). The Whole School, Whole Community, Whole Child (WSCC) model of education (ASCD & CDC, 2014; Care et al., 2020) and the Comprehensive School Physical Activity Program (CSPAP) (CDC, 2019) provide strategies to further improve student health and wellness. Combined, these programs outline the need to improve student health and fitness through participation in quality physical education and increased opportunities for physical activity throughout a school day (CDC, 2019; SHAPE America, 2015).

Theoretical Framework

A theoretical framework works as a blueprint from which to guide research, providing a roadmap from which the details of the research can materialize (Grant & Osanloo, 2014). For this project, there are multiple theoretical frameworks that encompass the needs of the intended subject, the effect on the educational system, the importance of the physical education profession, and finally, the action research process.

The overall theoretical framework for this research is the WSCC model of education created by the ASCD as a reimagined view of prioritizing the student in education (Bramante et al., 2007; Care et al. 2020). More specifically, the CSPAP, which is part of the WSCC model, provides the guidance from which this research has been based. Additionally, inquiry as stance have been used to conceptualize the

implementation of CSPAP within a school setting (Cochran-Smith & Lytle, 2009; Dana, 2015; Hargreaves & Fullan, 2012). The combination of these frameworks provides a guide to understanding and expanding the researcher's professional teaching role through an ongoing process of implementing an educational model designed to directly benefit students.

Whole School, Whole Community, Whole Child Model

In 2007, the ASCD presented a vision for the education of the whole child (Bramante et al., 2007). The report, titled *The Learning Compact Redefined: A Call to Action. A Report of the Commission on the Whole Child* (Bramante et al., 2007), indicated that we are failing to educate the whole child by concentrating primarily on academic measures as determinants of success. Bramante et al. (2007) defined whole child education as "the development of children who are healthy, safe, engaged, supported, and challenged within a sustainable approach to education and community engagement" (p. 3). Furthermore, when schools fail to meet these development needs, "students are more likely to become less motivated, more alienated, and poorer academic performers" (Slade & Griffith, 2013, p. 26).

The primary influence on the whole child education was the work of Abraham Maslow's *Theory of Human Motivation* (1943), which categorized various physiological and psychological aspects of human life and the potential order in which these things are needed to maintain a certain level of motivation for any given person. Maslow (1943) suggested the hierarchical order of these needs as "physiological, safety, love, self-esteem, and self-actualization" (p. 394). Furthermore, he proposed that the most basic of

these needs, physiological, must be met to an acceptable degree before the remaining needs can materialize for the individual.

While the whole child model of education is predicated on the theories espoused by Abraham Maslow, it is reinforced by research that links health and fitness to academic success. As an example, more fit students tend to have higher cognitive function than their less-fit peers (Scudder et al., 2014) and those students who perform well on measures of physical fitness tend to have higher levels of academic achievement (Grisson, 2005).

As a result of the research on fitness and academics, and the initial whole child model, the WSCC model of education was co-authored by the CDC and the ASCD (2014). The updated model proposed creating an educational system that improved capacity for learning and opportunity by enhancing the social, emotional, mental, physical, and cognitive development of students. Since its inception, the WSCC model has become the most widely adopted school and community health model in the United States (Care et al., 2020). The implications of this model are far reaching due to the vast array of effects that health contributes to individuals and, by extension, society and the economy. (ASCD & CDC, 2014).

Due to the positive correlation between health and learning, and the fact that more than 95% of children attend school, the ASCD and CDC (2014) advocated for improving student health and wellness within an education setting. Consequently, the focus of the WSCC model is centered around improving student health and wellness as a pathway to improve academic achievement which includes three areas: academic performance, education behavior, and students' cognitive skills and attitudes. Collectively, this model

serves as not only a predictor of youth health and wellness, but also as one for adult health and wellness (U.S. Department of Health and Human Services, 2013).

While the WSCC model provides the blueprint for change to influence academic achievement, the CSPAP provides the justifications, guidelines, and methods for implementing the physical activity protocols within a school-based setting to prompt a change (CDC, 2019). Specifically, the CSPAP identifies physical education and physical activity as a primary contributor to the whole child education (Care et al., 2020; CDC, 2019). Combined they form a complete framework for improving student outcomes through the practical application of Maslow's (1943) hierarchy of needs originally outlined in the whole child model.

Comprehensive School Physical Activity Program

The concept behind the CSPAP is that which recognizes the importance of movement, both structured and unstructured, on the developmental aspects of youth and adolescent populations. As part of the WSCC model, the CSPAP recognizes that school-based programs are an ideal location to expose the population to the concepts and benefits of improved health and wellness (CDC, 2013). As a result, the Comprehensive School Physical Activity Program "is a framework for planning and organizing activities for school physical education and physical activity" (CDC, 2019, p. 2). Five components encompass an ideal CSPAP, and each serves a unique role to address the need for increasing student movement throughout a typical school day. The five components are physical education, physical activity during school, physical activity before and after school, staff involvement, and family and community engagement (CDC, 2019).

Physical Education

Physical Education is part of a well-rounded K-12 education that provides a standard based curriculum and instruction. It is specifically designed to provide students with the knowledge, skills, and abilities to lead a physically active lifestyle (SHAPE America, 2015).

Physical Activity During School

This component includes activity performed while a student is in a class other than physical education. Typically, this component includes activities other than normal movements performed in a school day such as walking to class or to get needed supplies. However, it does include additional activities performed in a classroom setting like jumping, stretching and dancing (CDC, 2019). Also included in this category is recess, which is typically only offered at the elementary level (CDC & SHAPE America, 2017).

Physical Activity Before and After School

This component includes activities performed either before or after school that allow students to practice skills learned in physical activity. The CDC identifies potential activities to include physical activity clubs, intramural programs, interscholastic sports and extended day programs that could be offered at a school (CDC, 2019).

Staff Involvement

The importance of leading by example is the focus of this component. School faculty and staff are encouraged to serve as role models and integrate health and wellness concepts and activities into their daily teaching and personal routines. In an effort to support faculty and staff involvement, it is recommended that school entities offer

employee wellness programs as a way to encourage employee health and wellness (CDC, 2019).

Family and Community Engagement

The final component engages the extended school community for implementation of before and after school components. School entities are encouraged to garner support from community members and organizations to support clubs and activities that promote increased physical activity (CDC, 2019). This also serves to reinforce the importance of developing and maintaining a healthy and active lifestyle as a way to promote lifelong physical activity participation into adulthood (U.S. Department of Health and Human Services, 2013).

Professional Capital

Professional capital requires the teacher to be an integral part of the education process. In this theory, the greater the investment in professional capital, the greater the educational outcome (Hargreaves & Fullan, 2013). Capital, in the economic sector, is defined as something that adds value to net worth (Hargreaves & Fullan, 2012). Hargreaves and Fullan (2013) also stated that in the economic sector, if you want to get a return, you have to make an investment. In education there are currently two basic types of capital: business and professional.

Business capital is viewed in the education profession as a short-term investment that offers high yield returns in the form of technology integration and test results. In the business capital view, teaching is simple, cheap, and automated for maximum return on investment. The quickest way to increase returns in a business capital view is by reducing costs. In the case of teaching, cost comes from professional development, collaboration,

and training (Hargreaves & Fullan, 2013). Thus, teaching is reduced to an automated system managed by a teacher that serves as the technician to implement curriculum, produce and collect data, and utilize technology in a way that reduces the number of highly trained teachers needed, thus reducing costs (Hargreaves & Fullan, 2012).

In contrast to business capital is professional capital, which places the investment not in processes and procedures, but rather in the teacher and their abilities. Professional capital views teaching as a complex investment demanding time and attention to produce a long-term investment return. Success requires three essential elements: "human capital (the talent of individuals); social capital (the collaborative power of the group); and decisional capital (the wisdom and expertise to make sound judgments about learners that are cultivated over many years)" (Hargreaves & Fullan, 2013, p. 37).

According to Hargreaves and Fullan (2012), professional capital requires high levels of collaboration, data analysis, and technology integration to produce the greatest outcomes. Consequently, teachers are not a replaceable tool but rather an essential asset of the educational process that enhances the return on investment (Hargreaves & Fullan, 2013). Typically, physical education teachers are viewed as less essential than teachers of other content areas (Barney & Deutsch, 2009). However, in the WSCC and CSPAP, physical education teachers are the primary content area experts from which program implementation occurs. As a result, the professional capital of physical education teachers is called upon to implement the key aspects for each program to be successful.

Inquiry as Stance

Practitioner inquiry is typically viewed as a process that produces a change to immediate practice. In education, "immediate practice" is considered the classroom

setting and working directly with students by "those closest to the day-to-day work of teaching and learning" (Cochran-Smith & Lytle, 2009, p. 6). In this type of practitioner inquiry, referred to as inquiry as project, teachers may view the process as linear with a defined endpoint, and thus separate from their day-to-day practice. Upon completion of a project, the new information is assimilated into the teaching practice and then the teacher returns to "business as usual" because the "project" has concluded (Dana, 2015). In contrast to inquiry as project is inquiry as stance.

Inquiry as stance views practitioner inquiry as a professional stance "where questioning, systematically studying, and subsequently improving one's own practice becomes a necessary and natural part of a teachers work" (Dana, 2015, p. 163). Inquiry as stance puts "inquiry" at the forefront of the teacher's role as an educator as a way to best improve practice. Cochran-Smith and Lytle (2009) best define inquiry as

> A way of knowing and being in the world of educational practice that carries across educational contexts and various points in one's professional career and that links individuals to larger groups, and social movements intended to challenge the inequities perpetuated by the educational status quo. (p. vii)

Physical education is thought of to be less important than other content areas and as a result receives less focus within a school (Barney and Deutsch, 2009; Laureano et al., 2014). However, the WSCC and CSPAP model are intended to challenge this inequity by placing the emphasis on student health and wellness as a primary factor in overall student achievement. Inquiry as stance serves as the basis to ensure that the ideals of the WSCC and CSPAP model are implemented with fidelity over time.

Student Health and Wellness

In a school-based setting, there are numerous types of physical movements that take place throughout each day, and each has its own goal or purpose. In its most basic

form, walking to and from classes classifies as physical movement. However, while movement occurs daily, the capacity and environment in which they are performed dictates their effectiveness towards improving student health, fitness, and wellness. Consequently, there exists basic terminology as it pertains to student health, fitness and wellness. Delineating among, and between, different terms allow for a greater understanding of the varying types of movement that contribute to student health, fitness, and wellness. This section of the literature review will provide an overview of physical activity and exercise, physical fitness, physical education, physical literacy and Tabata fitness.

Physical Activity, Exercise, and Physical Fitness

Physical activity is the basis of all movement. Within the general category of physical activity exist subcategories. As a basic definition, physical activity is "any bodily movement produced by skeletal muscles that results in energy expenditure" (Casperson et al., 1985, p. 126). This broad definition includes activities such as walking, running, and yoga as examples (CDC, 2019). These examples are sometimes viewed as exercise, but exercise, while a physical activity, has its own, more precise definition. Exercise is "any physical activity that is planned, structured, and repetitive for the purpose of improving or maintaining one or more components of physical fitness" (SHAPE America, 2015, p. 3).

In contrast to physical activity is physical fitness. Physical fitness is not a specific activity but rather a measurement of physical performance when an individual participates in an activity. Physical fitness is defined as a set of attributes that can be measured with specific tests and the degree to which any individual possesses these attributes is a determining factor in their individual fitness level (Casperson et al., 1985).

Physical Education and Physical Literacy

Physical education has been part of the educational curriculum in American schools for more than a century (Brewer, 1922). As a content area, Physical Education has recently undergone a transformation as part of the CSPAP (SHAPE America, 2015). SHAPE America (2015) defines physical education as "a planned, sequential, K-12 standards-based program of curricula and instruction designed to develop motor skills, knowledge and behaviors for active living, physical fitness, sportsmanship, self-efficacy and emotional intelligence" (p. 3). The components of this definition are referred to collectively as physical literacy and serve as the primary goal of physical education (Young et al., 2020).

The aforementioned transformation of physical education, and subsequent focus on physical literacy, is the result of data that suggests student success is influenced by the effect of physical fitness on brain function, cognition, and academic achievement (Grisson, 2005; Hillman et al. 2014; Scudder et al., 2014). In an educational setting, physical education is the primary avenue from which physical literacy can be improved. Overall, physical education addresses the cognitive, affective, and psychomotor learning domains to address the mental knowledge, feelings and attitudes, and physical skills necessary for the development of physical literacy.

Physical literacy is a concept that has existed for nearly three decades (Whitehead, 2001). First developed by a physical education teacher, the concept has grown into a theoretical framework from which physical education programs are currently based. As a result, physical education programs have been tasked with developing physically literate students by developing the attributes that define physical

literacy (SHAPE America, 2015), which is "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" (International Physical Literacy Association, 2017, main page).

The original concept of physical literacy was developed in opposition to traditional physical education due to the perception that physical education was focusing its efforts on high-level physical performance and marginalizing the abilities of less physically capable students. As a result, the concept of physical literacy is focused on the importance of increasing movement in early childhood and addressing the increasing rates of sedentary behavior and subsequent reduction in physical activity around the globe (Young et al., 2020).

The inclusion of physical literacy into the working definition and design elements of physical education programs was spurred by the development of the WSCC model (ACSD, 2007; ASCD & CDC, 2014) and the inclusion of physical education as part of the CSPAP (CDC, 2019). The goal of these initiatives was to address the growing evidence to support the improvement of health and wellness as an integral part of the holistic development of the students in an educational setting (SHAPE America, 2015).

