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The purpose of this study was to determine the extent to which a flipped classroom of online programming in physical education would increase classroom moderate to vigorous physical activity (MVPA). In addition, this project sought student perceptions toward physical education from the flipped classroom approach.

Other disciplines are currently utilizing a variety of instructional designs and methods such as the flipped classroom for improved academic performance and motivation. Physical education, however, has the added responsibility of meeting both academic and physical activity performance standards.

Physical activity (PA) levels for adolescents remain dangerously low and have been associated with health problems that track into adulthood. For many students, physical education classes may be the only time they are active, serving as a place to not only develop skills and efficacy for lifelong exercise benefits and enjoyment, but also maximize PA minutes.

The approach taken for this study included an intervention of internet programming (flipped classroom) in which MVPA minutes were statistically compared to those of traditional programming within the same subjects. It was hypothesized that by modernizing the way physical education is taught, students would spend more time being active in physical education.

The results of a 2 x 2 mixed ANOVA indicated a significant main effect between traditional and flipped approaches, $F(1,48) = 40.69$, $p < .001$, $\eta_p^2 = .46$. MVPA was significantly higher in the flipped approach (M=.426, SD=.09) than traditional (M=.329, SD=.11). Student responses on questionnaires at the end of each two-week intervention and post intervention indicated positive perceptions of flipped learning. The results indicate that leveraging screen time in PE through the flipped classroom approach may be a valuable resource in the struggle to increase physical activity of adolescents. Further study is warranted to confirm the findings.

FLIPPING THE PE CLASSROOM TO INCREASE PHYSICAL ACTIVITY

by

Jeffrey Dennis Akers

A Dissertation

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Approved by

Dr. Pam Brown
Committee Chair

DEDICATION

To family, friends, and colleagues that have supported and encouraged me throughout this journey. It has not been easy or without sacrifice, and your patience, encouragement and understanding demonstrate just how lucky I am.

For Coltney, JaiDee, and Ace who always keep me grounded and are my beacons of hope and joy in this world. I appreciate you and in some small way hope that my experience can be an example of what you can accomplish if you set goals and work hard.

To Kelly, my best friend, travel companion, and the person that makes each day better than the one before. Without you this would not have been completed. You are simply the most caring, positive, and loving person in the world and your gentle nudging has brought me to the finish line.

And finally, to Summer Renae Perry, who started me on this journey with inspiration to dream big and enjoy life to the fullest. Though your dreams were cut short there will always be a part of you in all that you inspired, and beyond.

APPROVAL PAGE

This dissertation written by Jeffrey D. Akers has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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CHAPTER I: PROJECT OVERVIEW

While most facets of education have embraced technology as a unique and valuable vehicle for learning, physical education has struggled to identify best practices for its utilization and application (Thomas & Stratton, 2006). At the same time, adolescent usage of the internet at home and school continues to rise. The effects of this increasing usage upon physical activity remain unclear, but logic dictates that students spending more time on technology likely impacts their physical activity levels. The importance of this cannot be understated, as rates of adolescent physical inactivity in the United States continue to be dangerously high (Bouchard, Blair, & Haskell, 2012; Telama, 2009, The State of Obesity, 2018). According to the Centers for Disease Control and Prevention (CDC), only one in four adolescents get the recommended amount of 60 minutes of moderate to vigorous daily physical activity, and one third are overweight or obese (CDC, 2012). Although some researchers have attempted to associate internet and technology usage with decreased physical activity patterns, other researchers are working to identify promising strategies to increase the potential of the internet to motivate and increase physical activity in the adolescent population (Legrain, Gillet, Gernigon, & Lafreniere, 2015; Passey et al., 2004). The pandemic of 2020, with various forms of hybrid and at home learning, has added to the need for proven alternatives to traditional physical education.

Unlike other disciplines, physical education faces the dual dilemma of content acquisition along with physical activity guidelines. For example, the state of Missouri has both mandates for physical activity and guidelines for physical education, with state grade level expectations for content (Missouri, 2021). The daunting task of finding ways to learn the content, utilize technology, and maintain high levels of physical activity during class have been the focus of much interest and research. Current research suggests that adolescent physical education classes spend less than half of class time in moderate to vigorous physical activity (MVPA), the recommended level by NASPE (Gill et al., 2016). Moderate physical activity can be defined as physical activity that increases rate of breathing and heart rate to within 64%-76% of maximum heart rate (Physical Activity Guidelines, 2018). Based on fitness levels, genetics, medications, and various other factors maximum heart rate and MVPA can vary per individual. MVPA, therefore, would be activities that meet or exceed the above-mentioned heart rate range.

When designing curriculum, consideration of self-efficacy constructs can enhance the potential for lasting impact, which should be included in the goals of any physical education program. According to Metzler (2005), seeking means for students to experience lasting and enjoyable effects from physical education is a common theme among learning models. In addition, persistence and greater enjoyment become possible when self-directed motivation provides the impetus for physical activity (Ryan, Williams, Patrick, & Deci, 2009; Metzler, 2005; Marcus & Forsyth, 2009). Self -directed motivation is a product of increased self-efficacy, defined as confidence in one's ability to successfully perform a behavior (Bandura, 1997).

While higher physical activity patterns have been positively associated with increased academic performance and lower body weight, lower physical activity patterns have been positively associated with numerous diseases and disorders including cancer, obesity, metabolic disorder, heart disease, and type 2 diabetes (Freedman et al., 2005; Telama, 2009; Bouchard et al., 2012). The prevalence of these diseases remains strong and affects not only mortality and morbidity rates, but also the future economy, making it an important avenue for future research (Anis et al., 2010; Tsai, Williamson & Glick, 2009). Although initial investigations have associated adolescent internet usage with decreased physical activity (Carson, Staiano, & Katzmarzyk, 2015; Herrick et al., 2012; Koezuka et al., 2006), researchers and fitness experts are now seeking ways to re-allocate student engagement with technology to increase physical activity. As the field of kinesiology seeks tools of intervention to increase physical activity among adolescents, a closer look at internet utilization through the flipped classroom approach may provide valuable information for its potential to enhance physical activity and self-efficacy for physical activity among the adolescent population.

Review of Literature

A recent approach gaining popularity across disciplines for incorporating technology into learning is the flipped classroom. Flipping the classroom is a blended learning approach that has gained much attention as a pedagogical method defined by a flexible environment, learning culture, intentional content, and supervision by a professional educator (FLN, 2019). More specifically, flipped classroom is an umbrella term for reversed class strategies that include several key elements:

- First exposure outside of class where students gain preliminary information such as videos
- Mechanisms to organize and assess student understanding such as embedded questions in videos
- Promotion of a learning community including discussions and teams
- In class activities that focus on higher level cognition
- Use of familiar technologies such as laptops, phones, and LMS
- Increased feedback for individuals and groups

In terms of Bloom's taxonomy (Anderson and Krathwohl, 2001), benefits of the flipped classroom include providing opportunity to meet lower levels of cognition such as knowledge acquisition and comprehension from home. In doing so, higher cognitive tasks such as synthesis, analysis, and problem solving can be done under the supervision of the teacher in class (FLN, 2019). Flipped learning allows students to choose the space and time where learning occurs, making it more suitable for a variety of learning styles and challenging the standard of face to face instruction. While both achievement of learning outcomes and feelings toward courses have been shown in a variety of content areas (Baepler et.al, 2014, Butt, 2014, Hung, 2015, Love et. al 2014), very little research demonstrates the usefulness of the flipped classroom in physical education.

Flipped Learning Theoretical Basis

Much of the theory behind flipping the classroom can be rooted in the constructivist theories of Dewey and Vygotsky, which explain how knowledge does not exist but is constructed (Bratitsis & Demetriadis, 2013). Flipping the classroom helps enhance learning by introducing unique social exchanges and providing a zone of proximal development whereby students are free to explore the curriculum at their own pace. This not only creates unique relationships between teachers and pupils, but also among pupils, shifting the balance of ownership away from the teacher in a positive manner (Passey et al., 2004; Zuber, 2016). Significant numbers of students working with technology become actively involved due to their familiarity and high level of confidence working with technology, becoming more excited and eager to engage in assignments (Passey et al., 2004). By using technology, the curriculum becomes more student centered, capitalizing on the ability of technology to diversify tasks and address student interests (Zuber, 2016). Flipped learning empowers students by engaging them in the learning process,

allowing them to construct their own understanding while building upon prior knowledge. This results in a greater likelihood of enhanced motivations and self-confidence (Sandholtz et al., 1997). Many social disparities highlight the need for interventions made available by the flipped classroom, which allow students access at their own discretion rather than face to face, or within facilities (Marcus & Forsyth, 2009; Hingle, Nichter, Medeiros, & Grace, 2013). Due to increases in technology usage by adolescents, the flipped classroom allows learners to personalize their instruction with less significant change in lifestyle than other interventions. According to Metzler (2005), allowing students to personalize their instruction reinforces learning. Within internet based programming such as the flipped classroom, participants can view creative and interesting learning materials, communicate with peers, self-monitor progress, experience immediate assessment and gain more individualized attention from the instructor during face-to-face class time. Other positive features include extension of instructional time, added support at home, increased interactions and collaborations, and the differentiation and self-selected pacing of content (Metzler, 2005; Zuber, 2016). The extension of instructional time occurs outside of the classroom, allowing for practical applications during class. In physical education classes it could be theorized that flipped learning can result in more time for physical activity, but little research exists at this time.

