STRONG BODY, STRONG MIND: THE EFFECTS OF IMPLEMENTING PHYSICAL ACTIVITY WITHIN A MATHEMATICS COURSE FOR DEPLOYED SAILORS

A Dissertation

by

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ABSTRACT

Test anxiety can act as a major inhibitor for students to perform to their ability. Students can find that what life decisions they are going to be afforded is going to be determined by a series of multiple choice mathematics questions. There must be a way to deal with their test anxiety so that the true nature of their knowledge is displayed, and in the process promote learning. Meditative breathing, stretching, and physical activity have been shown to reduce stress. Furthermore, physical activity has also shown an effect on behavioral and cognitive states. This study investigates if these activities can be used in the classroom to promote learning and achievement within a mathematics course. In order to find students who share a minimum level of physical fitness and operate under some of the most stressful conditions possible, the participants were chosen from mathematics courses taught to sailors while on deployment. Two same class ships were chosen to be a part of the study. Each ship had courses split into exercise groups and a control group. Students were given a pre-test followed by eight weeks of instruction and then a post-test, interview data was collected after the course. During the instruction, weekly reviews were set so control groups were rewarded with points for correct answers and exercise groups were tasked with physical activity for incorrect answers.

Study A found that post test scores were not significantly different between the exercise and control group. However, the exercise group did attend more tutoring events

than their counterparts. Interview data did indicate students in the exercise group felt a greater sense of engagement, fun, and camaraderie. Based upon variations in mathematic exposure between the two groups another study was planned to find participant groups that were closer reflections of each other.

Study B was conducted with a more reflective representation of student math background. The results found that the exercise group scored higher in post-test and tutoring events than the control group. Interview data also showed consistent results with Study A, where the exercise group reported a greater sense of engagement, fun and camaraderie.

DEDICATION

I would like to dedicate this work to my grandparents, Alfredo and Nasaria Zavala as well as Charles and Francis Edwards. While many of my memories of them are vague, I thank Alfredo for instilling into me the importance of hard work, even as a child he emphasized a commitment to working hard and using both hands. Nasaria taught me about the strength of faith and the power of spirit, which can carry you forward despite any condition. Charles taught me the value of education and the importance to diversify your talent and knowledge base so that when you speak you not only stand on solid ground, but can relate ideas to others. Francis taught me about consistency, despite distance or circumstance, consistency will often be enough to keep you in a battle until you find your moment to grasp victory.

So here I sit, writing this dedication to recognize that hard work, faith, knowledge, and consistency are major reasons why I am able to write on what is to be the final part of a journey that I began when I put in my application to go to college. The fall of 1998 seems so very long ago, at times, like my memories may belong to someone else. Yet here I sit, on the verge of finally completing this journey, and looking for the next, taking the values that I have to find success in what is to come. To my grandparents who may have to read this from Heaven, this is for you.

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First and foremost I would like to thank my Savior Jesus Christ for hearing my prayers throughout my life. My vocabulary fails to adequately convey the gratitude that I feel for answering my prayers and providing me with strength to push forward. I would be a fool to say that I have stood alone, as through my journey I have been sent people through His mercy and love to help me along the way. And while I believe that tears are simply that manifestation of emotion that is so great that the body can no longer contain them…I have to be honest, I did not cry once through this process, but when it is over, I may have an emotion or two running down my face. While my Angel has worked overtime watching out for me on things that I cannot see, the Lord has sent me those to help me for things that I can.

To my committee, who I hope decides to sign this ;-) I want to thank you for helping me along the way. Dr. Kulm brought me to Texas A&M, and has stood by me as I worked through the trials that life has thrown my way. He has always understood my balance of academia and roughneck, and I am so very proud to have studied under him. When I first arrived, he said to me most people quit PhD programs. I told him I was not going to quit, and at times when I did not want to continue I remembered my words to him and found the will power to keep pushing forward. Dr. Wright I met by chance, and I found his research so interesting that he had to convince me not to change fields of study, but he did agree to be on my committee. I am grateful for the time he took during

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I could go on and on about my mother, but there is not enough memory on my terabyte hard drive to adequately express my thanks. Though I am sure that I am such a disappointment in so many ways, she loved me anyway. There is something that is perfect about a mothers' love, it is Christ like, and I could not imagine having a better

mother. It is funny that I avoided so much trouble in my life because I knew facing it in the ways I wanted would break her heart, so I walked away, and in doing so I saved myself from a life that nobody wants. I have always respected my fahters' work ethic. He has always been clear cut, as Yoda (Star Wars, Episode 5) said "Do or do not…there is no try." My sister, whose faith, kindness, and sacrifice has been with me as long as I can remember. She has been my greatest advocate and a source of inspiration for me, and I have such an admiration for her courage. My brother gave me a different type of inspiration, he gave me the ability to want to succeed so that I could show him that he could build his own dreams. Thanks also to my aunt Lydia for her belief.

I look back to my days as a kid in high school and remember Carlos Pasami who acted as a big brother, keeping me out of trouble. He always would tell me "…you can't do this, you can't be like us; you're the one with the future and I have to protect that." I do not know what it is that he envisioned for me, but I have to hope that what I have become is a tribute to his guidance. I have to thank Randy Guffy whose constant friendship has been priceless, he is my oldest friend.

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CHAPTER I

INTRODUCTION

Mathematics achievement throughout the United States is dangerously low when compared to other leading nations. The Ginsburg, Cooke, Leinwand, Noell, and Pollock (2005) reexamination of the Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) measuring the U.S. against eleven similar counties found that students from the United States ranked as low as eight out of the twelve.

Even as adult students (students over eighteen years of age) struggle to demonstrate fundamental skills while attempting to enter college, over one million students fail to test into college level courses, and nearly four out of five of these students have a minimal grade point average of 3.0 (Strong American Schools, 2008). The need for remedial education in core courses is drawing great criticism, as taxpayers find they must fund students twice for the same education (Saxon & Boylan, 2001). Hoyt and Sorensen (2001) found that despite taking college preparatory courses in high school, students enrolling into an urban state college still had high remedial placement rates.

Students' poor performance in mathematics may be largely due to their poor motivation and to teaching methods. There is an old saying, "When you bring your horse to the water and he will not drink, then feed him salt." In teaching a mathematics course, the salt may well be the reason that students will want to learn. Teaching styles

are important; however, students' desire to learn is crucial to the learning process. Every learning process begins with the learner's attention and desire to learn (M. Cox, personal communication, August 8, 2010). One way to improve student learning within an institution is by identifying those students who are disengaged and engage them into the learning process. Students who are actively engaged in learning will rise to the challenges that instructors demand (Kuh, 2003).

Jones et al. (1999) shared that test anxiety inhibits student performance. High-stakes tests are an important source of test anxiety in today's schools. Recent policy in the United States has resulted in the practice that students are often judged based on the results of a sole high-stakes test. With regard to such anxiety, attitude can play as great a role as student knowledge and, clearly, there does exist a possibility that the student scores do not accurately reflect the students' content understanding (Gulek, 2003). Many learners who deal with high levels of anxiety tend to perform at a lower standard than students who do not share such levels of anxiety (Hancock, 2001).

Various approaches have been suggested and implemented to reduce anxiety about mathematics, including test anxiety. However, one approach that has not been widely implemented in school classrooms is physical activity such as exercise. Physical activity is a method that may provide a viable means to address test anxiety and concomitant stress. Exercise has been shown to reduce the effect on state anxiety (anxiety that is temporarily caused by a stimulus, i.e. cat runs in front of car) and trait anxiety (anxiety that is present in person, this will cause a person to be more anxious and

need lower levels of stimulus to react) and, it can improve physical self-perceptions and, in some cases, overall self-esteem, while improving an individual's mood (Fox 1999). Stress reduction works hand in hand with self-esteem. A person who feels confident will be less susceptible to the drawbacks of stress. Studies of self-esteem in relation to exercise have shown interesting results. In a study conducted with children and young adults, researchers found that "...that exercise has positive short-term effects on self-esteem in children and young people. Since there are no known negative effects of exercise and many positive effects on physical health, exercise may be an important measure in improving children's self-esteem" (Ekeland, Heian, Hagen, Abbott, & Nordheim, 2004, p. 3). Exercise has even been shown to be an effective treatment for clinical depression and has reduced depressive symptoms in both healthy and clinical patients (Brosse, Sheets, Lett, & Blumenthal, 2002).

Purpose of the Study

The purpose of the study is to explore the effects of physical activity integrated into classroom mathematics instruction of adult students in the U. S. Navy. In particular, can physical activity improve learning and performance of mathematical knowledge, skills, and understanding? An ideal method to improve performance would be one that is time efficient, inexpensive, and able to provide benefits other areas as well. Physical activity, for the purposes of this study, includes but is not limited to aerobic and callisthenic exercises such as push-ups, crunches, squats, toe raises, and dips. Meditative breathing and stretching exercises are also incorporated. The fundamental

stretching and push-up techniques are described in the U.S. Navy pre-entry physical training plan, however, students also included various other stretches that they routinely perform while preparing for Navy Physical Training (Training Plan). Ideally, the implementation of these physical, meditative breathing, and stretching activities would improve mathematical performance while also contributing to maintaining the health and physical readiness that a Sailor or Marine must maintain. Additionally, the beneficial results of incorporating these activities in mathematics class may extend to students in other learning environments and age levels.