Tabata Fitness Protocol

Tabata fitness is a form of high intensity interval training (HIIT) physical activity that improves measures of physical fitness in a time efficient manner compared to traditional steady state exercise (Foster et al., 2015). Steady state exercise is exercise performed for an extended time period of time usually in increments of 20 minutes or more. This type of training is performed at approximately 30-80 of maximum effort

(Tabata, 2019). Tabata fitness "is defined as training at the intensity that exhausts subjects during the 7th or 8th sets of 20-s bicycle exercise bouts with a 10-s rest between the exercise bouts" (Tabata, 2019, p. 560). Typically, this is an intensity level of 85% or higher. Additionally, there are variations of this training protocol that involve other exercise modalities beyond bicycle exercise that include treadmills and bodyweight protocols, among others (Viana, 2019). Regardless of the modality, if exercise intensity remains elevated, a positive gain in fitness can be achieved (Viana et al., 2019).

In a study of untrained college-aged subjects, a four-minute Tabata style fitness regimen improved cardiovascular endurance to similar levels as 20 minutes of lower intensity, steady exercise (Foster et al., 2015). In another study, Lee et al. (2021) reported that twice weekly Tabata-style training session positively improved measures of fitness in middle school students over a ten-week period. Additionally, four weeks of Tabata-style training improved not only cardiovascular fitness, but also muscular endurance to a greater degree than traditional steady state exercise in young, active females (McRae et al., 2012). Overall, the time-efficient manner in which Tabata style training can potentially improve fitness and be adapted with various modalities makes it viable option for inclusion into a classroom-based setting as a way to enhance student engagement.

Student Engagement

In the WSCC model, academic achievement is defined as being the combination academic performance, education behavior, and students' cognitive skills and attitudes. Each of these areas is comprised of individual characteristics that define what each area represents. Academic performance concentrates on grades and testing, education behavior is concerned with attendance and school-based behavior, and students'

cognitive skills and attitudes focuses on aspects of concentration, memory and mood (ASCD & CDC, 2015). Because these areas of academic achievement are multifaceted, they require a high level of student engagement (The Glossary of Education Reform, 2016).

Pedler et al. (2020) reported that student engagement encompasses the behavioral, emotional and cognitive aspects of academic achievement and can determine how a student interacts with educational material and within an educational setting. Specifically, student engagement is defined as "a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and the drive to learn more" (Abla & Fraumeni, 2019, p. 2). While student engagement is a variable affecting academic achievement, Moore et al. (2015) identified it as non-academic because it is not considered measurable through classic achievement or IQ assessments. Furthermore, these non-academic attributes are contributing factors for physical, social and emotional health that represent well-being, and consequently, student engagement at any point in time (Moore et al., 2015).

As a result, it has been suggested that focusing on intellectual, emotional, behavioral, physical, social, and cultural engagement are areas of importance when considering options to improve student engagement within a school setting (The Glossary of Education Reform, 2016). In an effort to improve these non-academic measures of student engagement, the CDC (2019) recommended enhancing student physical fitness through quality physical education and increased opportunities for physical activity during the school day as a pathway to increased academic achievement.

Research has demonstrated that physical fitness and physical activity is related to student engagement through academic improvements facilitated by enhanced cognitive processes (Scudder et al., 2014; Hillman et al., 2014) and that these cognitive processes seem to be greater when there are higher levels of fitness (Scudder et al., 2014). Specifically, aerobic fitness tends to be the primary physical fitness factor related to enhancements on cognition and academic achievement (Hillman et al., 2008). While overall aerobic fitness level is an indicator of improved cognition (Hillman et al., 2014), acute bouts of activity also improve cognition in students (Hillman et al., 2008).

In a laboratory setting, third-grade students who participated in an acute bout of treadmill walking demonstrated higher levels of executive control than students who did not participate in an acute bout of treadmill walking (Hillman et al., 2008). This is evidence of the ability of a student to maintain task-specific cognitive control to a greater degree after an acute bout of exercise at submaximal levels of effort. Additionally, Hillman et al. (2014) found that this cognitive control is also related to, and seems to enhance, attentiveness and task completion as individual fitness levels increase as a result of participation in an afterschool physical activity program.

Specifically, the ability of a student to focus on a cognitive task, and complete the task, without distraction is improved with acute bouts of aerobic activity. Hillman et al. (2008) note that this trend continues as students exhibit higher levels of aerobic fitness as compared to less fit peers. Additionally, Pontifex et al. (2013) demonstrated an association between improved student engagement as it pertains to classroom behavior and mental focus with participation in physical activity and improved physical fitness.

Finally, improvements in physical fitness and increased physical activity participation have a positive impact on student mental health (Institute of Medicine, 2013).

Calfas and Taylor (1994) explained that physical activity can increase student engagement through improvements in self-esteem and reductions in anxiety and stress through an improvement in fitness. The interrelationship of the impact that improved physical fitness and increases in physical activity can be seen in the results of student academic performance. Grisson (2005) demonstrated that tests of overall fitness indicate that the higher the levels of fitness, the higher the levels of academic achievement in secondary students. Utilizing measures of health-related fitness on the Fitnessgram battery of assessments, Grisson (2005) determined that students who achieved a health-enhancing level of fitness in more individual areas of fitness produced individual academic performances that were greater than students who did not achieve a health-enhancing level of fitness on these assessments. This relationship is not just present in secondary students.

Castelli et al. (2007) explained that third and fifth grade students exhibit a similar relationship between fitness, specifically aerobic fitness, and academic performance when they reported that elementary students who perform higher on the same health related measures of fitness also perform better than their less-fit peers on measures of math and reading performance. The results of these studies suggest "physical fitness is globally associated with academic performance during maturation, independent of other possible factors" (Castelli et al., 2007).

Educational Inequities

The WSCC model (ASCD & CDC, 2014) coupled with the CSPAP (CDC, 2019) provides the blueprint for improving student health, fitness, and academic achievement. The CDC (2019) recommends increasing opportunities for physical education and physical activity within a school-based setting to achieve this goal. However, inequality exists concerning the perceptions of physical education compared to other content areas (Laureano et al., 2014), the available time for physical activity in a school (Kulik et al., 2015), and the equal access to resources (Turner et al., 2017).

Physical Education Perceptions and Marginalization

According to Barney and Deutsch (2009), the majority of elementary classroom teachers agree that physical education is important to the development of a student. However, there seems to be a marginalization when it is compared to other subjects (Laureano et al., 2014). While most educators agree that physical education is important for the overall development of a student, they do not view physical education as important as other subjects and the content learned is perceived as less applicable to future life (Barney & Deutsch, 2009; Laureano et al., 2014). Consequently, school entities prioritize the importance of reading, writing, mathematics, and science as a pathway to lifetime success and tend to marginalize areas related to health and wellness (Pate et al. 2006). As a result, subject areas such as English, math, and science are not tasked with justifying their effectiveness for future success or relevancy within a school, yet physical education has had to do nothing but this for the last two decades to remain viable. This has created inequities for physical education through a reduction in allocated time and resources which has led to reduced opportunities for students to participate in

physical fitness enhancing activities during the school day (Kulik et al., 2015; Turner et al., 2017).

Physical Education and Physical Activity Time

The World Health Organization (2011) recommends that children receive 60 minutes of physical activity daily. To help achieve this goal, the Society for Health and Physical Education, referred to with the acronym SHAPE, has recommended that students in elementary school receive 150 minutes per week of physical education and students in middle and high schools receive 225 minutes per week of physical education (SHAPE America, n.d.). Due to these combined recommendations, physical education has been identified as the primary place to provide students with opportunities to participate in physical activity. However, according to Kulik et al. (2015), most physical education programs fall short of meeting this goal. This is not surprising considering the increased prominence placed on high-stakes testing which has contributed to the reduction or elimination of physical education across the country since the start of the century (Institute of Medicine, 2013; Pate et al., 2006). Additionally, recess opportunities have also been reduced in many school systems as a way to provide a greater time for instruction in tested subject areas (CDC & SHAPE America, 2017). This reduction further complicates matters related to meeting recommendations for physical activity time, which minimizes the potential benefits of increased activity on student cognition and academic achievement (Grisson, 2005; Hillman et al., 2014; Institute of Medicine, 2013; Scudder et al., 2014).

Policy, Resources, and Opportunities

Physical Education and physical activity within a school day are the primary tenets of the Comprehensive School Physical Activity Program (CDC, 2019). To accomplish this goal, adequate policies and resources are needed. Examples of these include appropriate curriculum, adequate physical environment, and access to qualified professionals. Many of these areas require sufficient funding however, this is not always available and in fact, Picus and Odden (2011) suggested a reduction in funding for Physical Education as a potential solution to control budgetary spending in school districts. Consequently, equal access for all students may not exist and as a result, they experience further educational inequity compared to students who do have these resources available (Sanchez-Vaznaugh, 2012).

Improvements in physical fitness through the implementation of physical education, and school based physical activity, is best accomplished under the guidance of a qualified physical education specialist (McKenzie, 2007). However, Turner et al. (2017) reported that more than 10% of schools do not employ an elementary physical educator, many only have a part time physical educator on staff, and in some cases the physical educator is not a certified teacher, but rather a youth sports coach who implements the physical education curriculum. While having a physical education teacher is an important aspect of implementing a Comprehensive School Physical Activity Program, funding is equally important to ensure adequate access to the necessary equipment. However, financial allocation towards physical education and physical activity in many schools is less than two dollars per student, per year (Turner et al., 2017).

This insufficiency creates an inequity across content areas and limits potential student outcomes as it pertains to the benefits of increased physical activity and physical fitness (ASCD & CDC, 2014). Furthermore, many schools have altered their policies regarding what constitutes Physical Education, which further reduces opportunities for students to gain valuable education about physical literacy which reduces their ability to become physically literate individuals (International Physical Literacy Association, 2017; SHAPE America, 2015). In many states, schools offer waivers, exemptions, and substitutions for physical education allowing alternative physical activity to be credited towards the completion of physical education. This undermines the importance of developing the knowledge, skills and abilities to become a physically literate individual typically offered through a quality physical education program (SHAPE America, 2015).

Summary

In summary, student academic achievement requires a multifaceted approach to enable each student to achieve his or her highest level of success. Physical activity, physical fitness, and physical education play an interrelated role in positively contributing to this improvement by enhancing the physiological and neurological environments necessary to facilitate improved student engagement that leads to academic achievement (ASCD, 2020; CDC, 2019). As a result, improvements in cognition (Hillman et al., 2014), behavior (Pontifex et al., 2013), attentiveness (Scudder et al., 2014), and academic performance (Castelli et al., 2007) are indicators of the potential benefits for increasing opportunities for student participation in physical activity and physical education, which can lead to physical fitness improvements. However, regardless of the positive data that

indicates the undeniable benefits of improved student fitness and increased activity, barriers still persist to these benefits (Laureano et al., 2014).

The negative perceptions and marginalization of physical education has reduced available time and funding, minimized access to appropriate resources, and decreased the availability of qualified professionals to provide movement opportunities for students (Barney & Deutsch, 2009; Kulik et al. 2011; Picus & Odden, 2011; Turner et al., 2017). These inequalities are not only suppressing student opportunity for physical activity participation and improved physical fitness, but they are also denying students the opportunity for improved academic success through enhanced student engagement. Including fitness-based activity in a general education classroom intends to disrupt this marginalization and provide students with a stimulus to enhance their engagement as a pathway to improve academic achievement.

CHAPTER THREE: ACTION RESEACRH METHODOLOGY

Problem of Practice

Research has demonstrated that improvements in physical abilities, fitness, and health have a positive impact on student growth, development and academic progress, and are an incremental piece of educating the whole child (Bramante et al., 2007; Slade & Griffith, 2013). In an effort to facilitate the strategies proposed by Bramante et al. (2007) and Slade and Griffith (2013), schools, and more specifically physical education and physical education teachers, have been identified as a primary avenue for delivery of services to improve student health and wellness as tool to overall student achievement (Care et al., 2020). Because of this focus, I have directed my teaching towards the implementation of programs and curriculum for the Whole School, Whole Community, Whole Child (WSCC) model of education initiative to improve student health, wellness, and academic growth.

However, even though there is evidence to support improved student health and wellness as a method to enhance student achievement, physical education is often viewed as less important than other subject areas that have state and federal testing requirements (Barney & Deutsch, 2009; Laureano et al., 2014). As a result, suggested time allocation for physical education is typically less than national recommendations (Kulik et al., 2009). The addition of physical activity to a classroom setting is a potential option to

increase opportunities for physical activity throughout the school day as a method to improve not only fitness, but also student engagement.

Research Question

What impact does an in class Tabata based physical fitness protocol have on student engagement levels in a sixth-grade math class?

Purpose of the Study

The purpose of the study was to examine the impact of an in-class Tabata based physical fitness protocol, referred hereto as the Tabata-Based Physical Fitness Intervention (TBPFI), on the engagement level of students in a sixth-grade math class. For the purposes of this study, a TBPFI was a planned protocol of bodyweight exercises performed for specified time prior to the start of a typical sixth-grade math class. Moreover, for the purposes of this study, student engagement was defined as the self-perception of students on their level of attentiveness and involvement in a math class as indicated by the Student Engagement in Mathematics Scale (SEMS) (Rimm-Kaufmann, 2010).