Physical Activity

As physical educators and researchers look for ways to increase physical activity of adolescents, the utilization of technology has not garnered much attention. In fact, technology usage and screen time have a long history of positive association with obesity (Carson et al., 2015; Herrick et al., 2014). Dramatic changes in technology, however, have provided significant educational opportunities such as internet research, social networking, video production, and content development. Despite these changes in technology, the amount of obesity among children has more than tripled since 1980 (Ogden et. al, 2014; State of Obesity, 2018) and has been shown to track into adulthood (Telama, 2009). In contrast, research has shown for some time that regular physical activity and physical fitness have been associated with improved physical and mental health in children and adolescents, which can reduce the risk of many chronic diseases such as type 2 diabetes, cancer, and cardiovascular disease in adulthood (Bouchard, et al., 2012; Lee, 2007). For these reasons we now have recommended guidelines

for physical activity at all ages, including 60 minutes per day of MVPA for the adolescent age group (Physical Activity Guidelines, 2021).

According to Bouchard et al. (2012), human bodies have an inherent need for exercise and can adapt to a wide range of metabolic demands, while high levels of physical inactivity are associated with common diseases and premature death. In addition to the physical benefits of activity, there is a growing body of evidence suggesting healthier students are better learners (Burkhalter & Hillman, 2011). Physical activity, therefore, can improve academic performance and lead to enhanced academic success. Basch (2011) found significant impact of physical activity on learning, specifically when physical activity was deficient, learning suffered. Burkhalter and Hillman (2011) found evidence of increased cognitive health and function associated with physical activity. Improving student physical activity, therefore, helps students become better learners, reinforcing the need to expand the body of knowledge with additional research on the critical components of physical activity.

Motivation and Self-Efficacy

Motivation is considered an important aspect of physical education for optimal learning and engagement (Chen & Ennis, 2004), which further suggests that motivation should be an important part of program engineering. Motivation results from self-efficacy when confidence in one's ability to successfully perform a behavior is high (Bandura, 1997). Considerable research indicates that self-efficacy is a good predictor of physical activity, which is why Smith and Ragan (2005) suggest that technology-based lessons can be effective tools for learning and motivation by gaining learners attention in new and different ways. Technology usage has been demonstrated to produce high situational interest among adolescent students in several research studies, including Cox, (1997), which showed regular use of technology had a positive motivational influence on student learning. Passey et al. (2004) also found that technology usage improved confidence, motivation, and self-esteem in physical education lessons.

Technology in Schools

Schools, communities, and organizations consider technology literacy and usage so important that many have incorporated their use into curriculum plans, as well as mission and vision statements. For example, the Framework for 21st Century Learning (Framework, 2016), and among the standards recommended for new teachers by SHAPE America (Guidelines, 2018). To remain relevant and prepare workers for the changing job market, many schools have

adopted curricula with heavy emphasis on technology and internet skills. The emergence of technology in physical education has even resulted in the development of online physical education guidelines by SHAPE America (Guidelines, 2018).

Physical educators incorporate internet and technologies in a variety of strategies including heart monitor tracking, pedometers, orienteering, various phone applications, assessments, internet message boards, flipped content and social media to interact with other class members and the class content. Technology has been shown to motivate students (Sandholtz, Ringstaff, & Dwyer, 1997; Passey et al., 2004), in a variety of subjects including physical education. Poor training, however, along with misconceptions and costs associated with its usage have created barriers to full scale implementation and utilization (Allison, 2009; Djalalinia et al., 2015; Kirschner & Selinger, 2003). According to the review by Thomas and Stratton (2006), time was the major barrier in using technology in PE and therefore many teachers used traditional teaching methods instead. In addition, the lack of training and dealing with technical problems consistently derailed active time in classrooms. Internet technology does, however, influence learning because the perception of autonomy satisfies basic psychological need, which in turn leads to greater self-determined motivation and contributes to the enhancement of both cognitive skills and motor performance (Thomas & Stratton, 2006).

Teacher and student usage of technology in the regular classroom is at an all-time high according to the Times Educational Supplement, with 96 percent of teachers in a recent poll saying that technology plays a significant role in their classroom (TES, 2015). Over 90 percent of students in developed countries now have access to the internet at school or home (Dobbins, Decorby, Robeson, Husson & Tirilus, 2009). Given this ubiquitous nature of technology, it is incumbent upon researchers to investigate the role of flipped classroom programming for physical activity of adolescents. Physical education teachers need evidence-based practices to support changes to modernize curriculum and strategies. This is especially important because many organizations, for example the Mayo clinic, National Library of Medicine, and American Academy of Pediatrics, have called for screen time limitations due to studies associating screen time with decreases in physical activity rates (Herrick et al., 2012). In contrast, rather than focusing on possible limitations to physical activity brought about by technology-based approaches such as the flipped classroom, researchers in fitness and education fields have begun

investigating its potential to promote motivation, persistence, enjoyment, and creativity of physical activity among adolescents (Legrain, Gillet, Gernigon, & Lafreniere, 2015).

Deficiencies in the Literature

There are some deficiencies in the literature surrounding the topic of flipped classroom in physical education. Though various technology forms used for flipping the classroom have been found to promote physical activity, such as texting (Hingle et al., 2013), heart monitors (Thomas & Stratton, 2006) and social networking (Legrain et al., 2015), other studies, such as Ludwig and Gortmaker (2004) paint a different picture by finding adolescents spend 10 times more minutes each day viewing some type of screen than being physically active, with no intervention applied. The American Academy of Pediatrics has also recommended limiting screen time to two hours per day (Herrick et.al, 2012). The problem emerging, therefore, is finding an equilibrium between technology proliferation and overall health and wellness. As such, the technologies used for flipping the classroom must be weighed against calls for reductions in screen time. Missing in the literature is a deeper understanding of evidenced-based ways to use the flipped approach for benefit in physical education for greater learning and physical activity. These benefits may include increased bouts of physical activity, learning content, peer collaboration, and developing social skills. As evidence linking sedentary behaviors with technology usage mounts, physical education curriculum needs confirmation of the benefits of the flipped approach in order to promote physical activity and health in more modern ways.

Significance of the Current Study

The current study used a flipped classroom of internet programming to extend the classroom beyond the confines of the school building, taking advantage of emerging technology trends to allow student access to the content, curriculum, and educational learning communities. The premise of the study was that by incorporating a flipped approach, screen time would be re-allocated for beneficial educational purposes, including increased self-efficacy and physical activity. Increasing self-efficacy provides greater likelihood for persistence in physical activity (Deci & Ryan, 1985), and increased physical activity improves many facets of good health such as increased fitness, lower blood pressure, improved sleep habits, obesity prevention, and reduction of chronic disease (Physical Activity Guidelines, 2018; Bouchard, Blair, & Haskell, 2012). By enabling students to become persistently physically active there is a greater chance they achieve recommended daily physical activity goals and reduce negative health

consequences. Though some physical educators have resisted full-scale implementation of strategies such as the flipped classroom due to lack of funding, training, and confidence (Kirschner & Selinger, 2003; Legrain et al., 2015; TES, 2015; Thomas & Stratton, 2006), the current study provides evidence to support further research, potentially leading to greater implementation and utilization among the adolescent population.

Statement of Purpose

Given the importance of improving adolescent health, this study investigated the influence of a flipped classroom of internet programming on self-efficacy and daily physical activity (PA) in junior high male adolescents. The specific aims were as follows:

Aim #1. **To determine the effect of the flipped classroom of internet programming in physical education on daily classroom PA of adolescent males.**

It was expected that the flipped approach of internet programming content would result in increased daily classroom physical activity in adolescent males.