Significance of the Study

Math anxiety is inversely proportional to content mastery, learning, and motivation. Students who deal with math anxiety purposely avoid situations that would require mathematics which would include course work as well as and careers in which mathematics is required (Ashcraft, Krause, 2007). Mathematics courses are not simply limited to teaching theorems and calculations. The College Board (n.d.) recognizes that studying mathematics provides students with the ability to "identify and analyze patterns, develop logic and critical thinking, see relationships, and solve real world problems."

Jobs that require mathematics are often critical-need positions, where demand is high. Although many careers relate to mathematics within the U.S. Navy, for example, careers relating to nuclear propulsion are particularly in demand (Nuclear, n.d). The improvement of mathematics education for sailors will enhance their abilities and could

possibly lead to improved critical manpower demands for the Navy. Such improvements for sailors could also have residual affects upon their families, perhaps leading to long-term advances in mathematics performance across the population in the United States. Additionally, techniques found to improve mathematical achievement for sailor students may be implemented on their civilian counterparts in traditional civilian school systems as well as colleges and universities.

Research Questions

The study addressed the following research questions:

1. Can physical activity combined with stretching and meditative breathing promote an environment in which participants can learn mathematics and display both achievement and motivation?

2. What are participants' attitudes about using physical activity, stretching and meditative breathing within their mathematics coursework?

CHAPTER II

LITERATURE REVIEW

The review of the literature addresses several topics that are central to the purpose and goals of the proposed research. In the first section a general review of math anxiety and its causes is provided, especially as related to traditional classrooms and the recent focus on high-stakes testing. The next two sections review the physiological effects of various types of physical activity, with special attention to the activities of stretching and breathing. The fourth section summarizes research on the relationship between physical activity and stress relief, sense of well-being, and cognitive performance. The final section reviews approaches to implementing physical activity in the classroom, focusing on the importance of group activity and team work.

Sources of Mathematics Anxiety

Test anxiety, especially in mathematics, has been a concern for teachers, students, and parents for decades. The recent policies that require high-stakes tests at multiple grade levels in states like Texas, can result in cases where failure to pass this test would prevent a student to move to the next grade or even graduate. The pressure of twelve years of grade school rests at one point solely on the ability to pass a multiple-choice standardized test. Preparation for tests through effective teaching that leads to solid student understanding of mathematical concepts and procedures can reduce anxiety. Nonetheless, many students experience test anxiety no matter how well

prepared they are. Students often recall mathematics being taught in classrooms in which tension was created by an emphasis on timed computation drill and an emphasis on correct answers (Tobias, 1987). Though tension can be used as an effective tool for learning and knowledge demonstration, tension can be so great, Ashcraft and Kirk (2001) found, that math anxiety may reduce certain brain functions, possibly those that are needed most for mathematics learning retention. This anxiety and stress can lead to decreased performance, avoidance of mathematics courses and, eventually, avoidance of mathematics-related careers. Math anxiety compromises ongoing activity in a person's working memory, which impairs cognitive processing. This problem is as much personal as it is cultural, as even Barbie Dolls told children, "Math class is hard" (Ashcraft, 2002). Stuart (2000) believes that math anxiety is based in math insecurity, and these insecurities are initiated in various situations, ranging from performance to instruction to family/peer influence. She hypothesizes that math is like a sport, 90% confidence (mental) and 10% competence (physical).

The choices of approaches to stress reduction in a school setting may seem limited due to constraints on school resources. Education is facing deep financial cuts in across the country. For example, Texas legislators faced an $18 billion shortfall in January 2010 when they reconvened (Chron, 2010). Other states are facing similar dollars and cents issues, and in elective classes like physical education, cuts are becoming commonplace; some school districts are considering having teachers instruct two classes at once with the help of an aide (Sun, 2010). Current trends in school

resources and working conditions fail to keep enough mathematics teachers in the classrooms; teachers are being laid off due to budget cuts. The resulting teacher shortage leads to higher teaching loads and larger classes. Large class sizes in mathematics can have a substantially negative effect on student performance, particularly in classrooms comprised of high-achieving students – the larger the class, the less time is available for quality instruction and learning (King Rice, 1999). A cost effective, time effective method must be developed to improve achievement by reducing anxiety while it improve attitudes in both the students and teachers. Perhaps surprisingly, to some, physical fitness may be the avenue for success in the mission to combat test anxiety.

Physiological Effects of Physical Activity

Exercise is commonly associated with "getting in shape," yet an active lifestyle has a vast array of medical benefits for the human body. People who live this type of lifestyle reduce risk factors such as heart disease, some types of cancers, obesity, autoimmune diseases, Rheumatoid arthritis, non-insulin dependent diabetes mellitus, and a weakened immune system (Lovett, n.d.). The National Heart Lung and Blood Institute (n.d.) call for physical activity as a preventative measure for pulmonary embolism and deep vein thrombosis. Physical fitness, according to the Centers for Disease Control and Prevention (n.d.), has been broken into five main components. They are described as cardiorespiratory endurance, muscular strength, muscular endurance, body composition, and flexibility. Therefore, teachers and students have

various avenues to define physical activity, which may include but is not limited to non-cultic, non-religious meditation, meditating stretching, calisthenics, and cardio exercises.

While physical fitness may be described as being in good condition or shape, there are two areas of training that promote such a state, aerobic and anaerobic exercise. Both exercises offer various physical adaptations that are critical for a healthy lifestyle for people in all age groups. Aerobic and anaerobic have differences in how muscles are fueled as well as their intensity and duration. For the fuel of the exercises, the most basic component it is to recognize there aerobic exercise depends upon oxygen in its metabolism while anaerobic exercise does not. Aerobic exercise can be associated with endurance training, while anaerobic is associated with strength training. While training there exists multiple styles of training, examples are combination training and interval training. Combination training, often referred to as cross-training is a process where aerobic endurance exercise is supplemented into anaerobic training in order to promote muscle recovery. However, the addition of aerobic training can reduce strength, power, speed, and muscle size, which for many strength athletes is counterproductive. In contrast, the addition of anaerobic exercises for endurance athletes can provide beneficial results in terms of power and recovery. Interval training is a method that maximizes energy transfers that allows an athlete to train at a higher level for a longer overall duration by breaking the exercise up with periods of rest. This rest cycle has been shown to improve a runner's ability to keep a particular pace and go from running .81 miles without a rest period to completing 4.14, 3.11, and 2.07 miles using 2:1, 1:1, and

1:2 work-to-rest ratios respectively. However, the current research does not support a definitive guideline on the work-to-rest ratio, making knowledge of energy systems time periods and recovery cycles are critical when training for elite results (Cramer, 2008). Physical adaptations occur through training, some adaptations are unique to aerobic or anaerobic training, some adaptations are common that may have levels of efficiency based upon training, and as mentioned, some adaptation such as muscle girth can have very opposite adaptations.

What are anaerobic exercises and what are some of the physical changes that may occur when anaerobic training takes place? Ratamess (2008) spends an entire chapter answering these questions. Essentially, anaerobic training compasses exercises such as, plyometric drills, weight training, speed, and agility drills. These exercises are high-intensity exercises with a short duration. There are several physical adaptations that occur with anaerobic training. While peak cardio vascular and respiratory performance is achieved through aerobic training, the implementation of anaerobic training for untrained athletes has been shown to raise VO_2 max and for trained athletes anaerobic exercises increases heart rate, oxygen uptake, cardiac output, systolic blood pressure, stroke volume, and blood flow. Anaerobic training increases muscle fiber area and can also cause fiber type transitions. Muscle adaptations also include decreased capillary density, mitochondrial density reduction, increased buffering capacity, increased mitochondrial and capillary numbers, resistance to fatigue, and alterations in muscle substrate content and enzyme activity. Weight bearing and impact exercises also

cause bone to bend. These bends stimulate new bone formations which increase the bone density and strength. Tendons, ligaments, fascia are also stimulated to growth through anaerobic exercise, cartilage is also thought to benefit as well. While gains in strength are often attributed to by the growth of muscle fiber and transformations in muscle types, much of early strength gains are a reward of neural adaptations. Neural adaptations occur first within higher brain centers and then throughout the neuromuscular chain all the way to individual muscle fibers. As levels of force and new exercises are learned there is an increase in activity within the primary motor cortex. Much of the neural adaptations occur in the spinal cord along the coriticospinal tracts. This adaptation allows trained individuals to improve their ability to recruit motor units (the alpha motor neuron and the muscle fibers it is associated with), particularly fast-twitch units. Thus there is an increase in rate of firing, synchronization of firing, and muscle recruitment. Heavy lifting requires a greater level of force, which requires the recruitment of more muscles, adaptations may allow athletes to recruit motor units out of order (large ones first) for movements that require greater power or speed. The interface between the skeletal muscle and nerve is the neuromuscular junction. Studies in animals have shown that high-intensity running yielded superior results to low-intensity running. These adaptations include larger neuromuscular junction area, greater total length of nerve terminal branching, more dispersed, and irregularly shaped synapses. The end-plate perimeter area and length also yield increases along with greater dispersion of acetylcholine receptors in the end-plate region. Neuromuscular reflex potentiation also

shows improvements, resistance training has resulted in 19% to 55% gains in reflex potentiation, reflex response increases permit the rate of force and magnitude to increase.