Research Design

Ethical Considerations

Considerations were given to the ethical guidelines that needed to be followed in order to conduct a successful research study. As outlined by Efron and Ravid (2013), a few areas of focus are gaining permission to conduct the study, obtaining informed consent of the participants, maintaining confidentiality of the collected data, considering the potential effects on the research site, and ensuring the safety and well-being of the participants. These areas were addressed through communications with the district, the

individual building principal, and the participants. The risk level for the district, individual building principal, participants, and research site were low. Moreover, to protect the identity of the participants and setting, pseudonyms were used throughout the study. Additionally, I recognized that my primary responsibility was to perform my professional duties first, yet thoughtfully coexist with my research agenda. In this regard, the policies and procedures of the research site were maintained throughout out the research study.

Setting and Timeframe of Study

Setting. This mixed methods action research study was conducted at ABCDE middle school in Pennsylvania. The school building that was used as the research site was part of a larger school district that was comprised of two elementary schools, one middle school, and one high school. During the 2021-2022 academic year, the district served 1,372 students in total with 303 students in grades six through eight being at the middle school research site. Additionally, the research site employed 35 faculty members. The faculty was predominately white, highly qualified, and experienced with an average of 12 years of service. The school had very little racial or ethnic diversity being 99% white. Most of the student body were from predominantly low to middle income families with approximately 50% qualified for free or reduced lunch. The remaining students were from upper middle class socioeconomic status.

Timeframe. The timeframe for the study was a total of six weeks at the end of March and beginning of April 2022 during the final quarter of the 2021-2022 academic school year. This timeframe was chosen to avoid conflict with mandated state testing requirements and pre-determined schedules indicated by the state department of

education. The target class for data collection was during the 7th period of the day, after lunch, from 11:40 a.m. to 12:20 p.m. The pre intervention structured interviews for both teacher and student-participants took place on the first day of week one. The TBPFI, SEMS, and intervention field notes were conducted and administered during one through six. The post-intervention structured interviews for both teacher and student-participants occurred on the last day of the final week of data collection. Additionally, I conducted two observations each week for the entire six-week duration. The first observation of the week was conducted during a non TBPFI class and the second was conducted during a class following implementation of the TBPFI.

Study Participants

Recruitment Strategy

The goal of this research study was to have six students and one educator of a sixth-grade mathematics class participate in the study. The chosen class was based on my available schedule and the available middle school math classes at that time. As a result, a sixth-grade math class was the target class from which student-participants were selected and the educator participant was recruited. The strategy for participant recruitment was purposeful, non-probability, convenience sampling. This was a logical approach due to the need to use the constituents within my building based on the proposed problem, corresponding research question, and availability of courses. The educator participant was the teacher of the chosen sixth-grade mathematics class. Appropriate release forms and research explanations (Appendices A, B, & C) were sent home to all students in the selected class. Student-participants were decided upon based on the results of the returned release forms.

Participants

Upon return of all requested release forms and required documentation, I was able to gain participation consent from five students as well as the educator participant. While the target for student-participants was six students, five was an acceptable number from which to move forward and gather data. The individual characteristics of each participant are provided in the following descriptions:

Charlie

Charlie is a white male student. He voluntarily sat in the back of the class and frequently worked independently of other students. He would occasionally become distracted when people in front of him would begin talking. He was polite and well-mannered and provided answers to questions when asked of him directly but rarely volunteered himself. He was active outside of school in a variety of endeavors and also participated in school-based extracurricular activities. Previous interactions with Charlie revealed that he is a conscious worker and capable of high academic outcomes.

Suzy

Suzy is a white female. She was energetic and always positive. Occasionally she would complain about the work being asked of her, but she would happily work on it and then proclaim success when it was completed. She seemed friendly to others and well-liked by not only her classmates but also by the teacher. Suzy was a competitive athlete who exudes confidence and appears committed to completing high quality work even though she sometimes acts as if she is not concerned.

Nancy

Nancy is white female. She was primarily driven by grades and a desire to succeed academically. She maintained a quiet demeanor but was willing to work collaboratively with her classmates if needed without issue. She would frequently finish work prior to others but would not announce it and sat rather quietly near the back of the room. As a self-proclaimed hard worker, Nancy was not concerned with what the other students were doing and remained focused on the task at hand. She seemed to always be searching for a way to improve.

Betty

Betty is a white female. Although no formal grading or schoolwork was collected, it was obvious she was a high-performing student as observed by her classroom activities. She was outgoing and personable. In addition, she was willing to help others and would sometimes be asked to do so by the teacher. Her demeanor was polite and friendly. Betty was a competitive athlete as well and her competitive nature was demonstrated by her apparent desire to work hard in class.

Mabel

Mabel is a mixed-race female. She was quiet and reserved and many times appeared uninterested in the activities in the class. Reluctantly, she would perform them. In many cases she could be observed drawing on her notes or doing an art-based project on her Chromebook at the completion of her work. Of all the student-participants, Mabel was the most disengaged and removed from the daily happenings of the class. However, she was polite and never disruptive to the class, yet seemed to be less interested in her academic performance and more interested in getting through the day.

Educator-Participant

The educator-participant is white male in his mid-30s. He was completing his ninth year of teaching in a middle school math class during the course of this study. He was an engaging teacher who was always looking for ways to interact with his students. He circulated the room frequently and provided feedback as necessary, but he also provided the students space to solve problems on their own and then assisted them as needed. He conducted varying lessons ranging from direct instruction to flipped classrooms in an effort to meet as many learning styles as possible.

Research Methods

The research question and purpose dictated the data collection methods that were utilized to determine the impact of an in class Tabata Based Physical Fitness Intervention (TBPFI) on student engagement. This research study employed the use of both qualitative and quantitative data sets to provide for an information-rich research study to answer the research question (Merriam & Tisdell, 2016). This methodology promotes multiple data types to be collected and analyzed in an effort to highlight "different aspects of the same questions" (Efron & Ravid, 2013, p. 46). Consequently, a deeper understanding of the data was realized by comparing and contrasting my observations with the results of the SEMS and the structured interviews from the participants.

Prior to the study being conducted, student consent and assent, and educator consent was obtained (See Appendices A-C). Over the course of six weeks, data collection methods included a pre- and post-intervention structured interview, a SEMS each week after day two and day four of instruction, and finally, researcher observations and field notes of the class each week on both exercise and non-exercise days. Because

the research site used Google exclusively for communication and local data collection, the use of this technology created an efficient data collection method for the researcher and the participants. As a result, the SEMS was adapted for use through the Google suite of technology typically utilized in K-12 settings. Specifically, a Google form was used to administer the SEMS and a corresponding Google sheet was used to collect and store the data. Additionally, the use of a Google form for the structured interview questions for both student and teacher-participants was used. Finally, a research journal was used for class observations and all informal conversations that occurred during the study duration.

Quantitative Methods and Instruments

The quantitative method for this research was a pre- and post-intervention Student Engagement in Mathematics Scale (SEMS). The SEMS was administered on every Tuesday and Thursday during the data collection process.

Student Engagement in Mathematics Scale

The SEMS is a Likert style scale developed by Sara Rimm-Kaufmann (2010). This engagement scale is specifically designed to allow students to self asses social, emotional, and cognitive engagement in a typical mathematics class (Rimm-Kaufmann, 2010). Likert style scales are the most common rating scales utilized in research and allow participants to express their "opinion, attitude or belief about the question or statement provided" (Efron & Ravid, 2013, p. 116). The SEMS contains thirteen items to address the three dimensions of student engagement in mathematics. There is a five-item emotional dimension, a four-item social engagement dimension, and a four-item cognitive dimension with "internal reliabilities of .91, .98, and .89 respectively" (Rimm-Kaufmann, 2010, p. 1). The SEMS questions and ratings are represented in Appendix D.

Qualitative Methods and Instruments

Qualitative data collection methods included student and educator participant structured interviews (Appendix E and F), and observations and field notes from the researcher (Appendix G). The interviews, pre and post, served as follow up questions to the SEMS in an effort to further assess the "emerging worldview of the respondent" (Merriam & Tisdell, 2016, p. 111). The researcher field notes served as a method to understand the participants as they experienced new educational strategies rather than from their recalling the information at a later date (Merriam & Tisdell, 2016). Combined with the SEMS, the triangulation of these data sets provided validity and trustworthiness to the study (Efron & Ravid, 2013).

Pre- and Post-Semi-Structured Interviews

The use of semi-structured interviews was used to ascertain a deeper understating of the student-participants (Appendix E) and the educator participant (Appendix F) perceptions both before and after the intervention. Semi-structured interview questions allow the researcher to "gain comparable data" (Efron & Ravid, 2013, p. 99) across all subjects. This helped the researcher to better answer the research question and gauge the impact of in TBPFI on individual student engagement levels.

Researcher Observation and Field Notes

As the researcher, I maintained a research journal (Appendix G) where narrative data was collected. This observation data sheet is consistent with observation data sheets used in previous research and included a general engagement rating that was assigned based on evidence of engagement or disengagement (Li, 2021). On each observation day, I recorded an engagement rating that was indicative of my perception of each student's

level of engagement. The scale was a five-point Likert style scale with one representing low engagement and five representing high engagement. I utilized observed behaviors as evidence of engagement or disengagement to determine my perception of each student's engagement level at the end of each class.

In contrast to interviews, observational data is a powerful tool that allows insight into the "activities, people, and physical aspects" of a school that may be "unconsciously missed in the often-chaotic dynamics of teaching" (Efron & Ravid, 2013, p. 86). The researcher noted observations of participants' attitudes, actions, comments, and informal conversations. This data was used to create a more complete picture of the participants regarding their views on the TBPFI and its effect on student engagement.

Procedures

The purpose of this study was to assess the impact of the in-class exercise on student engagement in a sixth-grade math class. In order to accomplish this goal, an TBPFI intervention was developed from which it was hypothesized a change in student engagement would occur over time. The research protocol, represented in Table 3.2, consisted of specific days for the TBPFI, student engagement measures, and pre- and post-interview data.

Pre-Intervention Data Collection

Prior to the start of the in-class fitness program, the educator participant and the student-participants completed initial structured interviews. Interview questions for the student-participants and the teacher-participants can be found in appendices E and F respectively. The purpose of these interviews was to determine a baseline measure of student engagement in mathematics from the perspective of students as well as the

teacher. During week one, student-participants and the educator participant completed the structured interviews. These interviews were offered through Google forms and were completed asynchronously at the beginning of the first class of the first week of the study by the participants. I implemented the TBPFI intervention, which is outlined in Table 3.1 below.

Table 3.1 Tabata Based Physical Fitness Intervention (TBPFI)

Exercise	Time	Rest
Jumping Jacks	:30	:30
Burpees	:30	:30
Lunges	:30	:30
High Knees	:30	:30
Plank	:30	:30
Squat	:30	:30
Mountain Climber	:30	:30
Quick Feet	:30	:30

All exercises performed were bodyweight based due to the ability to be completed within a classroom setting with no requirement for extra equipment.

Bodyweight Tabata protocols have been used in previous research to enhance overall fitness, so this strategy is appropriate for the current study (Viana et al., 2019). However, while the design of the individual session was that an improvement in physical fitness could be achieved over an extended timeframe of multiple weeks to months, fitness improvement was not the dependent variable so therefore it was not measured as part of the data collection process.

Research Protocol

Over the course of six weeks, and indicated in Table 3.2, the students participated in two consecutive days of no TBPFI followed by two consecutive days of TBPFI.

Table 3.2 Research Protocol

Week	Day	Physical Fitness	Researcher Observation Schedule	Data Collection Method
1	Monday	No Exercise	No Observation	Pre-Interviews
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
2	Monday	No Exercise	No Observation	
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
3	Monday	No Exercise	No Observation	
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
4	Monday	No Exercise	No Observation	
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
5	Monday	No Exercise	No Observation	
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
6	Monday	No Exercise	No Observation	
	Tuesday	No Exercise	Observed Class	SEMS; Field Notes
	Wednesday	TBPFI	No Observation	
	Thursday	TBPFI	Observed Class	SEMS; Field Notes
	Friday	No Exercise	No Observation	Post-Interviews

The two non TBPFI occurred on Monday and Tuesday and the TBPFI occurred on Wednesday and Thursday of each week. Every week for the duration of the study, students would complete a SEMS at the end of class on Tuesdays and Thursdays. The SEMS data from Tuesday was to determine engagement on non TBPFI days and the SEMS on Thursday was to determine engagement on days where the TBPFI was performed. In addition, the researcher observed the class and recorded field notes on Tuesdays and Thursdays as method to view the class both with and without the TBPFI.

Post-Intervention Data Collection

At the completion of the six-week in-class TBPFI, the educator participant and the student-participants completed a follow up post-intervention structured interview. The purpose of this interview was to gain data to measure of student engagement in mathematics from the perspective of students, as well as the teacher once the study had been completed. During week six, student-participants and the educator participant completed structured interviews on the last day of the week. These interviews were once again offered through Google forms and were completed asynchronously at the beginning of the class.

Data Analysis

The process of analyzing data for this research study was both inductive and deductive due to the mixed methods design. The purpose of this study was to examine the impact of a Tabata based fitness intervention on an outcome of student engagement. Consequently, the deductive use of a SEMS and semi-structured interviews tested the hypothesis that there would be a change in perceptions of student engagement when a TBPFI was implemented. Conversely, the need to use inductive methodology as way to

determine a theory as to the reasons why the change in engagement and perceptions occurred is also warranted. The combination of these two approaches provided a more thorough answer to the research question.