Aim #2. **To determine the perceptions of a flipped classroom approach of internet programming in physical education on self-efficacy of adolescent males toward physical education and physical activity.**

It was expected that the flipped approach of internet programming would result in positive feelings toward physical education and physical activity in adolescent males.

Methods

In order to address the purpose and aims of the study daily physical activity patterns and self-efficacy of students in traditional programming were compared with those in a physical education program that was modified to capitalize on a flipped classroom of internet programming, delivery, and interactions. The design was repeated measures, with an intervention group of junior high male adolescents exposed to the intervention (flipped classroom) in physical education class for two weeks while a second group did not use flipped classroom (traditional instruction). These groups switched during a second two-week phase of the intervention for two more weeks.

Participant Information

The participants for this study were male adolescent students in two separate classes from a junior high school district in the Midwest United States. There were 50 total participants, with 26 in one period and 24 in another. As a convenience sample, all participants had the same instructor and volunteered for the study with parental consent. By using the same instructor it was anticipated that potential variabilities in teaching styles were diminished. Only male students participated because physical education courses in this district are not coeducational. All students in both classes were included, and the racial and socioeconomic status was not recorded or considered. There were no exclusions in this study. By design, even those students with no internet access at home were able to participate in the flipped classroom by accessing the course before or after school, during study hall period, lunch, or during their advisory (homeroom) period. The outside assignments were designed for small increments of time so as to be more easily completed.

Assessments and Procedures

The design was quasi-experimental with the intervention group exposed to the intervention (flipped classroom) for two weeks of the physical education class while the other class group did not use flipped classroom (traditional instruction). Participants wore polar F7 wrist watches with bluetooth link to chest band heart monitors which stored heart rate data during each class. Prior to the intervention, participants were instructed how to wear and maintain the Polar F7 wristwatch and chest band to properly collect heart rate data. Baseline data were collected for all participants. Each day participants put on their assigned watches and chest bands when they arrived to class. The watches and bands recorded continuous heart rate during each class period by a simple procedure of pushing buttons to start and stop. These devices recorded minutes of activity based on a programmed cut point. According to the CDC (2012) moderate physical activity begins within 64-76% of maximum heart rate (220-age), the Fox formula. The range is due to variation in fitness levels which were not considered as part of this study. This study utilized programmed watches that fell in the middle of this range at (70%). Therefore, watches were programmed at (220-age) X .7 beats per minute on a continuous monitor to determine minutes of MVPA. Bouchard et al. (2012), also explain moderate activity begins around 70% of the estimated max heart rate, therefore all minutes above this threshold were recorded as fitness minutes. It is important to note that other options for calculating

maximum heart rate and MVPA minutes exist, such as the Tanaka and Astrand formulas, more advanced clinical measurements, and field tests. Since the monitors and the CDC both suggest usage of the Fox formula it was chosen for this study. At the end of each class period watches were turned in to the researcher. The data collected were in the form of minutes of low physical activity (fat burning mode) and moderate to vigorous physical activity (MVPA, fitness mode), which were converted into a percentage of class time spent in MVPA.

At the end of two weeks the groups switched the type of instruction approach such that each group received flipped and traditional instruction for two weeks. The researcher downloaded the heart rate data each day and recorded it on a laptop spreadsheet for further analysis. At the end of each 2-week teaching unit and intervention period students completed an internet survey of perceptions toward the teaching unit and intervention. Questions (APPENDIX B) focused on student enjoyment, confidence in their ability to succeed, and confidence related to the unit. The two end of unit surveys and final intervention survey allowed students to compare their experiences and efficacy toward the flipped classroom approach and traditional teaching methods. These surveys intended to shed light beyond the physical activity aspect of the intervention, providing valuable insight toward sources of self-efficacy in flipped PE.

Analyses and Results

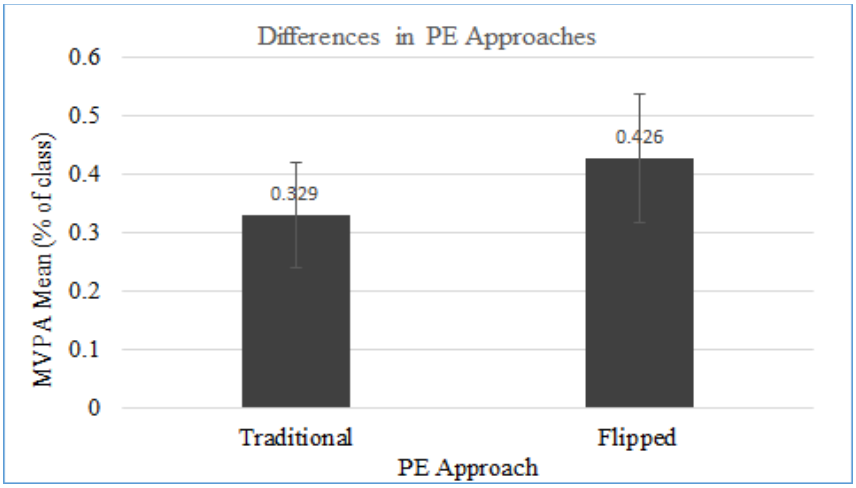
MVPA baseline (two days) was assessed before the intervention was initiated. The percentage of class spent in MVPA for participants was calculated by obtaining the mean values across the two-week period for each approach method, calculated from approximately 1,000 heart rate samples of participants. A repeated measures ANOVA was conducted using SPSS to compare MVPA percentages during the flipped classroom intervention to the traditional class.

Before computing data analyses, the data were screened to assess accuracy, missing data, outliers, and the violation of assumptions for PE approach methods (Traditional and Flipped). The data were found to be accurate. Z-scores in SPSS were assessed and found 1 participant who was an outlier was omitted from the analysis. Thus, a total of 50 participants were included in the final analysis. Lastly, the normality assumption was met, assessed by Shapiro-Wilk Test of Normality ($p = .277$) along with the homogeneity of variances assumption, assessed by Levene's Test.

MVPA Results

A 2 (Order) X 2 (PE Approach) ANOVA was performed to examine differences in MVPA between the two PE approaches (flipped and traditional). Results showed a significant main effect for the PE approaches, $F(1,48) = 40.69$, $p < .001$, $\eta_p^2 = .46$. In other words, the MVPA as a percentage of class time was significantly higher with the flipped approach (M = .426, SD = .09) than the traditional approach (M = .329, SD = .11). Given the small sample size with only male adolescents, this result should be taken with caution. See Figure 1 and Table 1 for a visual display of the descriptive statistics.

Figure 1. Mean and Standard Deviation for each PE Approach



There was also a significant main effect for order (i.e., group), $F(1,48) = 4.26$, $p = .044$, $\eta_p^2 = .08$. In other words, even though both groups received the flipped PE treatment, the MVPA was significantly lower for the participants who received the flipped approach first (M = .352, SD = .09) compared to participants who received the flipped approach second (M = .403, SD = .09). Given the probability and the small effect size, this result should be taken with caution as there may be no actual effect in the population. Lastly, there was no significant interaction, $F(1,48) = 0.078$, $p = .781$, $\eta_p^2 = .002$.

Table 1. Descriptive Statistics for MVPA

	Group	Mean	Std. Deviation	N
Traditional	1.00	.305	.10265	24
	2.00	.352	.08519	26
Total		.329	.09596	50
Flipped PE	1.00	.398	.10939	24
	2.00	.454	.11233	26
Total		.426	.11329	50

Unit Survey Results

At the conclusion of each unit (two-week period) participants were asked to complete a brief survey. The survey included four statements with a 5-point Likert scale of agreement on a google form with a drop-down selection menu. The survey (APPENDIX B) included items related to perceptions of confidence, clear objectives, opportunity to succeed, and enjoyment. Results indicate no significant differences between approaches, with students in each group rating survey items similarly. Specifically, students enjoyed the PE units, thought the class activities and objectives were clear, increased their confidence to participate in class, and units provided them the opportunities to succeed in class. See figures 2 and 3 for the means and frequencies. A Mann-Whitney U Test was also performed to statistically examine differences in the survey responses of the two groups in each PE unit 1 (i.e., Handball, Speedball) between the PE approaches. Survey results for the handball unit (Table 2) revealed no significant differences between approaches for PE enjoyment, clarity of activities and objectives, confidence to participate in class, or for the opportunities to succeed in class. As mean values for each survey question were high for each approach method, it is important to note the flipped approach maintained high ratings while at the same time generating more MVPA in classes.