Aerobic means "living in air" or "utilizing oxygen". Aerobic exercises include activity that is relatively lower in intensity with a longer duration than anaerobic exercise. The human body is not meant for a stagnant lifestyle, it requires exercise for physical adaptations of improvement and protection against disease (Cooper, 1982). Exercises based entirely on the use of legs are often associated with aerobics such as jogging and bicycling, though cycling using arm motion is another means to aerobic exercise. Additionally, there are many activities such as dancing, swimming, cross country skiing, and rowing that involve the entire body. The key to exercise is to move, a person can move their feet while sitting at the office or on an airplane. Under normal circumstances the limitation of our ability to exercise is simply our desire to take action (J. Burkhard, personal communication, November 8, 2011). Swank (2008) explains that while there are adaptations such as increases in capillary density, mitochondrial density, low power muscular endurance, and aerobic power. As with anaerobic exercise, moderate aerobic activities can lead to adaptations that benefit of nervous system, connective tissue, bones and cartilage improvements while decreasing body-fat mass. During aerobic exercise an individual will have an increase in heart rate, the amount of blood (in liters) pumped by the heart is increased (cardiac output), and the amount of blood ejected from each beat (stroke volume). And while diastolic blood pressure may

decrease, there is an increase in systolic blood pressure. There is also an increase in the quantity of oxygen consumed within the body tissue (oxygen uptake). Aerobic exercise has the greatest ability to stimulate oxygen and carbon dioxide to move across cell membranes. There also exists evidence that aerobic exercise is associated with the cingulum bundle and white matter in the uncinate fasciculus integrity and increased hippocampal blood flow (Voss, Nagamatsu, Liu-Ambrose, & Kramer, 2011).

Benefits of Stretching and Breathing Exercises

Stretching is involved in many physical activities, often enough incorporated with exercise to prevent injury. It can be used to promote circulation, flexibility, and mood benefits that will allow a person to make better choices about their actions and words (Dowd & Gealer, 2005). Yoga, an activity that, in part, focuses on various stretching postures has been a source of stress relief for thousands of years. Smith, Hancock, Blake-Mortimer, & Eckert (2007) found that yoga and progressive muscle relaxation are effective ways to reduce the stress and anxiety of daily life. Adults who participated in a ten-minute Tai Chi standing session followed by a ten-minute floor session of yoga reported a decrease in anxiety, and participants they scored higher on math computations in the areas of accuracy and speed of completion (Field, Diego, Hernandez-Reif, 2010).

Besio (2003) found that static stretching in the corporate arena also had a beneficial impact on anxiety levels. In another example, hospitalized children as well as and their parents who participated in stretching and meditation were found to have less

anxiety and more cooperative behavior when coping with medical personnel than children and parents who received only information about their identical medical procedures (Peterson & Shigetomi, 1980). A study conducted by Wynn (1998) found that African-American men who participated in stretch-based relaxation experienced less anger, disgust, and anxiety during exposures to stressors than African-American men individuals who did not participate in this type of relaxation.

Using meditative breathing to reduce test anxiety is a common practice. Students attending the University at B v uffalo, for example, are advised by their counseling services to reduce test anxiety by taking long deep breaths in order to relax their bodies (University at Buffalo, n.d.). A great advantage of this deep breath meditation is that practitioners require little training to make it an effective practice. After only four days, with a twenty-minute training session each day, meditation participants found improved mood, an increase in mindfulness, and a decrease in anxiety and fatigue. Participants also exhibited improvements in working memory, visuo-spatial processing, and executive functioning (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). The practice of meditation has been shown to improve attention and overcome attention deficits related to age (van Leeuwen, Muller, Melloni, 2009).

Meditation techniques coupled with stretching and movement have also been shown to be an effective way to reduce stress, anxiety, and depression in junior and senior level nursing students in Korea (Kang, Choi, Ryu, 2009). Doctor Mehmet Oz the director of the Columbia Presbyterian Hospital's Heart Institute published an article in

Time magazine (2003, p.71), stating that every heart patient at his medical center is offered meditation, yoga, and massage programs. Oz states that meditation effects the body on a hormonal and molecular level, and patients who mediate bleed less during surgery than those who do not. Meditation can also lower blood pressure, slow heart rates, reduce hardening of the arteries, anxiety, chronic pain, and depression and, when combined with dieting, may slow tumor progression in patients suffering from through prostate-cancer.

Cognitive and Emotional Effects of Physical Activity

Mental health also benefits from exercise, Bahrke and Morgan (1978) showed over three decades ago that stress can be reduced through exercise and meditation. They also showed that acute physical activity and non-cultic, non-religious meditation equally reduce stress. Even internet how-to websites recognize the benefits of deep breathing and exercise as ways to improve brain power (Gillman, n.d.). While current culture looks for a pill to cure their woes, Carlisle (2012) notes that there is no drug that can substitute for exercise, as the lack of exercise is the fourth leading risk factor for death world-wide. Exercise has been linked to improving functional abilities in older adults, blood cholesterol levels, and academic improvement.

Additionally, physical activity exhibits a positive effect on cognitive function, intellectual performance, concentration, memory, and classroom behavior (Strong et al 2005). Although consistent exercise certainly improves overall self-esteem and mood state, research also shows that exercise can have an immediate effect. Analyses of

subjects following a single period of exercise showed significant reductions in mood disturbance, tension, depression, anger, and confusion (McGowan, Pierce, & Jordan 1991). According to the research completed by Hansen, Stevens, and Coast (2001), subjects who maintain an aerobic level of sixty percent of their maximum oxygen uptake for ten minutes will have the benefits of increased vigor while decreasing their fatigue and total negative mood state. And, Anderson-Hanlye, Nimon, and Westen (2010) found that non-aerobic exercise (strength training) had significant benefits on cognition for older adults. Even among studies of mice, voluntary exercise has shown the benefits of an increased problem solving capacity when compared to mice that were unable to exercise (Adlard et al 2005). Non-human studies have allowed researchers to observe that exercise training may enhance synaptogenesis, neurogeniss, angiogenesis, and upregulate neurotrophic factors in the brain of a mouse (Hillman, Erickson, & Kramer, 2008).

To add more evidence for the implementation of physical activity within the classroom, students who demonstrate physical achievement have increased stamina and better physical conditioning. There is evidence that this physical conditioning may assist in academic achievement. In a California study, data showed that students who were able to obtain a greater physical achievement score were generally able to achieve greater test scores on their Stanford Achievement Test (SAT). Interestingly enough, students generally scored higher on their math tests, and there was a greater improvement in math scores (measured against reading) when comparing the lowest and

highest levels of physical achievers (Grissom 2005). Studies focusing on Canadian youth have shown that increased physical activity showed a weak positive relationship with academic achievement (Temblay et al 2002). Burkhalter and Hillman (2011) reviewed multiple studies that indicate that students who are obese have a higher risk in performing poorly in academics, making them a more likely to repeat a grade, drop out, or obtain lower education as adult. Furthermore, cognitive dysfunction has been linked to overweight and obese adults.

Implementing Physical Activity in the Classroom

Physical activity, incorporated within the traditional curriculum, offers a practical and effective approach to relieving or reducing test anxiety and stress, which, in turn, may give students a chance for greater achievement while assisting them in developing and maintaining healthy lifestyles. As an additional benefit, physical activity can address other medical issues of concern to a large portion of our students. According to Yaussi (2005), roughly nine million young people (approximately fifteen percent) are overweight, and many of them are actually categorized as obese; while more than twenty-two percent of high school students fail to exercise on a regular basis. Children who maintain unhealthy lifestyles are at a great risk to grow into adults with severe health problems. Physical activity has a wonderful cost/effect balance as there are countless ways to perform quality physical activities that require little time or training and no financial commitment. These suggestions are aligned with the recommendations set out by Pate, et al (1995) that adults should exercise throughout the day and

accumulate at least thirty minutes of moderate exercise each day. Simply living an active life can show benefits, as elderly people who participated in low intensity activities improved episodic memory performance (Ruscheweyh, et al., 2009). The American Academy of Pediatrics (2004) give reminders that it is more important for exercise to be consistent then intense and the environment should be safe, fun, regular, and have variety. Teachers may also contact their schools' physical education teachers to find creative ways to incorporate physical activity (Yaussi, 2005).