Data was organized into categories to better manage the analysis. The data analysis flowchart shown in Figure 3.1 provides an overview of the data analysis organizational pattern used.

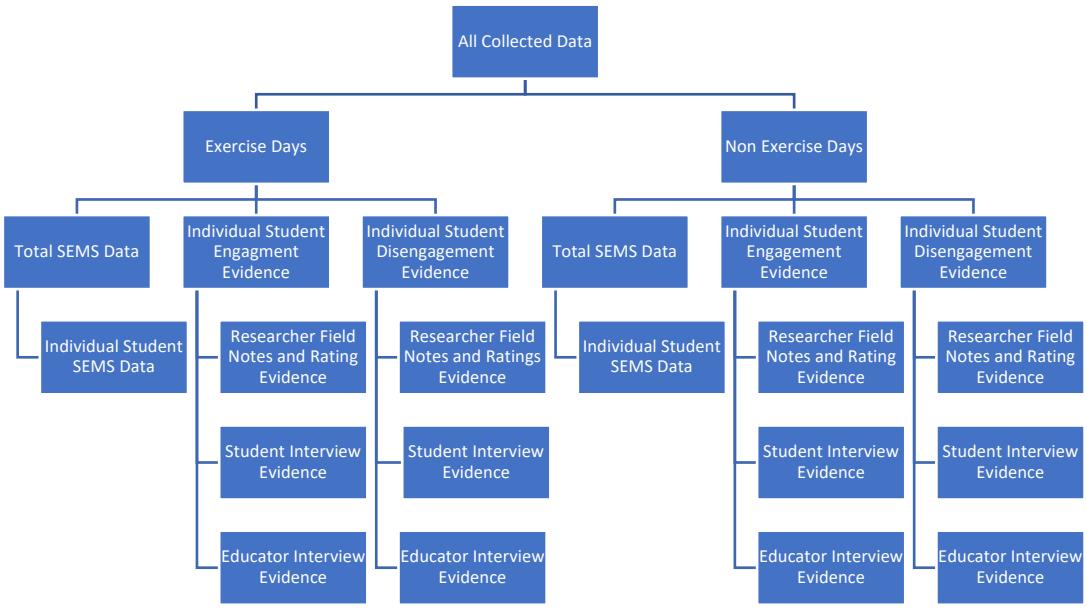

Figure 3.1 Data Analysis Flowchart

The first step was to organize the data into exercise and non-exercise days. Next, total SEMS data was organized under each of these days. Following the total student data was the analysis of individual student SEMS data. Once the quantitative SEMS data had been analyzed, I organized the qualitative data into exercise and non-exercise days.

The method used to analyze the qualitative data was based on the typological analysis method outlined by Hatch (2002). Data was coded based on recurring phrases,

and terminology used by participants in the semi-structured interviews as well as that found in the observation field notes. My observations and field notes for each student on both exercise and non-exercise days for evidence of engagement and disengagement coded first. Next, the student and educator participant interviews were categorized and coded based on positive and negative comments obtained about the exercise protocol and any perceived effect on student engagement. Finally, an aggregate analysis was performed that encompassed all data sets. The results of which are discussed in Chapter Four.

CHAPTER FOUR: FINDINGS FROM THE DATA ANALYSIS

This research study explored the effect of a Tabata Based Physical Fitness Intervention (TBPFI) on student engagement levels in a sixth-grade math class. The reason for this study was to examine whether high intensity physical fitness opportunities within a regular classroom setting could provide additional stimulus to improve student social, emotional, and cognitive engagement levels in a classroom setting. Utilizing multiple data sets, an in-depth analysis of student perceptions concerning physical activity in the classroom and its effect on their engagement levels in a math class was examined.

Data collection took place over the course of six weeks from March 22, 2022, through April 28, 2022. During this time, I collected field notes during the class two times per week on Tuesdays and Thursdays. Tuesday observations were conducted in the absence of a TBPFI and Thursday observations were conducted with a TBPFI being performed at the beginning of class. Student-participants completed a pre-interview prior to the implementation of the treatment and then a post-interview at the end of the process was conducted in order to gauge possible changes in perceptions and attitudes about math class and physical fitness within the class setting. Additionally, student-participants completed a Student Engagement in Mathematics Scale (SEMS) (Rimm-Kaufmann, 2010) on Tuesday and Thursday each week. Finally, the teacher-participant completed a

pre- and post-interview to gauge his perception of physical activity in the classroom as well as any perceived change within the math class overall.

Research Question

What impact does an in class Tabata fitness protocol have on student engagement levels in a sixth-grade math class?

Purpose of the Study

The purpose of the study is to examine the impact of an in-class Tabata fitness routine on the engagement level of students in a sixth-grade math class. For the purposes of this study, an in-class Tabata fitness routine is planned protocol of bodyweight exercises performed for time prior to the start of a typical sixth-grade math class. Moreover, for the purposes of this study, student engagement is defined as the perception of students on the level of attentiveness and involvement in a math class as indicated by the Student Engagement in Mathematics Scale (SEMS) (Rimm-Kaufmann, 2010).

Findings of the Study

The first data source analyzed was the SEMS for both overall scores as well as individual student-participant scores across each of the six weeks of the study for both exercise and non-exercise days. Next, the individual student pre- and post-intervention interviews were analyzed to determine student perceptions of the TBPFI as well as math class itself. The teacher-participant pre- and post-interviews were then compared to identify common trends concerning student engagement. Finally, the teacher-participant interviews were analyzed in conjunction with the researcher field note observations and were analyzed. Combined, these data sources supplied a rich description about the effect

of a TBPFI on student engagement levels in a sixth-grade math class that will later be discussed as two primary themes.

Student Engagement in Mathematics Survey Results

The Student Engagement in Mathematics Survey (SEMS) measures the social, emotional, and cognitive engagement levels of students in a math class through a series of Likert style questions. Full details and explanations about the SEMS (Appendix D) were described in Chapter Three. Once completed, the results of the SEMS provided a numerical score that combines all three engagement areas as well as scores for each individual area of engagement for each student-participant. The following sections provide a detailed analysis of the engagement scores for each participant, as well as group totals.

Social Engagement

Figure 4.1 illustrates each participant score for social engagement. Social engagement refers to "students' day to day social exchanges with peers that are tethered to the instructional content" (Rimm-Kaufman et al., 2014, p. 172).

This section consisted of four questions, numbers 2, 3, 4, and 5 on the SEMS (Appendix D), to assess the social engagement of students:

- Today I talked about math to other kids in class.
- Today I helped other kids with math when they didn't know what to do.
- Today I shared ideas and materials with other kids in math class.
- Students in my math class helped each other learn today.

Three participants, Charlie, Suzy, and Betty, collectively reported a 38-point reduction in engagement when a TBPFI was implemented. Suzy accounted for 31 of

these points with Charlie accounting for 3 points and Betty representing 4 points. Offsetting this reduction were the scores of Nancy and Mabel who reported increased social engagement scores of 17 and 5 points respectively when a TBPFI is implemented. Overall, the combined result of all participants revealed a reduction in social engagement of 16 points when a TBPFI is implemented.

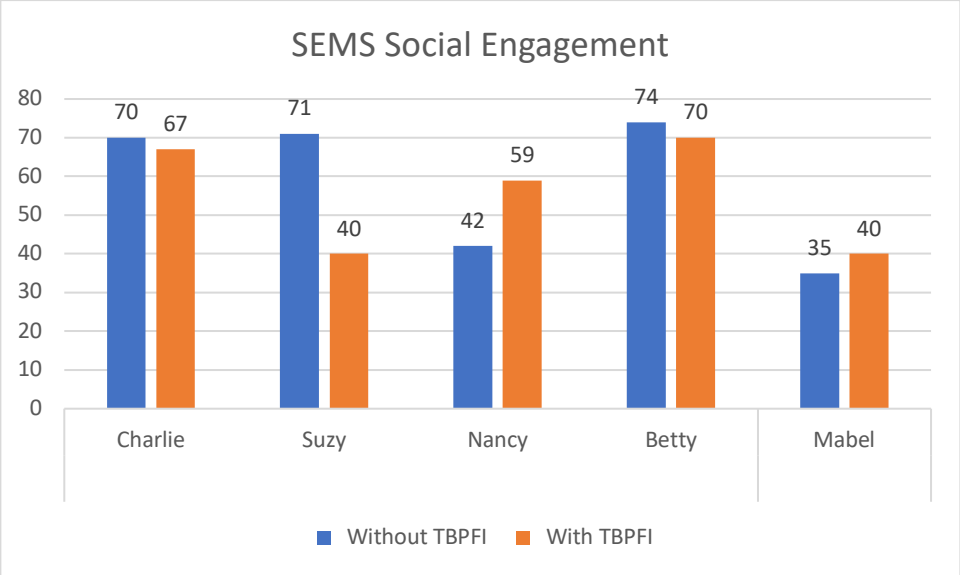

Figure 4.1 Individual Student Social Engagement Results

Emotional Engagement

Emotional engagement "refers to feelings of connection to content, interest in learning, and enjoyment of solving problems and thinking about content" (Rimm Kaufman et al., 2014, p. 172) The SEMS included five questions, numbers 6, 7, 8, 11, and 12 (Appendix D), to assess the emotional engagement of students:

- Math class was fun today.
- Today I felt bored in math class.
- I enjoyed thinking about math today.
- Learning math was interesting to me today.

- I liked the feeling of solving problems in math today.

As represented in Figure 4.2, two of five participants reported an increase in emotional engagement with the inclusion of a TBPFI. The remaining three participants reported a decrease in emotional engagement when a TBPFI is utilized. Increases in engagement were reported by Nancy with a 17-point improvement and Mabel with a 6-point improvement. These results produced a total emotional engagement improvement of 23 points. Conversely, Charlie, Suzy, and Betty had decreases in engagement with score reductions of 10, 7, and 1 point respectively. This produced a total decrease in emotional engagement of 18 points. As a result, there was an emotional engagement improvement of 5 points when scores for all participants are considered.

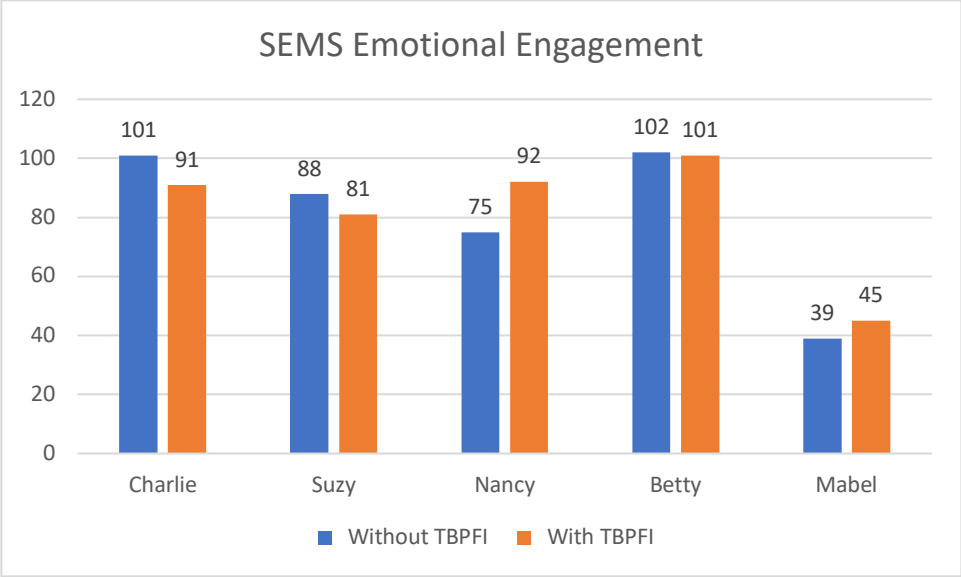

Figure 4.2 Individual Student Emotional Engagement Results

Cognitive Engagement

When considering cognitive engagement in mathematics, Rimm-Kaufman et al. (2014) refers to students having a "willingness to exert effort to understand content, work through difficult problems, and manage and direct their own attention toward the task at

hand" (p171). This section of the SEMS (Appendix D) consisted of four questions, numbers 1, 9, 10, and 13, to assess the emotional engagement of students:

- Today in math class I worked as hard as I could.
- Today it was important to me that I understood the math really well.
- I tried to learn as much as I could in math class today.
- I did a lot of thinking in math class today.

Figure 4.3 reports the cognitive engagement results for each student.