Figure 2. End of Handball Unit Likert Surveys

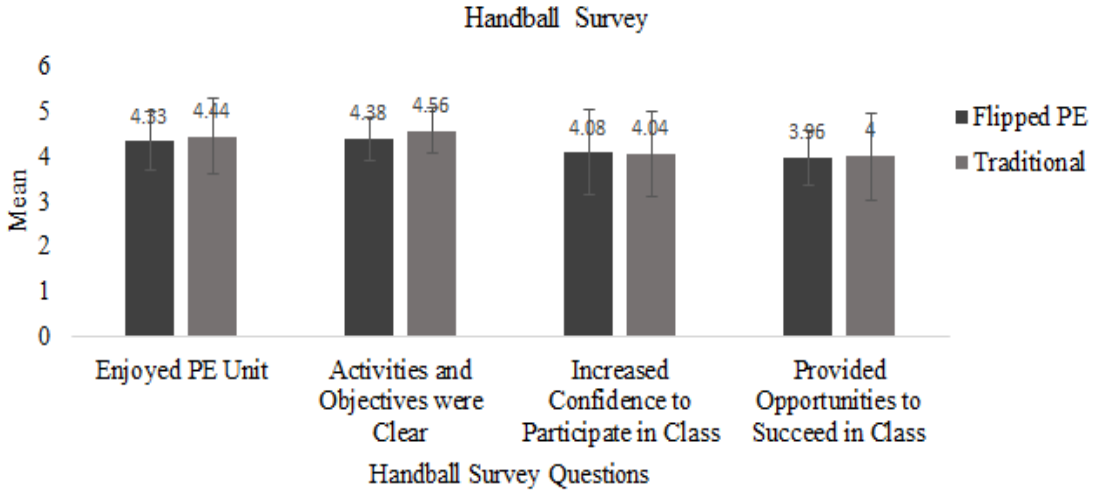


Table 2. Means and Frequencies of Responses from Handball Unit Surveys

	1 Enjoyment	2 Objectives	3 Confidence	4 Opportunity
Flipped PE				
1	0	0	0	0
2	0	0	2	1
3	2	0	3	2
4	12	15	10	18
5	10	9	9	3
Mean	4.33	4.38	4.08	3.96
Traditional PE				
1	0	0	0	0
2	1	0	1	1
3	2	0	7	8
4	7	11	7	6
5	15	14	10	10
Mean	4.44	4.56	4.04	4

For the speedball unit, students in each group rated survey items similarly. Table 3 shows that overall, students enjoyed the PE unit, thought the activities and objectives were clear, slightly increased their confidence to participate in class and provided them the opportunities to succeed in class. Means for questions 1 and 2 demonstrate overwhelming agreement that the unit was enjoyable and daily objectives were clear, as both were above 4.0 on the 5.0 scale. Means for questions 3 and 4 indicate slightly greater confidence to participate and opportunities to succeed in class I the traditional class. A Mann-Whitney U Test more specifically examined differences between the PE approaches in the survey responses of the PE unit 2 (i.e., Speedball). Results revealed no significant differences for enjoyment, clear activities and objectives, increase in confidence to participate in class, or for the opportunities to succeed in class.

Figure 3. Speedball Unit Survey Responses

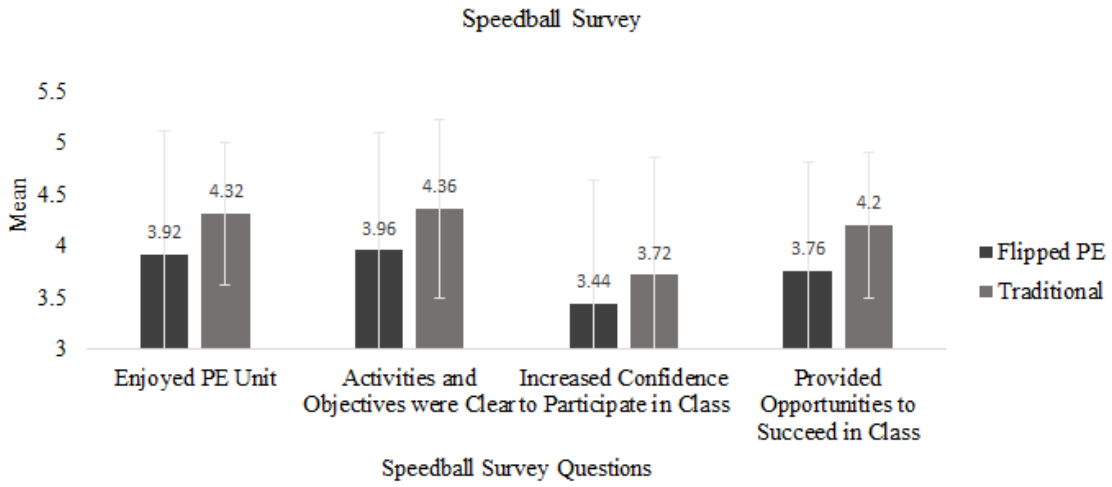


Table 3. Means and Frequencies of Responses from Speedball Unit Surveys

	1 Enjoyment	2 Objectives	3 Confidence	4 Opportunity
Traditional PE				
1	0	1	2	0
2	0	0	0	0
3	3	0	8	4
4	11	12	8	12
5	11	12	7	9
Mean	4.32	4.36	3.72	4.20
Flipped PE				
1	2	2	2	1
2	1	1	3	2
3	3	1	7	5
4	10	13	8	11
5	9	8	5	6
Mean	3.92	3.96	3.44	3.76

The end-of-unit surveys also included open-ended questions regarding likes and dislikes of the units. For the end of unit surveys most students commented that they enjoyed the units but had concerns about spending time at home for PE, wifi access, and perception of increased workload (APPENDIX B). They did, however, enjoy the increased amount of time in class being active. When asked what they would change for the units, their suggestions focused on rules of the games.

End of Intervention Flipped PE Survey

The final exit survey focused on participant perceptions of flipped learning in physical education by asking their levels of enjoyment, understanding, confidence, success, and the helpfulness of videos in flipped PE (APPENDIX C). A frequency chart with means in Table 4 indicates positive responses toward flipped PE. In every category, most participants selected the top two agree/strongly agree, indicating positive responses toward flipped PE. The largest

positive response was question 3 regarding video helpfulness, where positive responses outnumbered negative 34 to 7. In fact, all questions received more positive responses toward flipped PE than negative. Moreover, the absence of significant negative responses toward flipped PE in physical education suggest that motivation and confidence may not be inhibited by its application.

The specific question items were 1) I enjoyed internet PE, 2) Internet PE helped me understand daily activities and objectives, 3) The videos used during internet PE were helpful, and 4) Internet PE increased my confidence to participate in class, and 5) Internet PE increased my ability to succeed in class.

Table 4. Frequency and Means of Flipped PE Exit Survey Responses

End of Intervention	1)enjoyment	2)understand	3)videos	4)confidence	5)ability
1 Strongly Disagree	7	4	4	5	4
2 Disagree	7	7	3	10	6
3 Neither Agree nor Disagree	11	5	8	14	14
4 Agree	14	26	26	14	17
5 Strongly Agree	10	7	8	6	8
Mean	3.28	3.49	3.64	3.13	3.40

The end of intervention survey (APPENDIX C) also included questions regarding student preferences between flipped and traditional class, as well as likes and dislikes. One item asked if they watched content videos and where they watched the videos, while 3 other items asked them to compare the 2 approaches. Participants were asked preferences between internet (flipped) PE and regular (traditional) PE, in which approach they learned more, and in which approach did their skills improve more. Preference choices were internet (flipped), regular (traditional), or both the same.

Where did you watch the internet PE videos and lessons?

Home (17) School (9) Both (18) Did Not Watch(5)

The majority of students said they watched the videos at home or both, utilizing screen time outside of class to meet class objectives, as expected.

Which do you prefer- internet PE or regular PE?

Internet (5) Regular (31) Both Same (13)

It was expected students would prefer flipped PE for its modernization and utilization of technology, but respondents in this study preferred traditional PE and felt their skills improved more in traditional PE. This was interesting because students responded positively toward flipped PE in other survey questions. Based on other comments some students perceived flipped PE as additional homework rather than an exchange of screen time for activity in class, and may require other methods to overcome the idea that PE should only occur within the confines of the classroom.

In which did you learn more - internet PE unit or regular PE unit?

Internet (17) Regular (22) Both Same (10)

In which did your skills improve more - internet PE or regular PE?

Internet (8) Regular (33) Both Same (8)

Responses for questions asking in which approach they learned more were not significantly different, but in both questions about learning more and skill improvement participants often chose regular PE. It is possible they may have also interpreted these questions too literally, thinking the questions were asking whether work done from home improved their skills and learning versus active practice in class, an idea that should be considered for future research.