There are several methodologies that instructors use in order to convey their curriculum to students. Group work is a style of learning that is a form of cooperative learning, it is widely practiced in a multitude of areas. Members of a group who have been given the same information and understanding of content gain a benefit that "increases the vitality and pace of the discussion and raises the potential for locating a workable solution" (Eitington, 2001, p.262). Furthermore, Eitington has mentioned (as cited in Brawly, Paskervich, 1997) that in order to build teamwork, the coach or manager, who acts as the catalyst and standard-setter must possess listening skills, be able to give and receive constructive feedback, develop an open climate, and create an atmosphere of support and not blame. In the case of a mathematics classroom, the coach would be the math instructor. The role of the instructor is far more demanding than simply the dissemination of content curriculum.

Williams and Lord (1997) found that women between the ages of 26 and 82 who participated in group exercise showed improvement in memory span, well-being,

reaction time, strength, and mood states. These women participated in group activities where social interaction and fun were the major emphasis. Similarly, Polubinsky and Plos (2007) have found that a fitness challenge can improve camaraderie within a college environment. Benefits of such a camaraderie builder may include more collegiality between peers, increased interaction with instructors outside the academic classroom, a greater sense of belonging, simply having fun promoting fitness, and increased interaction with instructors outside the academic setting. The latter is especially important, as students whose faculty encouragement perceptions are high have score higher in academic motivation and academic self-concept in comparison with students who have a negative perception of faculty encouragement (Cokley, 2000). Students with high faculty encouragement perceptions are more apt to take advantage of out-of-class interactions such as tutoring sessions and office visits and, thus, students who take advantage of such opportunities may learn more (Clark, Walker, Keith, 2002).

CHAPTER III

METHODOLOGY

Research has shown evidence that training programs are most beneficial when they are long term, sessions last longer than thirty minutes, and have a combination of aerobic and anaerobic exercise (Colcombe & Kramer, 2011). Military personnel were chosen as participants in the current study because they are required to maintain a constant state of physical fitness. Sailors were chosen because the researcher served in the U.S. Navy, and would be able to understand and relate to the culture and climate of the participants' environment. Ships at sea were chosen so that students would be exposed to both the stress of school and the reality of maintaining a combat ready status. These conditions gave the researcher the opportunity to study adult learners who were benefiting from cognitive adaptations from an active lifestyle, and examine if supplemental brief periods of physical activity within the course would augment learning and achievement. Body-weight resistance training was selected in an interval type program to efficiently make use of time and space allowances and prevent attention loss due to fatigue. While student participation was optional, the instructor (researcher) and visitors were required to participate in all physical activities assigned during classroom lessons.

While at sea, sailors often work twelve to eighteen hour days and participate in ship-wide drills, in addition to regular duties. This schedule made them prime candidates

for assessing the benefits of physical activity, stretching, and meditative breathing within their mathematics coursework.

Participants involved in the study were a convenience sample of active duty U.S. Navy personnel who were enrolled in non-required college credit courses during their limited off-duty time. Students came from all over the United States as well as other nations. Each class had a diverse representation of socioeconomic, gender, ethnic, and racial backgrounds. Classes also had representations of rank that would model a typical Navy division. Detailed demographic information will be provided for the individual studies that were conducted. The research consisted of two separate studies, both of which incorporated physical activities and explored various strategies and combinations of activity and mathematics instruction.

Course Content

Courses ranged from developmental mathematics courses through trigonometry. The coursework was offered through Central Texas College, an institution regionally accredited by the Southern Association of College and Schools. Students selected the courses based on personal needs and placement tests typical of those used at a community or junior college. Course descriptions, as provided in the Navy College Pace Guide and Catalog (catalog), are found in Appendix A. Each course lasted eight weeks and students met for class instruction for a minimum of forty-eight hours per three credit-hour course. Classes were scheduled three times a week for two-hour-long

sessions without break. This schedule was enacted to ensure that the forty-eight contact hours required by the college were completed.

Physical Activities

Physical activities were conducted using techniques and procedures listed in the Navy Field Manual. Summaries of the activities are provided in Appendix B. The stretches named indicate the terms used in class for the stretches. Procedures indicate the action of the movement used.

Design and Procedures

Each study was investigated based upon the Pre-test and post-test math performance as a function of exposure to exercise. This was accomplished by using a 2 (Exercise, No Exercise) x 2 (Pretest, Posttest) analysis of variance (ANOVA) with repeated measures on the last factor. Students chose one of two sections of courses that were taught by the researcher. One section was randomly selected to be the experimental (Exercise) group and another section of the course taught on another day was selected to be the control (No Exercise) group. Class instruction had minimal variation between the two groups. The lecture, style of delivery, and explanations were based on identical examples from the daily lesson plan. Differences occurred only when a student would ask a specific question that was not asked in the other class; therefore, extra emphasis or a variation in explanation may have occurred in response to particular questions.

Tutoring events can be defined as a window of time where the instructor opened the classroom for students to study and if needed seek the instructor for guidance on a problem or topic matter. Students were encouraged to use their class resources, i.e. notes, textbook, classmates before they approached the instructor. Tutoring events were open on a daily basis so long as it fit the operational status of the ship. Due to work demands and schedule conflicts, many students used other locations and sources of assistance to complete their homework and study for exams.

Study A

Participants

This study consisted of 30 students on a ship during a six month deployment. There were two sections for the experimental group (n=13) and two sections for the control group (n=17). It should be noted that the rank is ordinal data. E designating enlisted service members and O designating officers. E-1 would be the most junior enlisted rank and E-9 is the most senior enlisted rank in the military, officer ranks begin at O-1 and increase as well.

For the first experimental class there were ten students, 1 Black female, 1 White female, 5 White males, 1 Hispanic female, 1 Hispanic male, and 1 Islander female. The rank distribution for this course was 1-E2, 3-E3, 2-E4, 1-E5,1-R6, 1-E7, 1-E8. For the second experimental class there were six students, 1 Black female, 4 White males, and 1 Hispanic male. The class rank distribution is 2-E3, 3-E4, 1-E7.

For the first control class there were eleven students, 1 Black male, 2 White females, 7 White males, and 1 Hispanic female. The rank distribution is 2-E3, 5-E4, 2-E5, 2-E6. The second control class had seven students, 3 White females, 3 White males, and 1 Hispanic male. Rank distribution for this class was 1-E2, 3-E3, 1-E4, 1-E5, 1-E8.

Exercise Treatment

The experimental group began class with a random student chosen to lead the class through stretching. Stretching would take approximately 5-10 minutes of the 120 minute class. After students entered the classroom and before beginning the daily lesson, a student was chosen to lead the class through a series of stretches. The stretch leader would stand at the front of the class and lead a series of stretches based upon their preference. The stretching exercises were based on stretches conducted through Navy physical training, usually with some personal touch added by the student. The instructor participated with the class in the stretches. Following this, the daily lesson began. The control group did not stretch at all, and were allotted the full time for instruction, namely starting class immediately, as opposed to going through stretches. Meditative breathing was not implemented for either group.

Instrumentation

For data collection, a study log was to record the number of times they attended a tutoring event, a pre-test and post-test to determine improvement of math knowledge and skills, and post-interviews to determine participants' thoughts about the class and methods used.

Instructional Treatment

The course of study was DSMA 0307 Intermediate Algebra for each of the groups. In this study, students received the same instruction and examples with the exception of information that would be presented to a class due to a particular question from a student. Teams of students were formed for both the control and experimental groups so that one student from each team could be at the board working alone, giving teammates at in their desks the ability to work in a pair or team. In order to form teams, team captains were randomly chosen by the instructor. A game of chance was played to determine the draft order and all students were drafted. Specifically, team one had first choice in the first round, second choice in the second round, third in the third round, and so forth. Before each review session, which occurred once a week, students chose new teams. Additionally, in reverse order of the draft, captains were able to choose the area of the room that their team would occupy during review sessions. Classes were divided as evenly where one experimental class had two teams of five and the other two teams of three.

During the course of the week, students got into their teams for what was called "the review game." The game was always held during the class period before a test, typically the second class period of the week, and these review games would make use of the duration of the class. On weeks without a test, the review game was held the third class of the week; nevertheless, there were some occasions when the review game was held more than once a week. Playing the review game on a lecture day may have lasted

fifteen minutes to an hour, depending on how long the lesson might take. Each team member would send another member of the team to one of the boards in the room designated for them. A problem, based on previous lessons, was given to the team to be solved. Problems were normally chosen by the instructor; they may have been taken from even-numbered problems in the textbook (to prevent students from getting answer in the back of the book, as odd numbered problems had the answers in the solution index) – or the instructor simply created a problem. There were also occasions when team members would choose an even problem from the textbook for an opposing team and, in some instances, create their own problem for that team. Students at the board worked the problem to the best of their ability. At the same time, the team would work the exact problem; however, they were able to work together, using notes and textbooks to solve the problem. At no time would the team interact with its representative at the board. However, during the process, the team could call for a "life line" if they believed their representative was making a mistake, or the representative could call for a life line if he or she felt the need for assistance. During a life line, another team representative would go to the team's board and discuss the problem with the designated student solver. This interaction gave the initial representative time to see what the team had come up with and decide on a correct procedure and final answer for the team. Review games were conducted in the same manner each week with the exception one non-test taking week where the instructor did not feel well enough to participate in the physical activities, so the review session was help without physical activity or points.