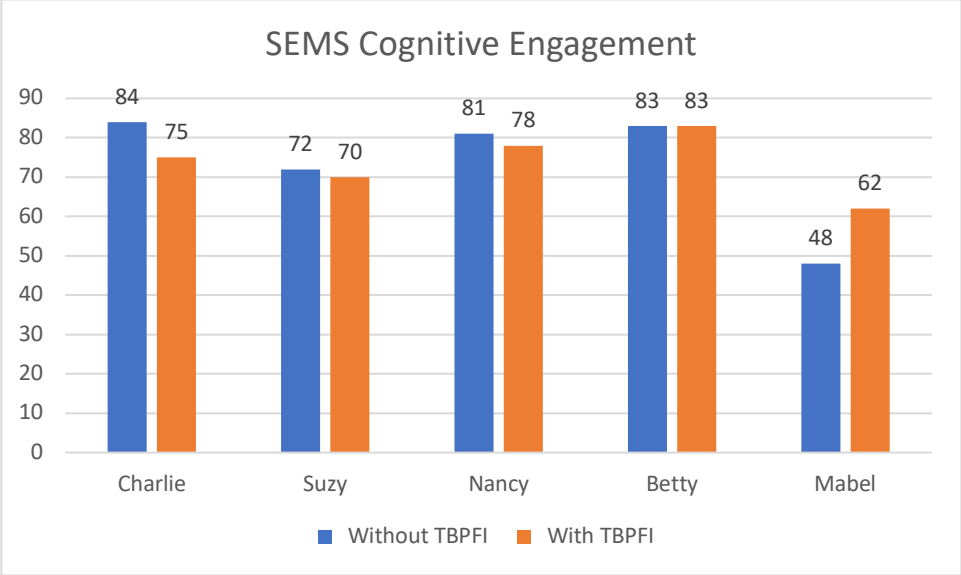

Figure 4.3 Individual Student Cognitive Engagement Results

These results reveal that one participant reported an increase in cognitive engagement, one participant had no change in cognitive engagement, and three participants reported a decrease in cognitive engagement with the addition of a TBPFI in math class. Mabel reported an increase in cognitive engagement of 14 points, while Betty reported no change. Collectively, the decrease of the other three students was also 14 points with Charlie, Suzy and Nancy reporting decreases of 9, 2, and 3 points respectively which results in no overall change in cognitive engagement.

Participant Overall Engagement Score

The individual participant overall engagement score combines the social, emotional, and cognitive scores into one complete score for each participant. As shown in Figure 4.4, this score encompasses all areas of student engagement as measured by the SEMS.

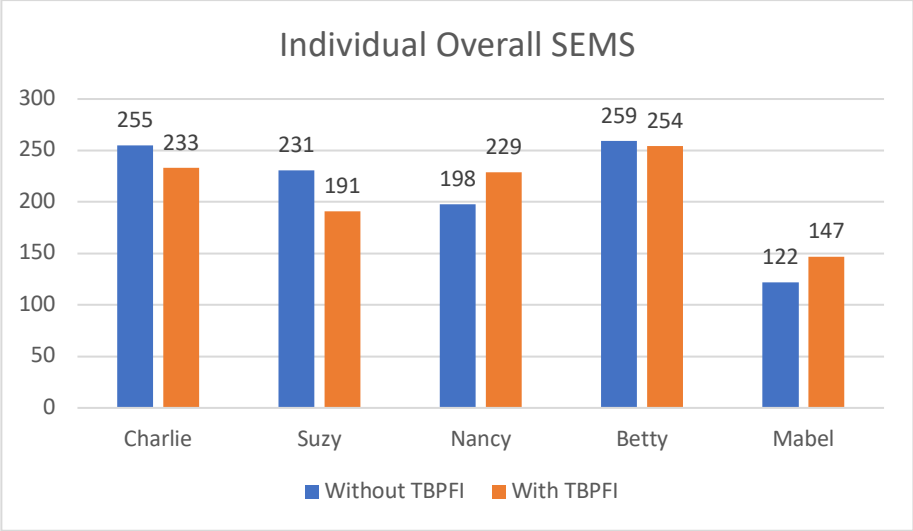

Figure 4.4 Participant Overall Engagement Score

Two of the five participants showed an improvement in overall engagement when a TBPFI is implemented. The remaining three students exhibited a decrease in overall engagement with the addition of a TBPFI. The scores from Nancy and Betty reveal an increase in engagement of 56 points while scores from Charlie, Suzy, and Betty indicate an engagement decrease of 67 points with the implementation of a TBPFI. However, 40 of these points were reported by one participant, Suzy. Regardless, this represents a decrease in total student engagement of 11 points when a TBPFI is implemented in a math class.

Total Social, Emotional, and Cognitive SEMS Results

When all scores are considered, there is a 9 point overall decrease in student engagement across all participants. However, as explained in the previous sections, the SEMS is broken down into emotional, social, and cognitive aspects of engagement and the result of the survey, shown in Figure 4.5, indicate that student engagement improved in the emotional aspect, stayed the same in cognitive aspect, and decreased in the social aspect of engagement.

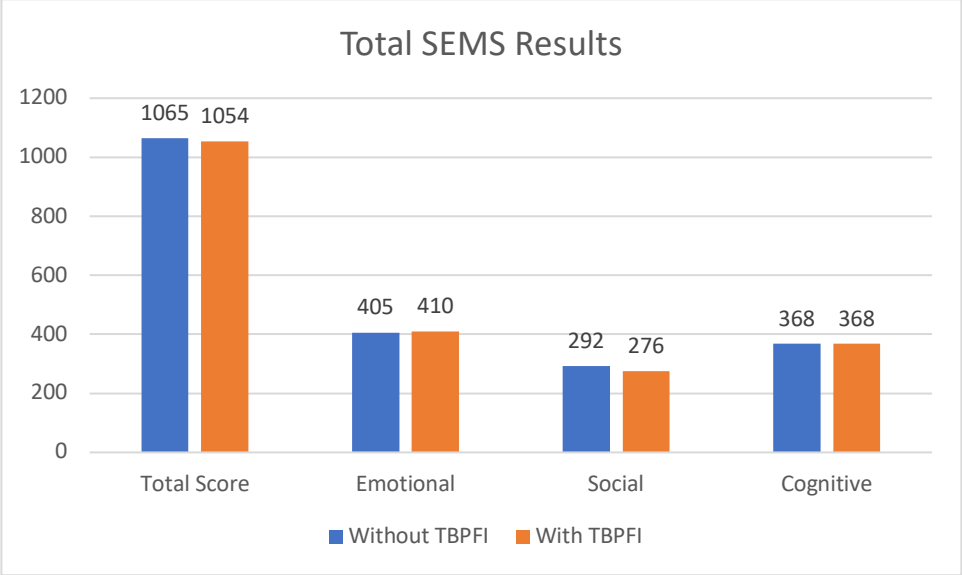

Figure 4.5 Total Social, Emotional, and Cognitive Results

In Summary

The inclusion of a TBPFI has varied results on student engagement in a math class. Based on the results, these variances seem to be specific to certain students. As an example, two students repeatedly showed improvements in the measured areas of engagement while the remaining three reported either no change or a decrease in engagement. The most notable change was a 31-point decrease in social engagement by Betty. This was much larger than any other change, positive or negative, for any other

participant in any area of engagement. The next largest change was a 17-point increase in both social and emotional engagement for Nancy. However, despite these seemingly large disparities, the overall results of the SEMS, with and without a TBPFI, are very similar in many aspects. The most notable differences are in the overall social engagement score and emotional engagement score. The results of which suggest that the inclusion of a TBPFI decreases social engagement but improves emotional engagement in a math class. However, further examination reveals that this simplified explanation fails to consider individual student differences in engagement results. Further explanation concerning the results of the SEMS will be explored later in this chapter.

Student Pre- and Post-Interviews

Students participated in a semi-structured interview process prior to the start of the study and then again at the end of the six-week study period. The questions asked of the student-participants can be found in Appendix E. This process provided a greater depth of knowledge concerning the students' attitudes, beliefs, enjoyment levels of math class and also physical activity in the classroom. Narratives of each students' participants pre- and post-interview responses are included in the following sections. The primary finding from the interviews is that students were positive as the benefits of exercise and the inclusion of a TBPFI as a part of math class. In addition, most students enjoy math but tend to get distracted by other students in the class.

Charlie

When asked during the pre-interview, "How do you feel about math class?" Charlie responded, "Yeah, its ok." As clarification, when asked, "What do you like or dislike about math?" he responded that he "doesn't like redoing work." Charlie responded

to the question “Do you get distracted during math class? Why or why not?” with the response of “sometimes but its due to others.” When asked about engagement with the question of “What keeps you engaged during math class?” he responded by simply stating “music,” which was interesting because there was never a time when music was being played during class. Finally, when asked his opinion of physical activity in the classroom, Charlie stated he was “not used to it.”

At the completion of the study, a post-interview was conducted. When asked “How do you feel about math class? What do you like or dislike?” Charlie responded by stating, “I like the class because I don’t have to do much work, and the work I do is fun.” Charlie responded to the question “Do you get distracted during math class? Why or why not?” with the response of “yes cause people talk to me and its more my fault.” The final two-questions dealt with physical activity in the classroom and Charlie responded that he was “not used to it yet but that it got his heartrate up and he liked it.”

Suzy

Suzy responded during the pre-interview that she “liked math class because it is easy” when asked, “How do you feel about math class? What do you like or dislike?” Interestingly, when Suzy was asked if she gets distracted during math class, she responded “Yes, I always do.” Furthermore, when asked “What keeps you engaged during math class?” Suzy responded, “I am not sure.” The final question was about physical activity and asked, “How do you feel about physical activity in the classroom setting?” Suzy responded that she thought “It sounds like fun!”

Suzy responded during the post-interview that she liked math class and that it is “her favorite class of the day and her favorite subject.” However, when asked if she gets

distracted during math, Suzy replied, “Yes sometimes if I am interested in the class but if I don’t know the stuff, I get distracted.” Suzy also responded that she stayed engaged during math “when we do something fun, have a hands-on activity, or there is something I am interested in.” Concerning physical activity in the classroom, she responded that “there is not a lot of space but it also kind of gets me ready.” Finally, when asked about the fitness protocol, she stated that “it was fun and it got me ready for things and ready for class because we don’t do much active stuff throughout the school day.”

Nancy

Nancy was asked during the pre-interview, “How do you feel about math class? What do you like or dislike?” and simply responded that “It is fun. I just like it.” In support of this answer was her answer to the second question “Do you get distracted in math class, why or why not?” with the response “No because it is easy to do and so it is easy to stay focused.” It was revealed that Nancy is driven by grades when she responded to the question “What keeps you engaged during math class?” with the simple response “My goal is to get all A+ all year.” Finally, when asked about physical activity in the classroom, Nancy responded that she “might like it.”

During the post-interview, “I like it, but I dislike tests” was the answer to the question of “How do you feel about math class?” She further explained during the post-interview that she gets distracted during math class by “people around me making weird sounds.” Her motivation to stay engaged during math continues to come from the desire to “Get all A+.” Also, she “feels fine” about physical activity in the classroom and liked the TBPFI because, as she stated, “It helps me build strength.”

Betty

When Betty was asked about physical activity in the classroom during the pre-interview, she stated that she "would like it because you have to sit down for a while," indicating that she would rather be moving than sitting. Considering that she responded to the question "How do you like math class? What do you like or dislike?" with "I like it because it's not boring and I understand it," it could be stated that she is engaged during math. Interestingly, she stated that she "sometimes" gets distracted during math class "because of the people around me." However, she finds math class interesting because she was asked, "What keeps you engaged during math class?" She answered, "The teacher, because he keeps it interesting."

The post-interview yielded the answer of **"**I like the class and I like the teacher" when Betty was asked the question of "How do you feel about math class?" This sentiment was reflected in the answer to the next question about getting distracted in math class when she responded "No, not a lot." Furthermore, she responded to the question "What keeps you engaged during math class?" with a simple response of "Just listening and working." The final two questions concerned physical activity more specifically. First, when Betty was asked about her feelings on physical activity in the classroom, she responded, "I like it." She extrapolated on this answer with the response of "I liked it because it got all of us some exercise" when asked specifically about the Tabata fitness protocol that was utilized.

Mabel

During the pre-interview, Mabel responded to the question of "How do you feel about math class? What do you like or dislike?" with a simple response of "Its ok, I just

dislike it." This dislike may stem from the classroom environment and not the content though based off her answer to the question of "Do you get distracted during math class? Why or why not?" Betty responded to this question by stating that "Certain people will distract me by taking my stuff and being annoying." She responded, "Being able to move around or draw" to the question "What keeps you engaged during math class?" Finally, when asked "How do you feel about physical activity in the classroom setting?" Mabel responded, "Yes. It's better than math."

"I dislike all math" was the simple response provided by Mabel during the post-interview when asked how she felt about math class. Mabel was also distracted during math class "because of other students." However, she stated that "fun math games" keep her engaged during math class. When asked about physical activity in the classroom setting, Mabel responded that "it's okay" but that she "didn't like" the Tabata fitness protocol at the beginning of each math class.

Teacher-Participant Interviews

The teacher pre- and post-interview (Appendix F) provided a deeper context into the daily occurrences in the class both with and without the Tabata Based Physical Fitness Intervention (TBPFI). The results indicate that there is perceived positive benefit for the inclusion of fitness-based activity into a classroom setting. The pre- and post-interviews for the teacher-participant provided a platform from which he could express his viewpoints about math class, student engagement, and the TBPFI. He was asked a series of questions and the responses are recorded in the following sections.

Teacher Pre- and Post-Interview Responses

Question One

The first question on the semi-structured interview asked the teacher-participant to "Describe the engagement level of the students in your math class."

Pre-Interview Response

> "This is a pretty active group that gives input throughout class. This group has a lot of energy, especially since they come to Math class right after lunch. This physical activity will be very good for this group."

Post-Interview Response

> "In this particular class, student engagement is rather high for the most part. I have found, over the school year, that this is a group that prefers to be hands-on. With this being said, the physical activity we started class with each day was a great way of engaging students from the very beginning."

Question Two

The second question asked of the teacher-participant was "How do you feel about the engagement level of the students in your math class?"

Pre-Interview Response

> "I like the energy of this class. They have a hard time focusing for long periods of time, but when focused they do good things. I think this physical activity may be something to look forward to for the students and may keep them focused."