There were several recurring themes within the open-ended responses which asked participants to provide likes and dislikes of flipped PE. Participants enjoyed the videos that included explanations and samples in advance of class. Some examples included:

- I liked how you can re-watch the videos
- I liked the videos that explained the games to me and allowed us to play more quickly
- We could watch the videos before and know how it worked
- There wasn't any interruptions and if you don't understand you can watch it again

The videos empowered them to self-pace or re-watch videos for greater understanding. This also allowed students to know ahead of time what class activities were upcoming so they could be more prepared. Comments also focused on noticeably higher levels of organization within flipped PE and enjoying the use of their laptops. Responses connected the higher level of

organization in flipped PE to increased amounts of activity time in class. These comments may indicate successful implementation of flipped PE to not only increase MVPA but also empower students in ways that may lead to increases in self-efficacy toward the class.

Another common response indicated students appreciated knowing what they were doing in advance, and some even realized that more class time was being directed toward activity as a result, indicated by the following responses:

- I liked that we could see what we would do the next day
- I liked that we don't have to spend our whole time explaining the activity in class
- We did not waste time explaining games in class, so we had more time to play

The most common theme when asked what they disliked about flipped PE was that students did not dislike anything about it, with 17 responses to that effect. One dislike was the perception of workload, indicated by the following responses:

- I would change that you do not have homework
- Not so much test
- Less quizzes
- I would change the quizzes at home and do it at school

Discussion

In the face of obesity and lack of physical activity among youth this study demonstrates the potential for an emerging instructional method, the flipped classroom, to increase physical activity among adolescent males. Research suggests that even small bouts of exercise are beneficial (Physical Activity Guidelines, 2021), making any increases in physical activity during school physical education critically important. In this study, participants' MVPA as a percentage of class time increased by nearly 10% during flipped PE compared to traditional PE. In a 50-minute class period that can be nearly 5 minutes each day, or 25 minutes per week. By using this approach physical educators may increase physical activity in class with flipped PE while reducing instructional and management time during class, thus leveraging screen time outside of class. This would be a modern approach to increasing MVPA that matches the current trends of both society and student learning.

This study was completed before the covid pandemic of 2020, making the results important for consideration as educators adapt and prepare for potential disruptions and changes in the way we educate. The pandemic was an extremely difficult situation for many disciplines in figuring out how to interact with students asynchronously with positive results. This study demonstrates an opportunity for PE to modernize by utilizing asynchronous formats toward both academic and physical activity guidelines and standards. In doing so, PE can not only be more prepared for future interruptions, but also adapt to a changing world where students have devices and rely on them for social interactions and learning.

The lack of technology saturation may inhibit full implementation of flipped learning in physical education, as some rural and socio-economically depressed districts may be more limited in what they can expect students to be able to accomplish away from school. Even within the school district of this study, some students voiced concerns about Wi-Fi access away from school. By design this study was meant to take this in consideration, targeting smaller blocks of time in the flipped assignments. In many cases, these blocks of time can be leveraged from other parts of the school day, such as before and after school, lunch, home-room, and free time. Modifications should be taken into consideration when designing flipped learning for physical education such that students without internet access at home can remain included and empowered to participate. Future studies should continue to monitor Wi-Fi access, infrastructure initiatives, and other novel trends for districts to provide technology.

This study also assessed perceptions of the participants toward the teaching units and overall flipped learning approach to PE. It was expected students would prefer flipped PE as demonstrated through questions about competence, skill development, and opportunities to succeed. Results showed no significant differences in these measures. The absence of significant differences may indicate that flipped learning maintains confidence and motivation for student learning and engagement, while improving MVPA minutes. Since the survey responses were generally positive for flipped learning in physical education, other research may be necessary to find inroads for significant increases in self-efficacy and motivation, which are important to improve persistence and continuing physical activity.

Training and organization are essential aspects in all areas of teacher preparation. The flipped classroom approach requires some technical knowledge of what is available, how to create and present content, and best practices for maximum utilization. Variations of these will

be key to the broad research initiative necessary to verify the benefits of the flipped approach in physical education. Professional development and teacher preparation programs should follow current research in order to modernize physical education. While other disciplines may find it easier to incorporate flipped learning, the increases in MVPA shown in this study show that further research is warranted and needed to utilize the flipped approach in physical education.

CHAPTER II: DISSEMINATION

The following outline will be presented as a PowerPoint (APPENDIX D) at faculty meetings during professional development or collaborations. The target audience for the results of this project are administrators, physical educators, and technology department representatives within the school district of study. The school district utilizes departmental and interdisciplinary collaboration to promote student achievement and improve efficiency in learning. The focus of the presentation will be more on defining flipped learning application, the results of the study, and how to incorporate flipped learning into the physical education classroom rather than detailed procedures and data analysis.

The key message points for the presentation will begin with a brief history of flipped learning so that teachers understand where it originated and how it has been used thus far. The next important point will be to get an understanding how flipped learning can be used to improve PE in the face of current challenges such as pandemic, content and physical activity standards. This will be followed by some examples of flipped learning in PE and discussion of the results from this study. The results are important and indicate students enjoyed flipped learning and it can help increase MVPA. At the conclusion of the presentation, we will work in small groups to brainstorm some ideas for flipped learning units based on what was presented.

Professional Presentation

SLIDE 1. INTRODUCTION. Flipping the PE Classroom

This project came about because it always seemed to me that, aside from measurement, technology was being largely ignored by the field of physical education. When our school issued chromebooks to each student, some faculty wanted to ban them from physical education altogether. It occurred to me that perhaps we needed to look at technology in physical education from a different perspective in order to maximize its potential. Flipped learning emerged as an approach that might improve achievement while helping students improve their health through increased movement

SLIDE 2. What flipped learning is vs. what it is not

There are some common misconceptions, often due to many teachers not being properly trained in flipped learning concepts. Flipped learning is instructors providing direct instructional content online in such a way that class time is spent on engagement of content and creative

applications. In other classes this might be working problems out with the teacher, but in PE this can mean more supervision to guide and development movement patterns. This can provide development of student autonomy, differentiate instruction, promote collaborations, raise levels of student engagement, and promote deep and active learning. The bottom line: Flipped learning is not simply watching videos or doing worksheets at home.

SLIDE 3. What this means for PE. Benefits of Flipped PE

We continue to be faced with the challenges of the pandemic and many districts struggle to find ways to have quality PE. The flipped approach opens the door for asynchronous and distance learning in physical education. By doing so, PE can increase movement during class while still finding ways to deliver necessary content in the three learning domains of cognitive, psychomotor, and affective. For the first time in a long while we have an opportunity to modernize our approach to learning and physical activity. Technology is not just for measuring but can be applied in other ways to help us face the dilemma of meeting learning standards and physical activity guidelines.

Flipped learning in PE has several benefits. Students can self-pace the material. Flipping modernizes the class to meet learners' expectations of a current education. It also increases interest and motivation while providing deeper learning opportunities through student-centered activities such as discussion boards, collaborations, and creative works. Teachers who flip can find more options to meet activity and content requirements.

SLIDE 4. Challenges of flipped learning

Getting students to work at home can be a struggle but setting routine and expectations can overcome this challenge. Students can initially feel as if they are being given PE homework. Another challenge is technology access, functionality and ability, which requires flexibility on the part of the teacher and a clear plan for when problems arise. Teachers also need training to create a space that is safe, inviting and easy to navigate within the school LMS.

SLIDE 5. Disadvantages of flipped learning

Getting students to participate at a high rate requires the development of motivation, it cannot just be expected. The way the class is constructed can impact motivation. There is admittedly a lack of research in the area of flipped learning in physical education, but the few I have found are positive. Reliance upon technology will always be a disadvantage. Luckily this district supports a 1:1 initiative and all students have devices. Underserved communities are not

so lucky. Not all students have internet service so putting a plan in place to help them or have alternative means of access is important.

SLIDE 6. Can we flip PE?

The short answer is yes, and we can flip PE in nuanced ways that maintain teacher autonomy and control. This is a novel approach to modernize PE rather than recycling traditional approaches. Many other fields of study have embraced flipped learning as a functional approach to higher achievement and deeper learning, therefore physical education also needs to explore its potential. Will it look the same as flipping core classes, probably not. This study was designed with physical activity deficits in mind, therefore I sought to find out if flipped learning could improve that aspect of PE.

SLIDE 7. YES! Here are some sample items

Discuss the success of the items, including student usage of technology and comments.