Occasionally, wagers made between students and the teacher would increase the physical activity or point value for a particular problem.

For the experimental group, physical activity was a source of reward or sanction. If the problem was correct and no life line was used, then no physical activity was asked of the team. If the answer was incorrect, however, the team would do ten pushups or another physical activity. Five pushups (or other physical activity) were executed for every life line the team used. The physical activities were not mandatory, and participation was at the discretion of the student, yet full participation was normal. In the rare case of illness or physical restrictions, the instructor did prohibit the student from participation. Again, the instructor participated in all physical activity whenever any student participated.

For the control group, a correct answer would result in two points for their team; an incorrect answer would result in one negative point, and each life line used would subtract one point from the team score. At the end of the session, the team with the most points would be the day's winning team.

Study B

After Study A was completed, Study B was conducted on the same class of ship during a similar type of deployment.

Participants

This study consisted of 50 participants enrolled in two sections of a developmental mathematics course, DSMA 0307 Intermediate Algebra, or a college

algebra course, MATH 1314. One section of each course was chosen at random as the experimental group (n=21) and the other section was the control group (n=29). As with Study A, rank is ordinal data. E designating enlisted service members and O designating officers. E-1 would be the most junior enlisted rank and E-9 is the most senior enlisted rank in the military, officer ranks begin at O-1 and increase as well.

Within the experimental students for the DSMA 0307 Intermediate Algebra course, there were 2 Black females, 3 Black males, 1 White female, 4 White males, 1 Hispanic female, and 1 Hispanic male. The rank distribution in this class is 1-E2, 4- E3, 3-E4, 2-E5, and 2-E6. The experimental group for the MATH 1314 College Algebra course consisted of nine students, 1 Black male, 1 White female, 2 White males, 1 Hispanic female, 1 Asian female, 2 Asian male, and 1 Islander male. Rank distribution for this class was 1-E2, 3-E4, 3-E5, 1-E6, and 1-O2.

The control group for the DSMA 0307 Intermediate Algebra included 6 students: 2 Black females, 1 Black male, 1 White male, 1 Hispanic female, and 1 Asian male. The ranks distribution for this class was 2-E3, 1-E4, and 2-E5. The control group for MATH 1314 College Algebra consisted of 23 students: 5 Black females, 3 Black males, 3 White females, 3 White males, 4 Hispanic females, 2 Hispanic males, 2 Asian females, and 1 Asian male. Rank distribution for this class was 2-E2, 7-E3, 6-E4, 6-E5, and 2-E6

Design

In this study students received the same instruction and examples with the exception of information that would be presented to a class due to a particular question

from a student. Stretching occurred in the same manner as Study A with the exception that both control and intervention groups did stretching exercises. Meditative breathing was also introduced to both groups before a test. On a test day, after stretching, students would sit in their chairs with a straight but relaxed posture, hands palm down and flat on the table. They were instructed to close their eyes, clear their minds and breathe deeply, concentrating on breathing and the number of breaths that they took. They were told to maximize their air intake, envisioning the air pathway as they inhaled through their noses and exhaled through their mouths. The breathing, timed by the instructor lasted for one minute, and students were challenged to take as few controlled breaths as possible while maintaining extended inhale or exhale status; they were not to hold their breaths at all. Again, the instructor performed the exercise with the students, and from demonstrating the ability to do it in one or two breaths, provided the students a goal. Following stretching and breathing, the test was administered. events were open on a daily basis so long as it fit the operational status of the ship.

Instrumentation

For data collection, a study log was to record the number of times they attended a tutoring event, a pre-test and post-test to determine improvement of math knowledge and skills, and post-interviews to determine participants' thoughts about the class and methods used.

Instructional Treatment

As in Study A, review games were conducted in the same manner each week. Unlike Study A, teams chosen would remain together for the duration of the course. In the experimental DSMA 0307 Intermediate Algebra group, there were four teams (three teams of three students and one team of four students). The experimental MATH 1314 College Algebra class was formed into three teams of three students. The control DSMA 0307 Intermediate Algebra class was split in half (two of three), while the control MATH 1314 College Algebra had six teams (five of four each and one of three).

Problems were chosen in the same manner as Study A as well as the physical activity guidelines. Complete class participation occurred for each week with the exception of the rare occasion that a student was directed by the instructor to not participate due to illness.

The control groups conducted their review game problems for points in the same way as Study A. They also kept the same teams each time they played a review game in the same manner as their counterparts.

CHAPTER IV

RESULTS

The results of each of the studies are presented in this chapter. The first section presents the results of Study A in which participants in the exercise group stretched before class and participated in physical activity when their team made a mistake on the review game, while the control group did not stretch before class and was awarded points for correct answers during their review game. Teams for this study were chosen new for each review game. The second section provides the results of Study B, where the review game was given the same results for correct or incorrect answers, though the teams for each group would be permanent and both groups participating in stretching and meditative breathing before a test.

Results of Study A

Pre-test and Post-test Math Performance as a Function of Exposure to Exercise

The mean proportion of correct math scores for the pre-test and post-test as a function of exercise condition are presented in Figure 1. The two (Exercise, No Exercise) x two (Pretest, Posttest) analysis of variance (ANOVA) with repeated measures on the last factor revealed significant main effects for Exercise, $F(1, 28) = 8.80$, $p<.01$, and Test, $F(1, 28) = 559.86$, $p<.01$. The mean proportion correct for math scores was greater for individuals who did not exercise ($M = 0.50$, $SEM = 0.05$) compared to the individuals who were exposed to exercise ($M = 0.40$, $SEM = 0.06$). As

expected, the mean math score for the posttest (M = 0.75, SEM = 0.03) was greater than the mean math score for the pretest (M = 0.17, SEM = 0.02). The Exercise x Test interaction, F(1,28) = 0.88, p = .36, failed to reach significance.

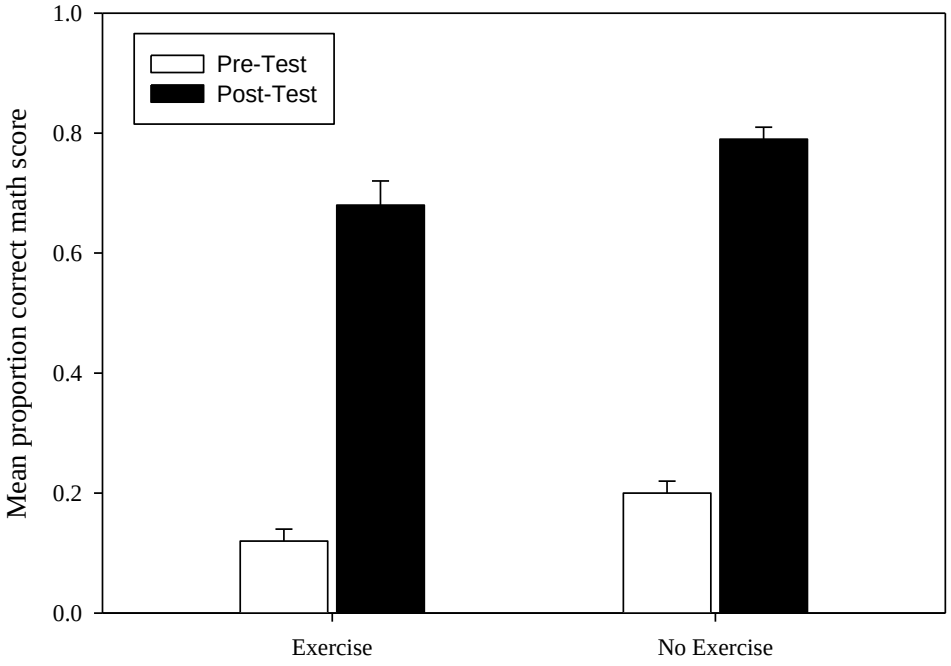

Figure 1. Mean proportion correct math scores for the pre- and post-tests as a function of exercise condition in Study A. Error bars are standard errors.

Tutoring Events as a Function of Exposure to Exercise

The mean number of tutoring opportunities as a function of exercise condition are presented in Figure 2. A significant t-test, t(27) = -2.71, p <.05, indicated that the

individuals exposed to exercise (M = 2.46, SEM = 0.27) had a greater average number of tutoring opportunities than the individuals that did not exercise (M = 0.63, SEM = 0.27).