Post-Interview Response

> "I feel that students engage themselves and remain engaged when they are interested in what is going on. It has always been a goal of mine to keep learning interesting, and with the new implementation of this physical workout it gives me more and more ideas and ways of making class exciting, yet beneficial for the students."

Question Three

The third question asked on the semi-structured interview asked "What are some strategies you have used to monitor and/or increase student engagement?

Pre-Interview Response

> The educator offered some strategies they have used to monitor and/or increase student when prompted by the third question by answering, "Using student interests such as hobbies and certain games, I can keep them motivated and engaged."

Post-Interview Response

> "First off, getting to know your students is important. You have to know who they are and what their interests are. Once you know this, it's easy to increase engagement. Some of the students in my class are into sports, but others are not at all. Some are into art or music, others aren't. It is crucial to somehow link these engagement strategies to their interests as well."

Question Four

The fourth question asked on the semi-structured interview was "How do you feel about physical activity in a classroom setting?

Pre-Interview Response

> "I feel that physical activity will benefit this group of students, and students as a whole. Increasing physical activity shows students exercises and activities they can do without being at a fitness center or weight room. Also, its effect on the body should be a direct benefit. All kids should have a time throughout the day to be active."

Post-Interview Response

> **"**I love the idea of keeping students active. It's a very cool thing to show them they can get a get cardiovascular workout with no equipment, in a classroom setting, and in only 8-10 minutes. This is a way of showing them they can do these things at home as well. I had several students in this class tell me they were going home and practicing their planks or their burpees so they would be better in class in front of everyone."

Question Five

The fifth and final, question asked on the semi-structured interview asked, "Do you have any other thoughts, comments, and observations about student engagement and/or physical activity in a classroom setting?

Pre-Interview Response

> "I know, from being around this group for 27 weeks, that physical activity is needed in the classroom. The high energy and distractions may be resolved or lightened with the addition of physical activity in class."

Post-Interview Response

> "Overall, I feel this is something that should be implemented into classrooms every day. It is quick, easy, and doesn't disrupt the flow of conventional classroom learning. Actually, I found it to give my students a short "burn-off" period coming straight from lunch, that allowed them to get that last little bit of crazy energy out of them before sitting and focusing on mathematical principles and concepts for the next hour. I feel this is an effective way of keeping students engaged, having them look forward to something, and working towards a goal to better their health and wellness."

Researcher Field Notes and Observations

Student-participants were observed two times per each week during the six-week study period. These notes reflect verbal interactions as well as actions that students took to indicate their level of engagement. In addition, there is a researcher observation rating scale that was used each day to determine student engagement levels.

The first day of observation each week occurred on Tuesday and was on a non-exercise day. The second day of observation was on Thursday and was a day that started with the TBPFI. The aim of these different observations days was to see the students in their normal daily classroom procedures both with and without a fitness protocol prior to class. On each day there were notes taken that indicated whether students were engaged or not engaged with the class and the material being taught.

Non-TBPFI Days

The first observation day of each week was a non-exercise day and as such, students began class as they have normally done since the start of the school year. Notes

from these days reflect the observed engagement from the student-participants as they function in their normal class setting.

Evidence of Engagement

During days where exercise was absent, students exhibited typical responses one might expect from a class of sixth grade students. At the beginning of class student-participants were attentive and respectful of the opening remarks. Comments such as “On target,” “eyes of teacher” and “Answering review questions” were common remarks. Additionally, Student-participants came prepared to class every day which is a reflection on the expectations held by teacher. However, within a few short minutes on most days, student engagement levels appeared to change, and students began to become disengaged from the class.

Evidence of Disengagement

Student disengagement was reflected in notes with phrases such as “Head down and staring at paper,” “eyes wandering around room and trying to get attention of other students,” and “teacher redirected students to remain on task.” Additional notes included, “hood up, talking,” “closed Chromebook and put head down during instruction,” and “drawing and doodling on worksheet.”

TBPFI Days

The second day of observation each week was an exercise day in which the students participated in the Tabata fitness protocol prior to class starting. Students entered class as they normally would; however, they would then at once find a spot in the room where they could complete the exercises routine presented for the day. At the completion

of the exercise routine, they would return to their desks and continue class as any other day.

Evidence of Engagement

Notes from these days showed that students "worked independently the entire class," "sat quietly," and "asked for help." Other notable observations included a student stating "Look at me go!" after successfully answering an in-class question and being particularly happy on days of exercise. In addition, students regularly would "would quietly work together" on problem solving during exercise days. This was observed on nearly every day exercise was a precursor to class. Likewise, the immediate attentiveness of the class after the completion of the in class Tabata fitness protocol was glaringly obvious when compared to non-exercise days. As soon as the protocol ended and the teacher asked for attention, the students sat down quietly, made eye contact and began working. After the second week, the teacher-participant noted to the researcher that it was "strange to see them so quiet at the beginning of class."

Evidence of Disengagement

There were very few observations about disengaged participants on exercise days during the course of the study. The only repeated offering was that of students "skipping exercises" in the routine. Additionally, there were a few incidents of students "talking during teacher instruction" but it was minimal and only repeated on two separate occasions by the same student-participant. Overall, the lack of note taking about disengagement was encouraging and reinforced that students were in fact engaged in the lesson of the day.

Researcher Observation Engagement Rating

Every Tuesday and Thursday during the study, I recorded a score for how engaged I thought each student-participant was based on observations and notes. Figure 4.6 supplies the results of these scores.

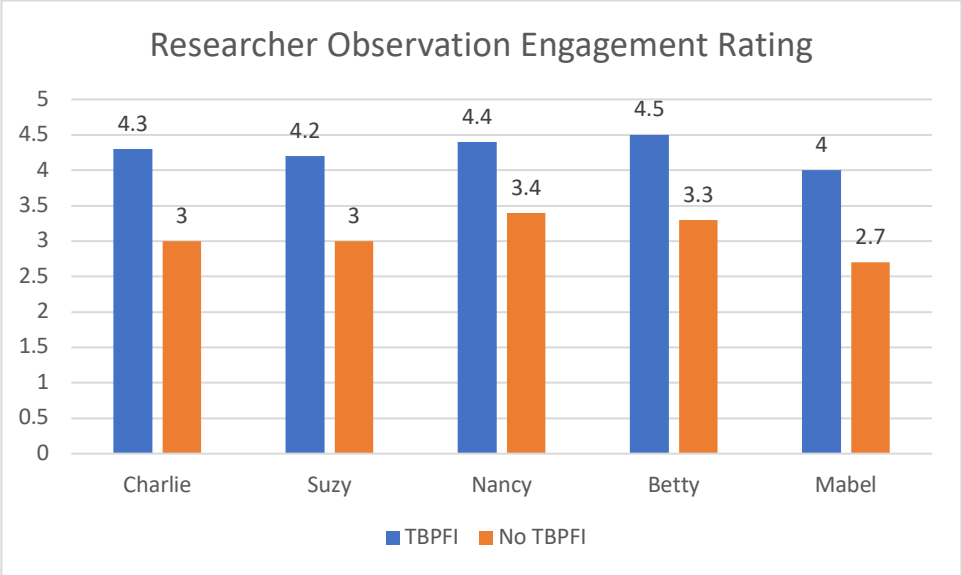

Figure 4.6 Researcher Observation Rating

The scale for this score was a 5-point Likert scale with a 1 representing low engagement and a 5 representing high engagement. Based off my field notes, engagement scores improved by at least 20% for each student-participant with the inclusion of a TBPFI. The highest engagement score was a 4.5 for Betty and the lowest score was a 4 for Mabel when a TBPFI was utilized in a math class. While Mabel had the lowest engagement score with a TBPFI, she also had one of the largest margins of improvement at 1.3 points, along with Charlie, when a TBPFI is used. Additionally, these improvements were followed by 1.2-point increase from Suzy and Betty and finally a 1-point increase for Nancy.

Interpretation of the Findings

As a result of the data analysis process, two primary themes emerged. First, student-participants, the teacher-participant, and the researcher perceived in-class physical activity and fitness as positive. Second, perceptions of engagement and reported engagement differ based on the results of the interviews and the SEMS. These results provide a unique perspective into the use of a TBPFI in a mathematics class and the effect it has on student engagement. The interview responses and researcher observations indicate that a Tabata based physical fitness routine is perceived as enjoyable and a welcome addition to a math class. In addition, there is an equally positive perception that a TBPFI improves student engagement. In support of this, the results of the SEMS reveal that emotional engagement can be positively impacted for most students. However, social and cognitive engagement seem to only be positively impacted for a select few students.

Theme 1: Physical Activity and Fitness is Viewed Positively

When reviewing the results of the interview data for the student-participants and teacher-participant, the common responses moved from uncertain and hopeful, to positive and enthusiastic, over the course of the study. The overall result indicated that physical activity in a classroom setting could be beneficial and was perceived as enjoyable.

Initially, the student-participants responded to the question of "How do you feel about physical activity in the classroom?" with varying responses that indicated uncertainty. Two students responded, "I don't know" and others indicated that they thought "It might help" and that it would be "different." Likewise, the teacher-participant said, "I feel that physical activity will benefit this group of students as a whole." The overall sentiment among student-participants and the teacher-participant towards

including physical activity into a math class was skepticism, yet they felt potential existed that it could be helpful. This sentiment shifted during the post-interview responses and was likewise supported by the researcher observations.

The researcher observations viewed the Tabata Based Physical Fitness Intervention (TBPFI) as a positive when it was noted that "students were engaged in the Tabata fitness protocol" on more than one occasion. However, it was also noted that some students "were not completing all of the exercises" during a few sessions. The reasons for this were not discussed with the students but it could be due to a preference for some exercises over other exercises. This will be discussed further in Chapter Five. In addition to the field notes, the researcher's engagement scores for each student represented an improvement with the inclusion of a TBPFI.

In concert with the researcher, the teacher-participant noted that sometimes the group would have a "hard time focusing" but that "the physical activity gave them something to look forward to at the beginning of class" and that it "helped keep them focused." In addition, the teacher-participant reported that the TBPFI "showed students exercises and activities they can do without being in a gym or fitness center" and that they "should have time throughout the day to be active." In agreement with the teacher-participant were the responses from the student-participants during the post-interview sessions. While initial student responses during the pre-interviews were somewhat skeptical, the post-interview results indicated a positive view of physical activity and the TBPFI as part of their math class.

In regard to physical activity in a math class, students reported that "It feels good and makes me feel pumped up" and "I like it" along with responses of "I feel fine about

it" and "it kind of gets me ready." In further support of a positive perception of physical activity and physical fitness in a classroom, students specifically commented on the TBPFI with "I like it because it's helping me build strength" and "it gets my heart rate up." Continued praise for the TBPFI was reported by responses of "it got us some exercise" and "It was fun and got me ready for things." The combination of positive affirmations from all three data sources about physical activity and the TBPFI supports the conclusion that physical activity and fitness is perceived as positive. However, the positive affirmations towards physical activity and the TBPFI was not completely supported by the results of the SEMS for all students. In fact, only certain students were the beneficiary of increasing physical activity in a math class through the use of a TBPFI.

Theme 2: Differences Between Perceived Engagement and Reported Engagement

The results of the teacher-participant post-interviews combined with the researcher field notes would indicate that a TBPFI was effective at eliciting an improvement in student engagement for all participants. Likewise, physical activity in a math class was also viewed as a welcome addition as a way to improve engagement and readiness to learn. However, the results of the SEMS indicated that student engagement was positively affected in some participants but was reduced for other participants. Furthermore, the specific type of engagement, social, emotional, and cognitive, are individually affected by the inclusion of a TBPFI and do not align with the all-inclusive engagement increase indicated by student-participant, teacher-participant, and researcher-participant perceptions. Combined, these data sets reveal a theme of difference in perceptions and results when considering a TBPFI as a method to improve student engagement in mathematics.

During a conversation with the researcher, the teacher-participant noted that he "had never experienced his class so quiet at the beginning" after one of the TBPFI sessions. Likewise, the researcher noted on numerous occasions over the course of the six-week study period that immediately following the TBPFI the students were quiet and appeared focused and ready for class. In fact, even the students had reported in the post-intervention interviews that they felt in class fitness was a beneficial for improving engagement and readiness by stating "it makes me feel pumped up" and "got us ready for class." Overall, these data points suggest that the general perception among the student-participants, teacher-participant, and the researcher was that the TBPFI was successful at improving student engagement for all students. However, the SEMS data suggest otherwise.

While the consensus among the participants and the researcher was that a TBPFI was effective at increasing engagement and was enjoyable for the students, the results of the SEMS revealed that total engagement had decreased for the participants when a TBPFI was utilized prior to a typical math class. This decrease in overall engagement was primarily due to the results of the social engagement scores which saw a decrease of 16 points across all students. Conversely, the overall emotional engagement scores realized a 5-point gain, and the overall cognitive engagement scores remained equal from pre to post treatment.

Interestingly, researcher observations frequently noted students were quiet and attentive which was perceived as a positive outcome. Likewise, and previously noted, the teacher-participant also felt as though his class was exceptionally quiet after the TBPFI was completed on treatment days. Together, these quiet and attentive students were

perceived as engaged and ready to learn by the researcher and teacher-participant. However, based on the results of the SEMS this may indicate a potential decline in social engagement.