SLIDE 8. Defining the problem

The purpose of the study was to better understand the potential of flipped learning in physical education by using a flipped classroom approach to leverage screen time outside of class to determine if moderate to vigorous physical activity (MVPA) increased during class time. Additionally, the study sought to better understand the effects of flipped learning on student perceptions of physical education and activity. The stated goals and aims of the study were to compare a traditional teaching model to that of flipped learning (non-traditional) by using internet resources and technology provided by the school district.

SLIDE 9. Participants

50 students from two different classes participated with parent consent. The school administration also consented. Participation did not influence grades. All participants were male adolescents, age 11-15 from two PE classes.

SLIDE 10. Methods and Equipment

Equipment used for measuring physical activity were the polar F7 watches with bluetooth enabled chest-bands. Other equipment items used were sanitizing wipes, a portable rack for the devices, laptop for collecting data files.

Students used their school issued chromebooks, phones, or home computers to access a variety of internet resources, such as blackboard, edpuzzle, kahoot, youtube, and google. The devices often have various functions such as cameras for filming and desktop publishing.

SLIDE 11. Procedures

MVPA minutes were measured daily with Polar wrist watches and bluetooth chest-bands. Each period students would put on the chest-bands and watches when dressing for class, pushing the start button as soon as possible. The watches were programmed to measure MVPA based on age and target heart rate. At the end of class students pushed the stop button, cleaned devices and put equipment away. The instructor recorded the MVPA each day from the watches into an activity log, then converted them to a percentage of daily class for data evaluation. Student perceptions were measured using end of unit and end of intervention surveys.

SLIDE 12. Results

Students increased daily MVPA in the flipped intervention by an average of nearly 10%. This percentage would be even higher if dress time before and after class were removed from total class time in calculations. Results showed an increase of nearly 5 minutes each day in a 50-minute class period (Figure 1). When contributing to a students' development of healthy habits and working toward 60 minutes a day of activity, daily MVPA increases of nearly 10% demonstrate future research is warranted and needed. Survey results also showed that students enjoyed flipped learning and had positive feelings of efficacy. There were no differences increases in student perceptions between flipped and traditional PE, leading to the important conclusion that flipped learning did no harm in this study (Figures 3,4 and 5).

SLIDE 13. Recommendations:

Increase utilization of flipped learning approaches to increase MVPA in physical education. Growing numbers of school districts are beginning to supply students with devices for a variety of uses. Along with greater internet access, these devices are capable of increasing educational efficiency through tremendous amounts of knowledge and applications at student fingertips. Just as other disciplines have successfully incorporated flipped approaches, the findings of this study suggest PE may benefit from the flipped approach. Flipped learning approaches resulted in increased MVPA of adolescent males in physical education by leveraging screen time in favor of physical education content. Sharing this information on the local level through professional development opportunities may lead to increases in creative outcomes of increased MVPA. Allowing students to choose flipped PE may also benefit those with learning habits more conducive to the approach.

Increase staff training of flipped learning design and incorporation of flipped learning in LMS. These recommendations will likely require increased training for staff on how and why to use technology for flipped learning in physical education, since PE teachers may have been trained with little to no technology-based methodology as part of their degree program, or have pre-existing bias toward technology as it pertains to physical activity. In order to accomplish these gains, school districts and organizations should encourage and utilize technology usage in physical education by increasing professional development opportunities and awareness for staff. This can be in a variety of forms such as workshops at the beginning of the school year, during the school year, as well as state and national conferences. As increasing numbers of districts become 1:1 with technology, student access to internet programming either at home or school improves. Students readily utilizing learning management software in core classes can, therefore, transition to PE usage with minimal difficulty or change in their approach to learning. Physical educators can receive initial training through their district, state, and national conferences through presentation of the study results and recommendations.

Improve school technology resources, internet access for underserved populations, and LMS functionality. Continue to evaluate and expand internet access to more schools, rural areas, and applications. This is a critical for successful implementation of flipped learning and a fair and equal education. These should be supported through initiatives which improve access, internet speed, and 1:1 equipment solutions often found in school bond projects. Developing positive community support is critical to passage of these types of projects.

Teacher training programs should continue to monitor the latest research on flipped learning benefits and modify curriculum to train teachers flipped learning approaches in PE. Results of this study indicate teacher training programs should consider a more modern approach where students engage with their devices and the internet for both content and associated enjoyment of PE. The results suggest teacher training programs in higher education should continue to develop greater understanding of the benefits of the flipped classroom for physical education through more advanced research. More specifically, how flipped learning may affect learning, content acquisition and perceptions in larger, longer treatment populations.
SLIDE 14. Discussion and Action Plan

Discuss results with faculty, ask for concerns. Ask for input on positives and negatives they sense about flipped learning. What training do they feel will be necessary to utilize flipped

learning? Review study intervention and choose beak-out groups, design a sample unit to be shared by the PE department.

SLIDE 15. References

Demonstrates that flipped learning is rooted in a variety of accepted theories including Bloom's taxonomy. In Bloom's taxonomy the more complex tasks can be accomplished in a creative social environment. Framework for 21st Century Learning also encourages increased technology usage at www.p21.org/our-work/p21-framework. For more beneficial information on a website dedicated just for flipped learning you can check: www.flippedlearing.org

CHAPTER III: PLAN OF ACTION

The complex relationship evolving between technology and physical activity in physical education warrants dissemination of these results using a variety of proactive strategies. The findings of the study can be summarized into two components: A flipped approach in PE significantly increased adolescent male students' MVPA, and the students had positive responses to the flipped approach and maintained positive perceptions toward PE class. These findings, along with future research, can be used to develop and justify actions aimed at increasing MVPA in schools, increase awareness of the flipped approach potential in PE, influence policy initiatives, and improve technology support. Technology has often been maligned as a detriment to physical activity, but with designed strategies to maximize the benefits of the study results, technology can enhance PE curriculum in ways that develop the whole student. It is important to note that flipped learning itself does not deviate from acceptable learning approaches. Though research of its impact on physical activity may be necessary to confirm how much (if any) differences can be expected through its implementation, it already satisfies many current educational guidelines and recommendations by incorporating technology in ways that develop literacy toward current societal trends. The plan of action, therefore, includes approaches emphasizing both breadth of knowledge to reach multiple audiences, as well as the targeting of key audiences where greater depth of knowledge is necessary to inform practice.

Short-Term Action Plan

Short term recommendations include teacher professional development, curriculum design workshops within the district, learning management software (LMS) training seminars by the technology department, and release of executive and plain language summaries to appropriate outlets of stakeholders. A plain language powerpoint (APPENDIX D) has been created to present results to the school PE department and administrators. In doing so, it will be possible to share the benefits of flipped PE lessons for increased MVPA. During the pandemic these presentations can also be accomplished virtually through zoom meetings, google hangouts, online videos, or other meeting applications. School districts can use the results to fashion departmental action plans to further incorporate flipped learning into physical education, creating more class time for physical activity while leveraging screen time for increased discovery

knowledge and content learning outside of class. Dissemination in professional journals for curriculum, physical education, and technology should coincide with these presentations in the form of an executive summary that emphasizes how the flipped approach hold promise to better utilize technology in PE to meet both academic and physical activity standards.

Curriculum design modifications designed to maximize the flipped approach can be personalized by each department or teacher. An example (APPENDIX A) designed in this study was to leverage screen time for MVPA, while protecting students' positive perceptions of PE. Increasing MVPA is important because it has been shown to improve health even in small bouts, and PE classes in recent studies were active less than 50% of class time (Gill et al., 2016).

Learning Management Software (LMS) such as blackboard, canvas, and google classroom training is also a vital part of successful flipped learning. Both teacher and student frustration can be reduced, and participation increased when LMS stakeholders are well trained on content development and simplified navigation. Since student screen times continue to increase, flipped learning can capitalize on this trend to maximize internet potential in PE and meet modern expectations

Long-Term Action Plan

In an effort to capitalize on modern student learning trends and MVPA recommendations in physical education, plain language summaries of this study should be released to journals and publications related to the businesses where technology and PE intersect. Technology based companies, application designers, and textbook manufacturers should all be advised of the changing needs in physical education and the potential benefits regarding flipped learning.

The results of the study may also impact future teachers. In order to modernize curriculum these findings should be presented to local teacher education departments in order to discuss current research, how they currently maximize technology and the flipped approach, and how they might modify teacher training to reach its potential.