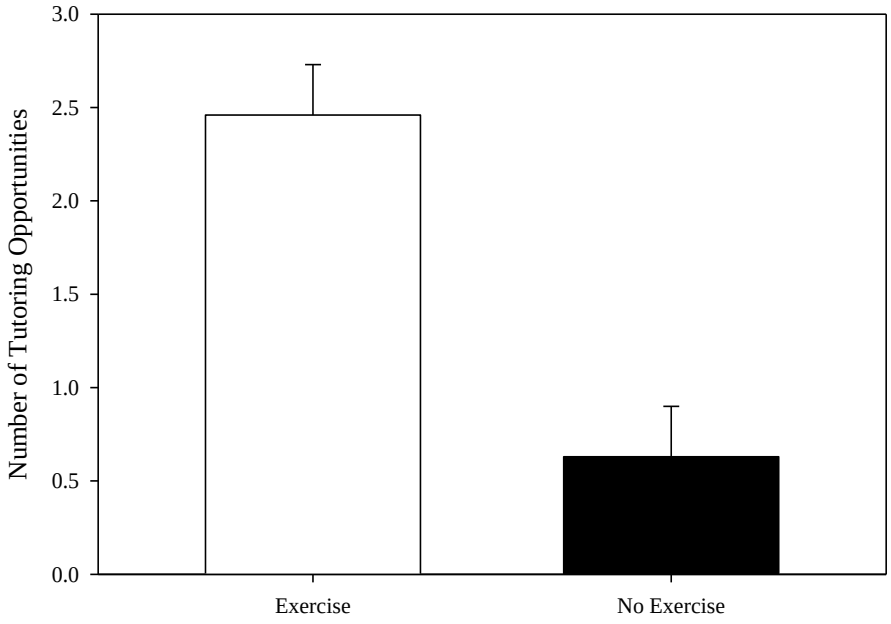

Figure 2. Mean number of tutoring opportunities entertained by individuals assigned to the exercise and no exercise conditions in Study A. Error bars are standard errors.

Results of Study B

Pre-test and Post-test Math Performance as a Function of Exposure to Exercise

The mean proportion correct math scores for the pre-test and post-test as a function of exercise condition are presented in Figure 3. The 2 (Exercise, No Exercise) x 2 (Pretest, Posttest) ANOVA with repeated measures on the last factor revealed significant main effects for Exercise, $F(1, 48) = 8.12$, $p<.01$, and Test, $F(1, 28) = 793.14$,

$p<.01$. The mean proportion correct math scores was greater for individuals who experienced exercise ($M = 0.43$, $SEM = 0.06$) compared to the individuals who did not exercise ($M = 0.34$, $SEM = 0.04$). As expected, mean math score for the post test ($M = 0.68$, $SEM = 0.03$) was greater than the mean proportion of correct math scores for the pre-test ($M = 0.07$, $SEM = 0.01$).

There was a significant Exercise x Test interaction, $F(1,48) = 10.14$, $p < .01$. Subsequent simple main effects analyses indicated that for the pre-test, $F(1,48) = 0.56$, $p= 0.46$, individuals assigned to the No Exercise group ($M = 0.07$, $SEM = 0.02$) and Exercise ($M= 0.08$, $SEM = 0.02$) conditions did not differ reliably. However, for post-test performance, $F(1,48) = 10.93$, $p<.01$, the performance of the individuals that experienced exercise ($M = 0.77$, $SEM = 0.03$) was significantly greater than that observed for the individuals in the no exercise condition ($M = 0.61$, $SEM = 0.03$). Moreover, for the individuals in both the no-exercise condition $F(1,20) = 187.79$, $p<.01$, and exercise condition $F(1,20) = 304.19$, $p<.01$, performance at the post test was significantly greater than that observed during the pre-test.

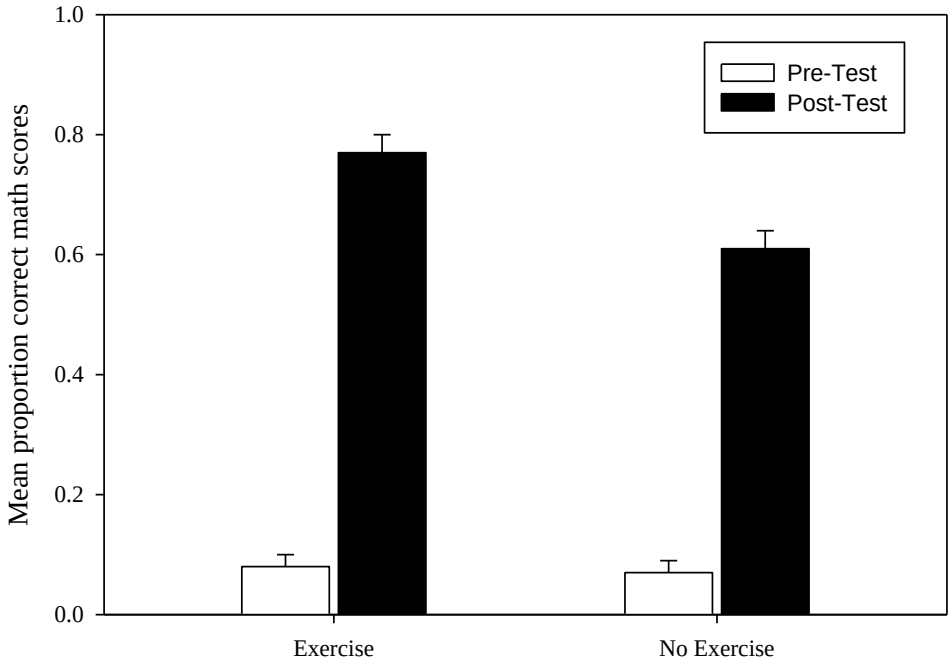

Figure 3. Mean proportion correct math scores for the pre- and post-tests as a function of exercise condition in Study B. Error bars are standard errors.

Tutoring Events as a Function of Exposure to Exercise

The mean number of tutoring opportunities as a function of exercise condition that are presented in Figure 4. A significant t-test, $t(48) = -2.561$, $p < .05$, indicated that the individuals exposed to exercise ($M = 3.48$, $SEM = 0.73$) had a greater average number of tutoring opportunities than the individuals that did not exercise ($M = 1.48$, $SEM = 0.41$).

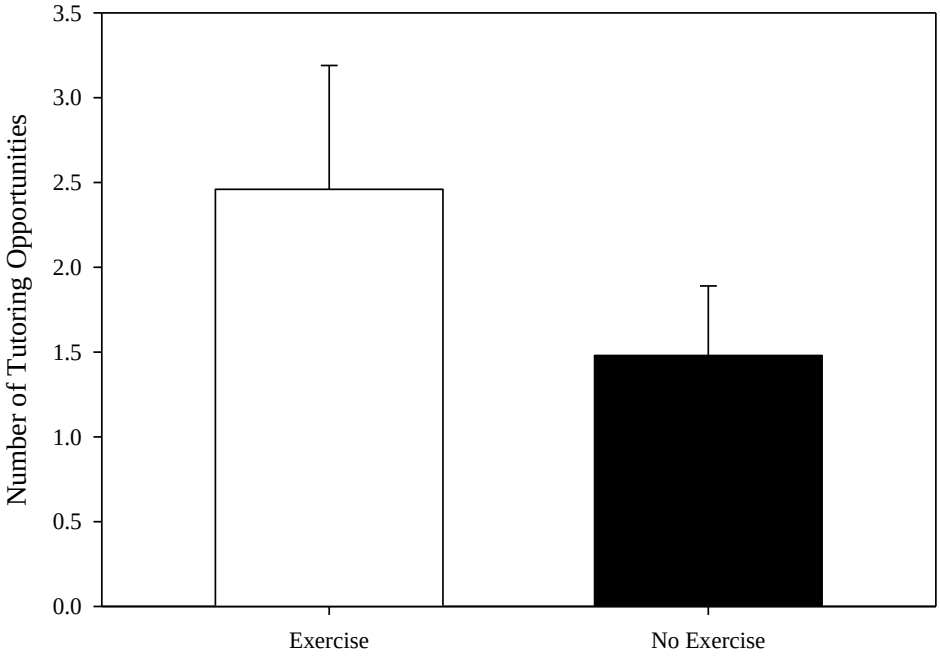

Figure 4. Mean number of tutoring opportunities entertained by individuals assigned to the exercise and no exercise conditions in Study B. Error bars are standard errors.

CHAPTER V

DISCUSSION AND CONCLUSION

Discussion of Study A

While the results of Study A lacked significant statistical results, there was evidence from student interviews to continue the study with minor alterations. Furthermore, the initial examination of the class make-up presented an unbalanced level of math competency based upon job fields. Plainly, the Navy allows applicants to choose fields of work based upon the needs of the Navy and the applicants' scores on the Armed Services Vocational Aptitude Battery (ASVAB). Technical positions such as those in nuclear, electronics, and mechanical fields not only require higher scores in mathematics, but often spend considerable amounts of time teaching mathematics to sailors while providing opportunities for mathematical applications within their job areas. Some algebraic concepts within the college curriculum would have been covered in these technical schools and in some cases provide college credits in mathematics. Within the first experiment there was a distinct imbalance of non-technical rates that required relatively lower scores in the math portions of the ASVAB within the experimental group, and proportionately more sailors with technical training in jobs that require higher math scores on the ASVAB.