Social engagement is referred to as the ability of students' social interactions during a class to be linked to the content being taught (Rimm-Kaufman et al., 2014) which means that social engagement is important for learning content in mathematics. However, behaviors that are perceived as positive by adults, such as being quiet and appearing attentive, may actually create a negative learning environment for students by reducing the social interactions needed to improve social engagement during any given class. In this case, the adage of "sit still, be quiet, and pay attention" may not be useful after all. That being said, this is not an absolute finding and is not the result for all students.

When individual student data is considered, a new picture emerges that reveals the TBPFI decreased social engagement for some students while increasing in for others. Most notably were the decreases 31 points from Suzy and the increase of 17 points from Nancy. The other differences, positive or negative, were five points or less over the course of the study. Furthermore, individual student attributes may be a determining factor in the effectiveness of increased or decreased social engagement when a TBPFI is introduced into a math class. As an example, Nancy and Mabel were documented as quiet students who kept to themselves and yet they experienced increases in social engagement when a TBPFI was implemented in math class. Conversely, Suzy, who was typically very excited and energetic, experienced a decline in social engagement. This trend was nearly identical for the emotional engagement measurements for these same students suggesting

that social and emotional aspects of student engagement are closely related. Finally, inconsistency existed with cognitive engagement as well in that some student-participants experienced declines while others experienced an increase.

Cognitive engagement declined, although slightly, among four of the five student-participants according to the results of the SEMS. The remaining student-participant, Mabel, experienced an increase in cognitive engagement. While this study did not measure academic progress, these results were interesting because cognitive improvements have been advocated as a primary reason for including more physical activity in a school day and even adding in class "brain breaks" as part of a normal classroom structure to improve academic outcomes (Care et al. 2020; CDC 2019). The results of the individual student SEMS data suggest that this may be student specific instead of broadly generalizable across all student populations.

One student, Betty, reported no change with or without a TBPFI whereas three students, Charlie, Suzy, and Nancy, experienced declines in cognitive engagement of 10.7%, 2.7% and 3.7% respectively. Conversely, a single student, Mable, experienced an increase in cognitive engagement of 50% when a TBPFI was implemented in a math class. To confound this difference even more, Mable was the most negative about the inclusion of the TBPFI when she said "I didn't like it" when asked specifically about the protocol. However, she was more positive about in class physical activity when she answered, "It's okay" to the question "How do you feel about in class physical activity?" These differences suggest that Mabel did not enjoy the specific exercises or routine of the TBPFI but liked the opportunity to be active prior to a math class. Conversely, Charlie, Suzy, Betty, and Nancy, all of which experienced either a decline or no change in

cognitive engagement, viewed the TBPFI positively. They responded to questions regarding the TBPFI with statements such as “I like it because it got my heart rate up,” “I like it because it got me ready for things and class,” “ I like it, it got us some exercise,” and finally “Its helping me build strength.”

The conflicting results of the positive perception of in class physical activity in the form of a TBPFI and the individual and total SEMS results does not support, nor does it detract from the potential of the inclusion of a TBPFI as a pathway to improved student engagement in math. However, the minimal decreases in cognitive engagement reported by a few students seem insignificant compared to the large increase experienced by a single student. In addition, the larger increase in emotional engagement by a few students offsets the small decrease realized by others.

Conclusion

The findings of this study indicate positivity for the inclusion of a TBPFI in a mathematics class to increase student engagement. First, physical activity is viewed positively, and most students felt that the inclusion of a TBPFI was a good strategy to improve their engagement levels as reported by post-interview responses. To corroborate this sentiment, the researcher also observed acute changes to student engagement immediately following the TBPFI in the classroom that yields positive perceptions towards improving engagement for all students during a typical math class. Furthermore, the educator participant noted that the students seemed more engaged as evidenced by the results of the post-interview questions. However, the positive perception of in class physical activity and the TBPFI did not improve engagement for all students when measured by the SEMS. In fact, the determining factor in the success or failure of a

TBPFI on student engagement appears to be dependent on the individual student characteristics and not generalizable to all students regardless of the perceptions of effectiveness. That being said, the overall positive sentiments towards physical activity and the TBPFI in a math class outweigh the negatives due to the ability to equalize the engagement levels of students who are highly engaged and those who are less engaged. Essentially, the highly engaged stay highly engaged and the less engaged become more engaged with the inclusion of a TBPFI in a math class.

CHAPTER FIVE: DISCUSSION, IMPLICATIONS, AND RECCOMENDATIONS

Improvements in academic progress are carried out through a variety of strategies to increase student engagement throughout the school year. Engagement is traditionally referred to as the social, emotional, and cognitive aspects of learning the content of any specific subject area. However, there is an additional avenue that has been touted as pathway to improve academics and it focuses on enhanced student health in the form of improved physical fitness (CDC, 2019).

The physiological improvements from fitness participation, specifically cardiovascular fitness, have been shown to enhance cognitive function, executive function, and improve overall academic achievement in elementary students, and standardized testing results in middle and high school students (Castelli et al., 2007; Grisson et al., 2005; Hillman et al., 2014). In fact, the more fit a student, the greater their improvement in academic outcomes as compared to their less-fit peers (Grisson et al., 2005). This is not to say that students need to be superiorly fit. In fact, individual improvements, regardless of baseline assessments, have been shown to assist in improving cognition and executive function (Hillman et al., 2014). Despite the evidence for improved fitness as a strategy for enhancing academic outcomes, opportunities for physical activity and physical fitness in a school-based setting have been decreasing over time. Typically, this has been accomplished by a reduction in requirements for physical education in an effort to create additional instructional time for tested content areas. As a

result, the problem of practice for the current study was born from the inequality in available time allotted to tested content areas versus that which is afforded to physical education.

As a result, the need to offer time efficient methods of physical fitness improving physical activity while also enhancing the academic progress of students was the primary goal of this study. More specifically, this study evaluated whether student engagement could be improved when in class physical activity was performed prior to the start of class. A strategy for this type of activity is called Tabata fitness and it involves numerous exercises being performed in sequence for a specific amount of time with a short rest period between. This type of routine takes approximately 5-8 minutes to complete and has been shown to be equally as effective at improving cardiovascular fitness as compared to longer duration, lower intensity exercise such as jogging or riding a stationary cycle ergometer (Tabata, 2019).

Research Question

What impact does an in class Tabata based physical fitness protocol have on student engagement levels in a sixth-grade math class?

Purpose of the Study

The purpose of the study was to examine the impact of a Tabata fitness routine on the engagement level of students in a sixth-grade math class. For the purposes of this study, a Tabata fitness routine is a planned warmup of bodyweight exercises performed for a specific time interval not to exceed eight minutes prior to the start of a typical sixth-grade math class. Moreover, for the purposes of this study, student engagement is defined

as “a condition of emotional, social, and intellectual readiness to learn characterized by curiosity, participation, and the drive to learn more” (Abla & Fraumeni, 2019, p. 2).

Summary of the Study

This action research study was designed to examine the impact of an in class Tabata Based Physical Fitness Intervention (TBPFI) on student engagement levels in a 6th grade math class. Over the course of six weeks in the spring of 2022, five students participated in the study by completing a TBPFI twice per week prior to the start of their sixth-grade math class. The remaining classes per week were held as they normally would without any physical activity. Data collection included quantitative and qualitative methods. A Student Engagement in Mathematics Survey (SEMS) provided the quantitative data in the form of a Likert scale, as did the researcher engagement rating. Qualitative methods included semi-structured interviews for the student-participants and the teacher-participant, and finally, the researcher’s field notes and observations.

Prior to the start of the study, student-participants and the teacher-participant completed interviews to gauge their initial thoughts about math class and also the inclusion of physical activity in a classroom setting. During each week thereafter, students would attend math class on Mondays and Tuesdays as it normally took place. At the conclusion of class on Tuesdays, each student-participant completed the SEMS with a focus on what they thought about class on Monday and Tuesday. On Wednesday and Thursday of each week, students participated in the TBPFI prior to the start of math class and then had class as normal the remainder of the class period. At the completion of class on Thursdays, each student-participant once again completed the SEMS as a measure of engagement for class on Wednesday and Thursday. The researcher recorded observations

and field notes on Tuesdays and Thursdays each week for the duration of the six-week study. This allowed the researcher to observe a class without the TBPFI and one with the TBPFI each week. At the conclusion of the study, the student-participants and the teacher-participant completed a post-interview. Once completed, all data was compiled and thoroughly analyzed to determine patterns and themes that were consistent across all data sets. Based on data analysis process, the following two primary themes were apparent:

1. physical activity and fitness are viewed positively, and
2. differences between perceived engagement and reported engagement.

Implications of the Findings

The goal of this research study was to determine if in-class physical activity is a useful tool for increasing student engagement in a classroom setting. Physical activity has already been shown to improve academics, cognitive function, and executive function; however, these areas have not had any positive effect on increasing physical activity time in schools. In fact, the opposite has happened, and many schools are decreasing opportunities for physical activity. The results of this study suggest that schools rethink their approach to offering physical activity opportunities in school depending on the needs of the students.

The first finding of the study was the consensus among all individuals involved that physical activity is beneficial and a welcome addition to a math class. Only one student reported negativity towards the TBPFI; however, they only reported negativity towards the TBPFI routine and instead viewed physical activity itself as a positive addition in a math class. As a result, the perception of physical activity in a classroom

setting was positive, which suggests that it may be a convenient method for implementing physical activity in small bouts during the day with minimal pushback from students. This is especially important considering a difficult part of improving fitness is a lack of consistency among participants which is partly due to lack of enjoyment (Hoare, 2017). Additionally, by implementing these activities into numerous classes daily, the cumulative dose of physical activity across a school day could produce greater fitness and thus the opportunity for enhanced academic achievement (Grisson, 2005). Based on the second finding of this study, it could be especially useful at improving the achievement of students who are less active outside of school or students who appear withdrawn and uninterested.

The second finding of the study revealed that while perception of physical activity and fitness on student engagement was positive, it did not produce positive engagement results for all student-participants. Student engagement stayed the same for 60% of student-participants and improved for 40% of student-participants. Interestingly, the three students who were deemed to be outgoing, jovial, and participated in extracurricular activities as reported in their individual characteristics remained unchanged and, in some cases, even dropped a point or two on the SEMS with the inclusion of a TBPFI. Conversely, the two students who seemed quiet and withdrawn demonstrated a marked improvement in student engagement, particularly in the social and emotional aspects as measured by the SEMS. The lack of change for some students and positive change for others could be related to a potential improvement in physical fitness over the course of the study.

It is accepted knowledge that increases in fitness are linked to increases in academic achievement (Care et al., 2020; CDC, 2019; Grisson, 2005). In support of this notion, the current study indicates that certain students may have large improvements in cognitive engagement in a math class with the inclusion of a TBPFI while others show minimal or no change. Of particular interest was that the single student that reported an increase five times that of any other student in cognitive engagement when a TBPFI was implemented. Coincidentally, this student was also the only student that did not participate in extracurricular athletics or physical fitness-based activities other than the single quarter of physical education offered by the school district. This lack of physical activity could explain the increase in cognitive engagement reported on the SEMS. Over the course of the six-week study, this student may have improved their overall fitness levels and gained the benefit of increased cognitive function and executive control that has been reported in the research when increase in fitness are realized (Hillman et al., 2014; Pontifex et al., 2013). The present student reveals a similar trend with the revelation that this may be the result of the individual activity levels of students and their unique personality traits. Considering that the other four student-participants exhibited little to no change in cognitive engagement, it demonstrates that increasing opportunities for physical activity during a school day can positively impact students the students who need it the most and has minimal negative effects for other students.

Action Plan

The results of this study suggest that including Tabata based physical fitness into a classroom setting can have a positive impact on those students who may not be exposed to regular bouts of physical activity throughout the day or week. The positive impact can

be realized in the improvement of social, emotional, and cognitive student engagement. In addition, while it seems that students who participate regularly in physical activity outside of class remain unchanged when considering student engagement levels, they still perceive it as beneficial. As a result, there does not appear to be a negative to including physical activity at the beginning of a middle school math class. Therefore, the proposed action plan includes dissemination to district administration, explanation to the mathematics department of potential benefits, and education for the students on the benefits of physical activity, physical fitness and the inclusion of a TBPFI as part of a regular mathematics class.

First, the district administration will be made aware of the results so that they are able to support the proposed implementation by faculty into a classroom setting. A detailed explanation will be provided that includes how it can be included, when it should be included, and how effectiveness is able to be assessed. Once this is complete, the members of the mathematics department will be made aware of the results of the study.

The mathematics department must be allowed to explore the results and extrapolate the relevant information for their own understanding. This will provide an opportunity for personal understanding and ownership over the individual ways that each educator may implement this plan into their personal classroom setting. Additionally, this will help to create an individual value system among the department with respect to the nuances of implementing in class physical activity. In conjunction with the researcher who is the physical education teacher, a plan can be developed to best meet the needs of each class individually. Finally, it will promote a cohesive message across content areas

that this addition to a math class is beneficial, and the information can be appropriately relayed to students for whom it is intended to benefit.

As a faculty, the math department will provide relevant information to the students in their classes that includes the notion that physical activity in the classroom setting will help them achieve greater success academically and allow them to learn easier. In this way, the students can also take ownership of the process and develop a personal value system about in class physical activity so that they are able to view the benefits of maintaining their own personal level of fitness as more than just something that is done in a physical education class or as part of athletics. The results of the dissemination of research from the administration to the teachers and finally to the students promotes the further development of a comprehensive school physical activity program and the Whole Child model of education (Care et al. 2020; CDC 2019).