Underserved students are a concern for the success of flipped learning. It will be important for the PE department and administrators to engage with the IT department to seek opportunities for increased access to technology devices and internet. By seeking current rates of access and programs that are available for those in underserved communities, schools can ensure flipped learning is fair and equal for all students. In order to facilitate good will and support for increasing technology usage and funding, summaries to stakeholders are to be offered

through the school social media releases and publications. These are often sent to emails and mailboxes in the community and can be a good source of publicity related to topics that may be part of future bond and funding issues impacting technology.

In addition to the 2020 pandemic, physical educators find themselves not only held to content acquisition standards for students, but also to recommended physical activity accumulated minutes (Physical Activity Guidelines, 2020; Ryan et al., 2016). This dual responsibility makes it important for key stakeholders such as physical educators, curriculum and instruction designers, policy makers, and instructional technology and application developers to explore the potential benefits of flipped learning in physical education that were indicated from this study.

This study provides a foundation for reasonable conclusions of benefits to not only pedagogical stakeholders, but also toward technology driven initiatives and policies that are becoming increasingly popular in education, such as the 1:1 ratio of students with technology devices. As this study suggests, utilization of the flipped approach for physical education to increase MVPA shows promise for future research. If proven effective, leveraged screen time through the flipped approach may be a unique and critical component in future challenges to meet recommended minutes of MVPA for today's youth in physical education.

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APPENDIX A: FLIPPED PE PLAN

FLIPPED PE PLAN

Intervention Plan	Flipped PE	Traditional PE
Weeks 1-2	Group A-handball	Group B-handball
Weeks 3-4	Group B-speedball	Group A-speedball
	Online survey	Online survey

Handball Unit Week 1

Flipped unit on Blackboard	Traditional unit in class	Monitor
Day 1 Fitness Day-Students preview activity options in advance (videos/edpuzzle) and choose their workout: Cardiovascular endurance, muscle strength, muscular endurance. Personal Fitness Plan Assignment introduced (blackboard/google drive), due next Friday. **At home**: Preview required handball introduction video and powerpoint (blackboard/edpuzzle) specific to our class	Students are explained their options and choose their workout. Introduction of Personal Fitness Plan assignment due next Friday. **At home:** Packets available for PFP	yes
Day 2 Handball Skills and Drills. **At home**: Students take physical activity survey on google form which may determine future assignments and suggestions --for their PFP based upon where they are on the continuum of physical activity.	Explain history and powerpoint review of team handball before skills and drills (handout available) **At home:** none	yes
Day 3 Fitness Day, same choices as Monday, survey response determines workout group. **At home**: Complete Fitness plan worksheets 1-4 which will be emailed/shared, review Handball skills and drills videos II	Fitness Day, students take physical activity survey at beginning of class, response determines workout, 3 groups **At home:** Fitness Plan pages 1-4, review handball information and PFP	yes

Day 4 Handball Skills/Drills/Small sided games **At home**: google form vote on Fun Friday activity (dodgeball or choices) AND discussion question/responses due Monday	Demonstrate and discuss the skills, drills, and small sided games. Practice **At home:** review handball information, continue working on PFP	yes
Day 5 Fun Activity Day **At home:** Personal Fitness Plan pages 4-8 , see google form for Monday fitness choice	Fun day, discussion question then class vote **At home:** PFP 4-8	yes

Handball Unit Week 2

Flipped	Traditional	
Day 1 Fitness choices from google form **At home**: Discussion Question Responses Due, review for rules quiz, continue work on PFP	Fitness Choices explained **At home:** Continue completing Fitness Plans	yes
Day 2 Handball League Play **At home**: Handball Quiz over rules/sportsmanship and finalize fitness plan	Handball League Quiz then Play **At home**: finalize fitness plan	yes
Day 3 Fitness, try a different choice from Mon. **At home**: Discussion board question on handball rules/suggestions; finalize fitness plan	Fitness, choice by class discussion/vote **At home**: finalize fitness plan	yes
Day 4 Handball League Tourney **At home**: Complete Fitness Plan and discussion responses	Handball League Tourney, Discuss Handball league/rules needing change. **At home**: Complete Fitness Plan	yes
Day 5 Fun Day, Fitness Report Due Perception survey	Perception survey, Submit Fitness Report Fun Day	yes

Week 3, Speedball Unit Week 1: Switch intervention groups

Day 1 Fitness Choose in Advance Online **At home**: Speedball introduction of Skills, Rules and Sportsmanship video/quiz on EdPuzzle	Fitness groups choose in class **At home** Speedball rules and sportsmanship handout	yes
Day 2 Speedball Skills and Drills **At home***:* Video FITT, edpuzzle Answer Discussion Question fitness	Review Rules/Sportmanship of speedball Take Questions, explore skills and drills specific to speedball **At home**: none	yes
Day 3 Fitness, choice offered in preview of FITT principle video At home: Respond to 2 posts in discussion	Fitness, choice by class discussion/vote about FITT principle At home: none	yes
Day 4 Speedball League Play **At home**: vote for Fun day activity google	Quick Review, FITT principle Speedball League Play	yes
Day 5 Fun Day **Weekend At home**: Edpuzzle Video Progression and Overload, provide workout choices	Fitness Report, Fun Day Progression and Overload handouts available	yes

Week 4, Speedball Unit week 2: Final Week

Day 1 Fitness, Fitness assignment review Progression and Overload, select workout. **At home**: Perfect pushup video assignment	Fitness, progression and overload discussion, select workout **At home**: Perfect pushup worksheet	yes
Day 2 Speedball League Play **At home**: Speedball Rules and Sportsmanship online quiz, continue perfect pushup video	Speedball Quiz begin Speedball League Play **At home**: Perfect pushup worksheet	yes
Day 3 Fitness Day **At home**: Discussion question	Fitness, choice by class discussion/vote after review of Progression Overload	yes
Day 4 Speedball Tournament Play **At home**: Finish perfect pushup video, vote on Fun Friday Activity on google	Speedball Tournament Play	yes

Day 5 Fun Activity Day, Perfect Pushup Video Due	Collect perfect pushup worksheet, vote Fun Day activity	yes
END OF INTERVENTION	END OF INTERVENTION	

Follow-Up

Perceptions Survey, online	Perceptions Survey, online	

APPENDIX B: END OF UNITS SURVEY/RESPONSES

End of Units Survey (to be completed using a google form after each 2 week unit)

Answered using a five-point drop-down likert scale:
1 Strongly disagree 2 disagree 3 neither disagree nor agree 4 agree 5 strongly agree

1. I enjoyed the PE unit.
2. The daily activities and objectives were clear.
3. The PE unit increased my confidence to participate in class.
4. The PE unit provided me opportunities to succeed in class.

Open answer:

5. Give one example of something you liked most about the recent PE unit.
6. Give one example of something you would change about the recent PE unit.

OPEN ENDED RESPONSES-HANDBALL UNIT

Give one example of something you liked most about the recent PE unit.	**Give one example of something you would change about the recent PE unit.**
FLIPPED PE RESPONSES	
Handball	The rules of the game
handball unit	nothing i think it is fine
Football	more of a street ball set
handball wasn't confusing.	more enforcement on the No Cherry Picking rule.
I liked playing hand ball	differant teams
doge ball	more doge ball
i liked that everyone had a chance to do something	i would change that everyone has to be active and pass or points are taken off
The competitiveness	Doing more fun fitness days
I liked how the ball was passed more often	Less Competitiveness
I like handball	No fitness day
I liked how easy and simple the game is of Hand Ball is played.	That we could play it more often.
Handball	play basket ball first unit
how we had a draft to choose teams.	Nothing
Handball	Burpies

Handball	I wish we could do basketball
the heat rate stuff	hand ball
we went against three other groups	Goals
I like how we got be drafted on to teams instead of you just picking us	That there is two big teams instead of four
The game was fun and fast paced.	New teams every game.
Basketball	not doing stations
it was complicated	I would do a different unit before it
I liked that we played handball because it is fun.	I didn't like the running fitness days.
Handball	no football
It was practical, in the way that i exercised AND had fun	I would have liked to have been there for more than a few days
TRADITIONAL PE RESPONSES	
the competition	the three second rule
where everyone got to play	positions in handball
being goalie	Nothing
being able to be goalie	Nothing
it was fun	new team
I like how we had large teams	I would make the unit longer
Handball	more handball
that you get to throw the ball in the net	Nothing
I liked the football unit because it was a lot of fun	I would change the stations because it was not as fun as the others
I like that you had a time limit with the ball	I wish the that the time limit would go up because it ends up ending as fast as you can
It was active	new teams
people liked this unit. And it was a good substitute to normal sports	I would change the dodgeball to a real handball
Handball	more than one person watching and making foul calls
I just really liked playing handball, it was fun and I got to play with friends	some of the teams have all the football kids
I liked the running part	I would change it so you could smack the ball out of anyones hands
I really like handball and working in a team	playing more games not just only one
how quick it was	make it last longer
working together	letting us get in groups to be our own teams
I enjoyed the handball unit and I hope that we can do it again.	I would like random choosing so there is less stress on the leader and so choosing is easier
the flag football unit	handball teams
the teams	paying attention to the rules