This imbalance was highlighted by the pretest scores, where the mean average of the control group (group with more technical trained sailors) scored higher on the

pretest. In many cases of the control group, students would be receiving a course that would act in part as a review, while this could not be said about the experimental group, who had few technical fields. Realizing the imbalance of math related fields a second experiment was planned in the hopes of finding groups that would better reflect each other. However, the disproportion of math related fields and the initial testing did not discourage the continuation of the research. Yet the combination of the pretest scores and the balance of technical and non-technical jobs did warrant the need for another experiment with groups similar in scores and job fields. Furthermore, interview data revealed that the non-exercise group viewed the course as "a refresher" which gave them a confidence that they would have an advantage in being successful in the course.

The study did reveal interesting results for possible implications to improve scores for students, promote a desire to study, and increase physical fitness levels for individuals. Though there did not exist a significant difference in post-test scores, there is the issue that if a single outlier of the experimental group was removed who had a pretest score of 10 and post-test score of 25 (which was dismal compared to every other score change), then experimental group closed the gap of mean difference of 5 points to the control group, which was populated students who had a better history with mathematics. This concept rings true in the spirit of various initiatives such as No Child Left Behind, to promote math achievement within a group that traditionally performs lower. Furthermore, the data does show that students who participated in the exercise group had a greater attendance rate than the non-exercise group with regards to tutoring,

which could indicate an increased motivational factor. Finally, consistent exercise does have a positive effect on healthy adults and in this case supplemented conditioning programs implemented on the ship.

Interview data revealed that students in the exercise class felt a greater sense of engagement and enjoyment in the course than the course without the exercise. Furthermore, students in the exercise class encouraged each other to attend tutoring so that they would be able to work together. While students in the non-exercise group were not organizing themselves to come in together as a group to learn, this would account for some of the differences in tutoring events. Furthermore, students in the exercise group reported greater sense of awareness of their classmates that extended outside of class, which led them to discuss math problems in areas outside of class. While students in the both groups felt it important to study for themselves, the exercise group also indicated the need to study so that they would not let their team down. Students also felt a sense of competition that motivated them to study more. The effects of exercise can reach through age groups, as Buchanan (1996) who found that youth sports foster caring, respect, responsibility, justice, and competition. These are some of the same qualities that allowed students to take responsibility to study for the good of the team and the feel of competition that fueled their desire to learn. Students in the exercise group also reported a reduction in math anxiety. Student responses concerning anxiety were not a surprise as reducing anxiety through exercise has been found practical for a various populations. Carraro and Gobbi (2012) found that exercise reduced stress in adults with

intellectual disabilities. Thus, there may be application using exercise to teach students within special needs. Making teaching with exercise a possible implementation for various curricula.

Discussion of Study B

Unlike Study A, this study produced comparable pre-test results as well as similar make up in job fields. Results for the second study showed significance in testing and like the first study also showed that students who participated in the exercise group also attended more tutoring opportunities. Plainly, not only was there a significant gain in the post-test, but a higher indication of motivation through tutoring sessions. The results of the data are consistent with findings that students who are more active are generally able to achieve higher scores. This experiment failed to collect any physiological data, which prohibits the analysis to determine exactly what types of changes to the students' body may have occurred. Several students did remark that the exercise in class was an avenue to ensure they maintained physical fitness levels.

As in the first study, responses concerning stretching were unanimously positive. Overall, students described it as a way to separate stress from the working environment and create an opportunity to revitalize or act as a means to wake up students who may be tired or coming to class strait from their sleep time. Stretching also provided a type of ritual to allow students to change their mindset from a professional state to a student state. Remarks also compared student experiences in organized team sport stretching to classroom stretching, giving the classroom a team environment. Some students also

described the stretching as a way to help them resolve issues with mathematics anxiety, allowing them to focus on learning. The breathing was also overall a positive, as a means to relieve pretest anxiety, claiming that it helped them perform better on tests. Though one student did remark that he felt the breathing was just delaying his opportunity to begin his test, this student does not suffer from math test anxiety and regards mathematics as his favorite subject. The implementation of the stretching before class and stretching and meditative breathing before a test gave the students a sense of focus and made them more alert and as one student said, "it was relaxing physically and mentally."

While some students came alone to tutoring events, it was common for students to come in their group. In fact, while Christmas was a holiday routine on the ship, there were a couple of groups who requested that tutoring be opened so that they could use the holiday to work together.

McInerney, McInerney, & Herbert (1997) found that cooperative learning has shown significant results for computing competencies in areas such as self-concept, achievement on tests, and control-mastery. For this study, cooperative learning was reported to have a positive impact, particularly with students who were in the course with the pushups. Students felt that the class with the pushups had complete student participation while students experiencing the course without pushups felt that despite having a group they felt alone at times and often lacked a cohesive atmosphere within their group. Additionally, camaraderie was reported to be very high within groups of the

pushup class, students maintained relationships outside of the classroom and met within structured tutoring sessions or informal meeting throughout the ship. "If you are up there, you have the backing of your team, so if we did not get the problem right then it was all of us, not just one person." While the camaraderie within the course without pushups had responses that were less favorable and at times viewed as frustrating in some respects.

Burguillo (2010) found that the use of game theory coupled with friendly competition creates motivation in students that helps to increase student performance. Factors that may have contributed to the tutoring difference may have been team competition and participation by the instructor. While the competition brought out by the point class was trivial, the pushup class thrived upon it. While students generally were willing to help anyone before class and outside of class, during competition some students confessed that they hoped the other groups would get the problem wrong so that they would have to push. The pushups drove the competition to receive tangible rewards, watching other teams do pushups when their team did not have to do pushups "felt great, I was like I won the world series or something like that, and my group was just sitting there talking crap the whole time and it felt good." Students came up with team names, laid claim to areas of the classroom and their board that they would work problems on while away from their group. "The competition drove us to want to complete the problem, and challenge ourselves to ask more questions as on how to do it. It was fun overall." The competition also promoted growth, as students who were once

reclusive began to emerge with confidence and in some occasions become leaders in the class, in one students case her transformation from a reclusive nature who emerged as a leader within the class, teaching others, she explains that it was from "a lot of tutoring and a lot of pushing, and a personal desire to be better."

Leadership can have a profound effect on a group. Personal example from a leader can promote the same type of contributions from a group, though this leader must be deemed worthy of leadership status by the group through being an admirable role model. (Yaffe & Kark, 2011). In order for class participation to continue it was critical that the instructor participated with pushups, thereby leading by example, "you cannot ask someone to do something if you are not willing to do it." . This allowed students to not feel embarrassed about doing them, "it motivated everyone else to do it with you so that we did not feel silly." Students did not feel like a punishment or negative influence, they were viewed as a motivational factor because of his participation, they felt as their instructor was in the same boat as they were and that he was "a deck plate worker." This promoted an atmosphere of camaraderie that the students felt for their instructor, "it was teamwork, effort and it's like everyone going in doing what they go to do so we can learn." The responses also showed that the students recognized that the instructor always did the most pushups because he pushed anytime any team did pushups, which acted as a motivational factor to complete the pushups but also demonstrate that the instructor was " enthusiastic about us learning, but uh it build that respect factor as well. Because we knew that no matter what you were willing to get down there with us and

even though we might now be able to do the problem, whatever, but you're willing to go the extra mile with us no matter what."

While the initial thought of exercise can seem negative attitudes towards exercise are often positive. Ruby, Dunn, Perrino, Gillis & Viel (2011) found that people often underestimate how much they will enjoy exercise. While the initial reaction to doing pushups was met with some apprehension from some students, they felt positive about it. Pushups did not feel negative, they were "a push in the right direction" to avoid mistakes. It also promoted a group mindset while making learning interesting. They also were used to keep student attention "it kept me awake and kept me going, it was all good."

One student who described himself as one who dislikes group work, nevertheless enjoyed the group environment because of the pushups. He liked the pushups because "it made you held accountable for what you knew." He liked that the group had to do the pushups together because "if you knew something and your group didn't know something then you should be just as guilty as they are." Both pushups and points helped students to remember their own mistakes, the pushup class also had students watching the work of other groups to ensure that they did not make mistakes. Students claimed that doing the pushups reinforced the thoughts of not making the same mistake on a test, yet the pushups was what ignited the challenge between their group which made it positive reinforcement, the pushups were a point of focus to make sure they got the problem right.

The point system also provided a sense of competition, but because the points were awarded and had no tangible meaning (bonus points were mentioned) they were unable to seize the attention of the entire class. Every student interviewed stated that given the choice of taking a class with the same type of circumstances, they would take the course with pushups rather than a "meaningless point." While the pushups as one student described "I think it gave people more drive to get more focused and get the problem right, it was more of a team builder." The pushups gave the student as sense of commitment to his team to take steps (studying) to ensure that he was not the reason they were doing pushups, the pushups inspired them to work together and ensure that they were productive. Students felt that the pushups gave a reason to pay attention and learn, to not focus on just getting through a problem, but being able to "kick everyone else's butt."

Students did feel that doing pushups was a benefit for many sailors who do not make the time to regularly workout while at sea. Some sailors mentioned that they personally struggle with pushups and that the class helped them prepare for their PRT and the stretching also helped out, as stretching is also an area that is often neglected despite regularly working out. However, there were some occasions that group teams would do pushups with other teams voluntarily as a show of support. Darlow and Xu (2011) found that close relationships can influence exercise habits through social support. Sailors felt that they were supporting each other and preparing for the PRT.