Reflection on the Research Process

This action research study presented many unforeseen challenges; however, it also provided confirmation for the inclusion of physical activity throughout the school day as a necessary benefit for students. Specifically, professional position changes and observations of students that were not specifically related to the study created situations and thought processes that not only made data collection a challenge, but they also spurred new questions and insights into the benefits of fitness and wellness throughout the school day.

The primary challenge of this study revolved around the disruption in my professional life. When this action research process began, I was employed as an elementary physical education teacher and had been performing the job for more than 13

years. As a result, the original research plan was centered on improving the academics, fitness and wellness of upper elementary students; however, this changed when I was transferred to a middle high school position at the beginning of the school year in which I was to collect data. The result was a rapid transition to adapt the project to meet the needs of my new teaching environment yet maintain a similar research question and methodology. While the same problem of practice existed, I conducted an action research study in a situation that included less-familiar students, teachers, and administrators. As a result, new challenges arose during the data collection phase and represent limitations discussed previously. Specifically, the inclusion of only five student-participants in the study was a direct result of unfamiliarity between me and the students. Had this study been conducted in the originally intended elementary setting, I am confident that a greater number of students would have participated thus strengthening the results. Interestingly, the unfamiliarity with the students may have contributed to an unreported observation of the non-participants within the classroom that has created new questions.

While there were only five student-participants, all students had the opportunity to participate in the TBPFI at the beginning of class each day; however, there were several students who chose not to participate at all in any of the available exercises. I found this to be an interesting observation and it highlights the challenges of improving student wellness in a school setting. Even though the results of this study suggest that a TBPFI has the ability to enhance student engagement, it only works if students are willing to participate. Regardless, the need to improve student health, fitness, and wellness remains an important aspect of student achievement and should not be overlooked. This study supports this notion and generates a series of new questions to be investigated.

Suggestions for Future Research

The results of this study are encouraging but more research is needed to find a more specific reason as to the student engagement improvement in some students and the lack of change in others. Specifically, including additional participants, measuring fitness parameters, and analyzing academic achievement are three areas where more information is needed to determine the effectiveness of in class Tabata based physical fitness.

First, an increase in sample size would aid in confirming the effect of a TBPFI on student engagement. This study only had five participants. Inclusion of more students would help to determine a more definitive answer as the effect of a TBPFI on student engagement. Based on the results of this study, it is possible that the students who remained the same in the engagement measures may not have realized an increase in fitness because of their participation in extracurricular activities and athletics. Instituting selection criteria that equalizes the number of student-participants who are physically active in extracurricular activities, and those who are not, would be a reasonable strategy for participant recruitment.

Next, because it was noted that the student who reported the largest engagement improvement, particularly cognitive engagement, was also the only student that lacked extracurricular activity, the future inclusion of a fitness measure is necessary. It is already known that less fit students perform worse academically than their more fit peers (Grisson, 2005). Additionally, recommendations for increasing physical activity in a school are partly based on data that suggest improved fitness from increased physical activity enhances academic achievement (CDC, 2019). Previous research has indicated that improvements in fitness have a positive impact on academics and this study seems to

trend in those directions as well (Castelli et al., 2007; Hillman et al., 2014). As a result, figuring out if the relationship between student engagement and physical activity reported in this study is due to increases in physical fitness further strengthens the relationship between the measures of engagement and physical activity. A follow up study that examines the impact of Tabata based physical activity in a classroom setting and its effect on measures of fitness, specifically aerobic fitness is warranted to determine if fitness improvement is related to increases in student engagement.

Finally, there was no measure of academic progress in the current study. It would be prudent to measure academic progress throughout a research study so that if improvements in engagement occur, they could be correlated with improvements in academic achievement. This would further strengthen the link between increases in physical fitness, student engagement, and academic achievement.

Conclusion

Improving academic achievement is the primary goal of an educational entity. The methods by which these improvements take place traditionally fall within the classroom setting and tend to be prioritized towards content areas that are part of annual state assessments. Even though physical activity and improved fitness levels have been shown to have positive effects on academic achievement, opportunities for enhancing fitness in a school are being diminished in favor of classroom-based activities in tested content areas. The current study aimed to determine if incorporating physical activity into a classroom setting could assist in enhancing student engagement as a pathway towards improved academic achievement.

The results of this study suggest that Tabata based physical fitness activity in a classroom setting could have positive outcomes for students in a math class, specifically those who are typically less active overall. The researcher was encouraged by these results, even though fitness was not measured, as they indicate the potential of short bouts of physical activity as a pathway not only to academic achievement, but also to the potential improvement of overall health and wellness. This reinforces the aspects of the Whole Child Model of education as well as the Comprehensive School Physical Activity Program as a method to improve overall student achievement in a school-based setting (Care et al., 2020; CDC, 2019). With this in mind, the researcher confirmed his notion that a reimagination of the role of physical educators is needed. They should now be tasked with providing guidance and expertise on how best to improve student health and fitness as an additional tool to enhance student achievement. This can be accomplished through methods that extend beyond traditional roles and procedures expected of physical education teachers to provide equitable opportunities for students to be physically active throughout the school day in a variety of settings.

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APPENDIX A

PARENT/GUARDIAN CONSENT

Dear Parents/Guardians:

My name is Justin Kulik. I am a Health and Physical Education Teacher at the River Valley School District and also a doctoral candidate in the School of Education at the University of South Carolina. As part of my degree, I am conducting a research study, and I would like to invite your child to participate.

My research is designed to improve student engagement in mathematics through the inclusion of in class physical activity. If your child decides to participate, he/she will be asked to complete a few short surveys each week for six weeks about their feelings and perceptions on their math classes. The surveys should last about 5-10 minutes. The students do not have to answer any questions that they do not wish to answer. The students' answers in the surveys will only be reviewed by me and destroyed upon completion of the study. **All identifying information will remain strictly confidential and be changed when reporting results in the research write-up.**

Participation, non-participation, or withdrawal will not affect your child's grades in any way. If a student begins the study and later decides to withdraw, it is completely fine.

Your consent to have your child participate is completely voluntary. I do appreciate you thinking about allowing your child to participate in the study. If you would like your child to participate in the study, please complete the bottom of this form, and return the letter to me by March 11th, 2022. Thank you for your time and consideration in this matter.

We will be happy to answer any questions you have about the study. You may contact me or my faculty advisor, Dr. James Kirylo at kiryloja@mailbox.sc.edu.

Sincerely,
Justin Kulik, Doctoral Candidate
Email: kulik.j@rvsdpa.org
Phone: 724-459-5500

By signing below, I give my permission for my child to participate the research. I understand that this is a completely voluntary project, and my child can withdraw if needed without any penalty or conflict.

Parent/Guardian's Name_____ Childs Name:_____

Parent/Guardian Signature_____ Date:_____

APPENDIX B

STUDENT ASSENT

UNIVERSITY OF SOUTH CAROLINA CONSENT TO BE A RESEARCH SUBJECT

The Impact of a Tabata Fitness Protocol on Student Engagement Levels in a Sixth Grade Math Class

Dear students:

I am working on a study about the impact of in class physical activity on student engagement and how this might help you in your math class. I hope to see an increase in student engagement as a result of doing physical activity in class, thus improving students' performance in math.

I would like to invite you to participate in my study. Your parent/guardian has already said it is okay for you to be in the study, but it is up to you if you want to be in the study. If you would like to participate in the study, please complete the bottom of this form, and return the letter to me by March 14th, 2022. Thank you for your time and consideration in this matter.

If you want to be in the study, you will be asked to do the following:

- Answer some written questions about your feeling and perception on math class each week during the study.
- The process will take about 5-15 minutes a few times per week.
- Any information you share with me will be private. No one except me will know your answers to the questions.

You do not have to help with this study. Being in the study is not related to your regular class work and will not help or hurt your grades. You can also drop out of the study at any time, for any reason, and you will not be in any trouble, and no one will be mad at you.

Please ask any questions you would like to about the study at any time.

Mr. Kulik

☐ My participation has been explained to me, and all my questions have been answered. I am willing to participate.

Print Name of Student_____

Age of Student _____

Signature of Student _____

Date_____

APPENDIX C

TEACHER-PARTICIPANT CONSENT

Teacher-Participant Consent

UNIVERSITY OF SOUTH CAROLINA
CONSENT TO BE A RESEARCH SUBJECT

The Impact of a Tabata Fitness Protocol on Student Engagement Levels in a Sixth Grade Math Class

Dear Teachers:

My name is Justin Kulik and I am a doctoral candidate in the School of Education at the University of South Carolina. I am also a Health and Physical Education teacher in the River Valley School District. The University of South Carolina, School of Education is sponsoring this research study. The purpose of this study is to examine the impact of in class physical activity on student engagement in math class. You are being asked to participate in this study because you are a teacher of Middle School Mathematics. This study is being done at River Valley Middle School and will involve approximately six volunteers. I would like to invite you to participate in my study as the teacher-participant.

The study will last for six weeks. If you agree to participate in this study, you will complete two surveys; one before and after the study, implement the proposed model in your course twice a week, and complete two field note observations accordingly each week. I will come to your classes for student observation twice a week and collect some field notes as well.

There is no risk if you choose to participate in or not participate in the study. Taking part in this study is not likely to benefit you personally and you will not be paid for participating in this study

Participation in this study is voluntary. You are free not to participate, or to stop participating at any time, for any reason without negative consequences. In the event that you do withdraw from this study, the information you have already provided will be kept in a confidential manner. If you wish to withdraw from the study, please call or email me. Your participation, non-participation, and/or withdrawal will not affect your relationship with the researcher, site school, or the University of South Carolina. Participation in this research study is voluntary.

Your participation in the study will be confidential. Results of this research study may be published or presented at seminars; however, the report(s) or presentation(s) will not include your name or other identifying information about you.

If you would like to participate in the study, please complete the bottom of this form, and return the letter to me by March 11th, 2022. Thank you for your time and consideration in this matter.

Sincerely,
Justin Kulik, Doctoral Candidate
Email: kulik.j@rvsdpa.org

- ☐ I have been given a chance to ask questions about this research study. These questions have been answered to my satisfaction. If I have any more questions about my participation in this study, or a study related injury, I am to contact Justin Kulik at 724-459-5500 or email kulik.j@rvsdpa.org

- ☐ Concerns about your rights as a research subject are to be directed to, Lisa Johnson, Assistant Director, Office of Research Compliance, University of South Carolina, 1600 Hampton Street, Suite 414D, Columbia, SC 29208, phone: (803) 777-6670 or email: LisaJ@mailbox.sc.edu.

- ☐ I agree to participate in this study. I have been given a copy of this form for my own records.

If you wish to participate, you should sign below.

Signature of Subject_____

Participant Date_____

APPENDIX D

STUDENT ENGAGEMENT IN MATHEMATICS SURVEY

We are interested in your thoughts about math class today. Please read each statement, and circle the number that fits

Statement	No, not at all true	A little true	Often true	Yes, very true
1. Today in math class I worked as hard as I could.	1	2	3	4
2. Today I talked about math to other kids in class.	1	2	3	4
3. Today I helped other kids with math when they didn't know what to do.	1	2	3	4
4. Today I shared ideas and materials with other kids in math class.	1	2	3	4
5. Students in my math class helped each other learn today.	1	2	3	4
6. Math class was fun today.	1	2	3	4
7. Today I felt bored in math class.	1	2	3	4
8. I enjoyed thinking about math today.	1	2	3	4
9. Today it was important to me that I understood the math really well.	1	2	3	4
10. I tried to learn as much as I could in math class today.	1	2	3	4
11. Learning math was interesting to me today.	1	2	3	4
12. I liked the feeling of solving problems in math today.	1	2	3	4
13. I did a lot of thinking in math class today.	1	2	3	4

APPENDIX E

STUDENT INTERVIEW QUESTIONS

Students Pre-Interview Questions

1. How do you feel about math class? What do you like or dislike?
2. Do you get distracted during math class? Why or why not?
3. What keeps you engaged during math class?
4. How do you feel about physical activity in a classroom setting?

Students Post-Interview Questions

1. How do you feel about math class? What do you like or dislike?
2. Do you get distracted during math class? Why or why not?
3. What keeps you engaged during math class?
4. How do you feel about physical activity in a classroom setting?
5. What did you think about the Tabata Fitness Protocol at the beginning of each math class? What about it did you like or dislike?

APPENDIX F

TEACHER INTERVIEW QUESTIONS

Teacher Pre-Interview Questions

1. Describe the engagement level of the students in your math class?
2. How do you feel about the engagement level of the students in your math class?
3. What are some strategies you have used to monitor and/or increase student engagement?
4. How do you feel about physical activity in a classroom setting?
5. Do you have any other thoughts, comments, and observations about student engagement and/or physical activity in a classroom setting?

Teacher Post-interview Questions

1. Describe the engagement level of the students in your math class?
2. How do you feel about the engagement level of the students in your math class?
3. What are some strategies you have used to monitor and/or increase student engagement?
4. How do you feel about physical activity in a classroom setting?
5. How do you feel about the Tabata fitness protocol used in this study?
6. Do you have any other thoughts, comments, and observations about student engagement and/or physical activity in a classroom setting?

APPENDIX G

FIELD NOTES/OBSERVATION FORM

	Overall Engagement scale rating for this observation (1=Low; 5=High)	Evidence of Engagement	Evidence of Disengagement	Additional Comments
Student 1	1 2 3 4 5			
Student 2	1 2 3 4 5			
Student 3	1 2 3 4 5			
Student 4	1 2 3 4 5			
Student 5	1 2 3 4 5			