Though, it is cautioned that sailors should not rely on classroom pushups as their source of maintaining Navy standards of physical readiness.

This study provides evidence that the implementation of physical activity promotes achievement. In the case of the Navy, this could enable sailors to become eligible for positions that are critical ratings due to high value and low numbers. It may also be an avenue to ensure a greater depth of fundamental mathematics for school age children so that colleges would not have to offer so many remedial courses. Additionally, exercise in the classroom may also help struggling school districts maintain some type of physical fitness program for their schools while budgets force them to limit or close physical education programs. While providing academic benefits, students are also reaping the rewards of a healthier body, which has become a significant problem in both adults and children, who are facing health risks based upon inactive lifestyles. Not only is a healthy lifestyle preventative maintenance for many diseases, it also moderates mood and self-esteem. Implementing exercise may free up resources for medical treatment, but improve the overall quality of life of a person.

Summary

Can physical activity combined with stretching and meditative breathing promote an environment in which participants can learn mathematics and display both achievement and motivation? While the relationship in test scores was not consistent between the two studies, there does exist evidence that this study merits further investigation into the effects of physical activity within a mathematics classroom. In

Study A, students who traditionally should not have scored as well as other students were able to score almost as well as students who are targeted as students with math aptitude. For this reason alone, there exists a rationale to begin further testing on the potential of this teaching strategy. In Study B, where student groups were better reflective upon each other there did exist a significant difference in test scores, where the exercise group outperformed the non-exercise group. In regards of motivation, students in the exercise class did show a greater desire to attend tutoring sessions; which may be interpreted as a demonstration of a motivation for achievement and an indication of a sense of teamwork within the class.

The idea of exercise being used as a means to bring teams together is nothing new in any team based sport. Football coaches, for example have been using exercise as a means to bond individuals together to forge a team. Any sports fan can recall various teams in various sports who were stacked with individual talent, yet were defeated by lesser talented opponents who "played as a team." As with a mathematics test score, only one person will be credited with scoring a goal, basket, or a touchdown; yet, the acts that led to that score whether they be points on an exam or points on the scoreboard can very often be dependent of the efforts of others. There is a clear indication that the exercise brought individual students together as a team and they performed in a manner that was not only reflective of them taking responsibility for themselves, but taking responsibility for each other. While this study does not take into account exact physiological conditions of individuals nor mathematical history/aptitude it does provide

a starting point to investigate the relationship between the physical, social, and psychological effects of implementing exercise within a mathematics course to promote learning and achievement. In the case of the Navy, it also shows evidence in promoting their physical readiness standards as well as promoting a sense of camaraderie within a crew, both of which is a vital part to any sea going command.

What are participants' attitudes about using physical activity, stretching and meditative breathing within their mathematics coursework? Students in the exercise group also expressed their appreciation in having a mathematics course in an environment that they thought was fun and had a sense of risk in it to keep them current with studying. Students expressed that stretching gave them an opportunity to relieve themselves from a military environment and gave them the tools to put themselves in the mindset to learn mathematics. The meditative breathing gave many of them the focus and relaxation to rid themselves of mathematics test anxiety and perform to the best of their abilities.

In a later trigonometry class that was taught under the same conditions (but not part of any study), one student asked if the course would be a push-up class, after the affirmative response was given she declared that it meant she would have to study throughout the course instead of simply cramming for exams. During that course the same student brought her mother onboard as part of a tour, and wanted her mother to experience math class and was given the option to bring her mother under the condition that exercise will only take place if her mother wanted to participate, and if not then the

class would simply conduct as usual but without the exercise. When they both arrived to class the student conveyed that her mother would be participating and that the class would be conducted as usual. She and her mother were on the same team, though the mother was not asked to do problems on the board on her own, she certainly worked with the group to find answers and exercised when a mistake warranted it. Though the most important aspect of that experience was that mother and daughter had fun together in math class, and enjoyment is such a motivation for a desire to learn, and it is learning that leads to success.

In order to maintain an exercising classroom that builds unity and enjoyment it must first come from the instructor. The same woman who brought her mother introduced her instructor as "their fearless leader" not as her math teacher. This introduction stresses that she saw her instructor as more than a guy who simply went over math problems. Students in both experiments maintained that the instructor participation made them feel as though their grasp of the material was something of a personal motivation and success. The exercise could have been viewed as degrading or hazing and met with rebellion had it not been for instructor participation. Furthermore, the desire of the instructor to maintain a leading presence promoted a lifestyle change that resulted in the loss of approximately fifty pounds and returned him to a physical condition that would let him step back on a football field for another game. Not only did the exercise provide students with motivation to learn, but it provided the instructor with motivation to live.

The research findings not only show the possibility to use this teaching method to sailors at sea in a mathematics class, but to extend into other areas and populations. Exercise within a style of instruction has the ability to reach not only other service members but athletes in school systems as well as active students, particularly those in the elementary schools. This method, if started at the elementary level may not only boost scores but help combat the sedentary lifestyle that has become a plague of our society. And the implications of instilling healthy lifestyles into children are boundless, they would range from easing the medical community of the burden of many preventative conditions (children diabetes), to supporting a lifestyle for individuals to maintain cognitive functions as they become senior citizens. The research presented has provided evidence for the old saying "strong mind, strong body".

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APPENDIX A

Course Descriptions

DSMA 0307 Intermediate Algebra 3.0 credits

Intermediate Algebra requires an understanding of the topics taught in DSMA 0306 Introductory Algebra . This course teaches such topics as operations with rational expressions, exponential and logarithmic equations, systems of linear equations, radical expressions, complex numbers, quadratics and functions. Successful completion of this course fulfills the prerequisites for college-level mathematics courses.

Prerequisite: DSMA 0306 Introductory Algebra with a grade of "C" or above or appropriate test scores.

Textbook: DSMA0307 – ISBN 055844489X

MATH 1314 College Algebra 3.0 credits

A study of relations and functions, polynomial functions and equations of a degree higher than two, exponential and logarithmic functions and equations, matrices, and determinants, sequences and series, binomial theorem, and mathematical induction. This course meets the college core

requirement and is recommended for students planning to transfer to bachelor's degree programs.

Prerequisite: DSMA 0307 Intermediate Algebra or equivalent with grade of "C" or higher or acceptable placement test scores.

Textbook: MATH1314 – ISBN 0558508952

APPENDIX B

Sample questions that came up through interview process

Describe a regular day of class and your thoughts concerning it.

Describe a review day and your thoughts concerning the game.

Describe your thoughts from the night before the test, through getting to class to completing the test.

How would you describe the physical activity, breathing, and stretching?

Did instructor participation in physical activity have any effect on the class?

You started off in a reclusive role, then became a class leader on the boards, what was the transition and how did it feel?

What was the camaraderie like in and out of class?

Do you think the physical activity, stretching, and breathing could be used in other courses?

How did you feel when your team got the answer wrong because of you, and how you felt when someone else on your team got the answer wrong?

What was the feeling that you had for other teams?

Did the exercise help prepare you for the PRT?

What is your feeling towards the class and to mathematics?

APPENDIX C

Stretches, procedures, and pictured demonstrations

Stretch name	Procedure used in class	Pictures
Upper Back Stretch	Stretch one arm across torso and with other arm grasp arm in elbow/tricep area and pull arm into chest for a ten count, then stretch the other arm in same manner	
Triceps Stretch	With one arm reach for the opposite shoulder blade, with the other arm place hand on the reached elbow/tricep area and pull arm towards shoulder blade for ten seconds. Perform this action for the opposite	

	arm	
Chest & Biceps Stretch	Stretch arm outward parallel to torso, use hand to anchor arm and then rotate torso forward for ten seconds. Perform this action for the opposite arm	
Quadriceps Stretch	While standing, bend one leg at the knee and grab it at the ankle with the same side arm, pull ankle into buttocks and hold the position for ten seconds. Repeat procedure for other leg.	

Calf Stretch	Spread legs with one leg forward and heels flat on the floor. Lean forward with hips, a wall may be used to assist balance. Hold this position for ten seconds. Repeat procedures for other leg	
Right over left	Cross right foot over the left foot keeping the feet close together, bend forward extending hands to reach towards feet. Hold this position for ten seconds. Repeat procedures for other leg.	

Toe touch, feet together	Place feet together, bend at waist with arms extended reaching for feet. Hold position for ten seconds.	
Toe touch, feet apart	Spread legs apart and reach with both hands to each leg for ten seconds. Then bend forward at hips and reach for the floor for ten seconds.	
Trunk twist	Lift arms should high and twist torso fully to the right then the left. Complete this motion ten times	

Overhead reach	Place feet shoulder width apart extend arms strait up while giving slight bend to torso. Hold this position for ten seconds.	
Arm Circles	Arms fully extended parallel to the chest, rotate arms forward in a three inch diameter circles for fifteen complete rotations. Then do the same movement with a backwards rotation. Next rotate arms forward with an 18 inch diameter circular motion for fifteen rotations and finally do the same procedure with a backwards rotation