Teamwork	decent referees
that we got to play with new people	having a different ball
it was fun and I was amazing at it	that you can truck people

OPEN ENDED RESPONSES-SPEEDBALL UNIT

Give one example of something you liked most about the recent PE unit.	**Give one example of something you would change about the recent PE unit.**
TRADITIONAL PE	
that I could participate well in it	make the basket worth 1 point instead of 2 points
the speedball unit	longer games
speedball and football	I don't
It involved some of my favorite sports	The amount of time we did it
I liked speedball	more fitness days
dodgeball	more dodgeball
I like how everyone was involved	We should make it to where there is no cherry picking
Playing speedball and winning	No problems
I liked the teams	less arguing
I like the competition and how there were a lot of sports combined together	no fitness days
the multiple things you can do in speedball	The three second hold
basketball	basketball unit first
having multiple sports in one	Nothing
speedball	Nothing
it had our favorite sports	it had too many sports
it had favorite sports	it had too many sports
we had fun and we played for awhile	The ball was in the middle
I like that we got to pick teams	I would change that you got to pick the ball up
How there was so many ways to score	Different teams every game
It combined alot of sports	Having basketball earlier
It was new, never heard of speedball	can't score twice rule
I liked speedball	The recent PE units fine
it included handball	everyone play together
The combined sports	Somehow incorporate baseball
FLIPPED PE	
it had every sport	i cant think of one
speed ball	speed ball rule were you can't score twice
I got to be goalie	No basketball hoop option to score
being able to score in four different ways.	Jack
it was fun	Nothing

I enjoyed playing speed-ball this unit.	I would like to have more time to in this unit to play speed-ball.
speed ball was fun	more speed ball
I enjoyed playing speedball	What we do on fitness days
I liked the speed-ball because it mixed a lot of sports that I like.	The holding time because it does not give us enough time to go back forth.
I liked the many options on how to score.	I wish I could change the intensity of the game because some people get to out of hand.
Speedball	Speedball
i liked the implement of soccer and other sports into one game	I would like it if the teams were evened based on skill, and even teams in general
Fitness Dodgeball	I would change all the fitness days to fitness dodgeball.
Handball	make sure everybody uses the three second rule
I like that we played speedball.	I think I would change it so there are less fitness days.
The team effort.	The unfair team that were chosen.
The very quick action.	Nothing.
The amount of sports in one game	The amount of time in each game
How we had to use teamwork to win a game.	I think you could use the pug goals more instead of the mats.
i liked the stations	i would change nothing
Handball	more flag football
the teams	the rules
When teams didn't cheat, (which was not often)	More refs and more supervision of the game
that the games were watched and that the rules were enforced	having more games
that i was the best	i want to score 5 times in a row

APPENDIX C: END OF INTERVENTION SURVEY RESPONSES

End of Intervention Survey (to be completed on the internet using a google form after week 4)

To be answered using a five-point likert scale:
Strongly disagree disagree neither disagree nor agree agree strongly agree

1. I enjoyed internet PE.
2. Internet PE helped me understand daily activities and objectives.
3. The videos used in internet PE were helpful.
4. Internet PE increased my confidence to participate in class.
5. Internet PE increased my ability to succeed in class.

To be answered with a 3-point scale:
Internet PE regular PE both the same

6. Which do you prefer- internet PE or regular PE?
7. In which did you learn more - internet PE unit or regular PE unit?
8. In which did your skills improve more - internet PE or regular PE?

Select answer:

9. Where did you watch the internet PE videos and lessons?

home, school, both, did not watch

Open answer:

10. Give one example of something that you liked about internet PE.
11. Give one example of something you would change about internet PE.

RESPONSES

Which do you prefer- internet PE or regular PE?

Internet (5) Regular (31) Both Same (13)

In which did you learn more - internet PE unit or regular PE unit?

Internet (17) Regular (22) Both Same (10)

In which did your skills improve more - internet PE or regular PE?

Internet (8) Regular (33) Both Same (8)

Where did you watch the internet PE videos and lessons?
home, school, both, did not watch

Home (17) School (9) Both (18) Did Not Watch (5)

Give one example of something that you liked about internet PE.
Good explanation of the game
that they are easy and you know what your doing ahead of time
it was on the computer.
Quizzes
I liked how it would tell us what we need to do in class
I liked how you can rewatch the videos
i liked that we could see what we would do the next day
watching the handball videos
I liked it because it was more organized
I liked that we dont have to spend our whole time explaining the activity in class.
that I could learn about the games and how they are played ahead of time.
it told us how to play games
taking surveys
not sure
we used our Chromebooks
that we got to vote on the next day
showed up what we did
Yes
how we voted on what to do the next day
We did not waste time explaining games in class, so we had more time to play.
Nothing
Nothing

I liked how some days we could choose what we do.
Online
The work was easy to get to and understand
it was helpful
the videos
Nothing
being able to know stuff before
n/a
I liked how internet PE helped me with my speed-ball quiz
we had more fun activities
We get to choose what we do
We could watch the videos before and know how it worked.
I liked how you can know your schedule for the days ahead.
nothing
I liked the videos that explained the games to me and allowed us to play more quickly
Edpuzzles to tell me about stuff
Learning
I liked the videos.
No opinion.
Knowing what were going to do
I could do it at home.
the chilled vibe
their wasnt any interruptions and if you dont understand you can watch the video again
the videos
You could do it on your own time
being able to do it when i want
Nothing

Give one example of something you would change about internet PE.
Nothing
posting it a day before
None
the vids are really cheesy
I don't like having to go home and take time so maybe take time before class
I would make mor videos
no change
Not doing all the surveys
less test
I would change the quizzes at home and do it at school
One thing I would change is the amount os time to do the test/videos at school.
not do it
Nothing

Nothing
i dont know
no change
less quizzes
I do not know
no soccer
Honestly I think it is perfect, I did not have any problems with it at all. Just me forgetting once to do it.
Everything
we dont have enough time to play
Nothing
not so much test
maybe the subjects
not doing internet pe again
Nothing
Everything
?
To not do it just do regular PE
I would change to put more helpful things up to learn about the unit
more chooses
I would not change anything
Nothing
I wish that you did not have to do everything on the internet because if you don't have wifi or you are going somewhere that day and you don't have time then it could be hard. I think we should have a vote on the internet vs regular PE.
Nothing
I would change the surveys to canvas quizzes
Smaller thing on it
long projects
I would change that you do not have homework.
No opinion.
Not everyday
I think you could put due dates on things so we can keep track of everything we need to do.
Nothing
Nothing
i dont know
Nothing
having a chance to watch it in class
Nothing

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Flipping PE to Increase Physical Activity: A Presentation to the Faculty at NJH

Background

- What flipped learning is…
- Flipped learning is defined as an instructional strategy that delivers instructional content outside the classroom so that it can be applied in the classroom. In seated classes this means those activities assigned as homework would be done in class and those traditionally taking place in class would be done outside of class, using internet resources. It has been around for about ten years.
- What flipped learning is NOT….
- Flipped learning is not just funny cat videos, but an opportunity to meet learners on common ground and allow them more ways to participate in their learning.

Benefits of flipped learning

- Students can selfpace the material, leading to better understanding while promotion of active learning
- Student centered education from online collaborations can create deeper learning and reduce social awkwardness and inhibitions
- In PE, more physical activity can take place during class and deeper understanding of movement and theories can be developed outside of class. These are areas often glossed over in order to "get to the game"
- Teachers in PE can meet instructional and physical activity standards more efficiently and optimize class time
- Students are generally proficient and enjoy technology usage
- Demonstrates that PE has modern approaches
- Allows PE to intersect with at home learning during challenging situations such as the pandemic, creatingmore versatility of instruction

Challenges of flipped learning

- Getting students to work at home
- Internet access
- The idea that it is "extra work"
- Teacher training and preparedness, if not done properly it can fail
- Technology issues

Disadvantages of flipped learning

- Relies heavily on motivation, which often must be developed
- Lack of research to support usage specific to physical education
- Reliance upon technology resources

Can we flip the PE classroom to get more physical activity?

- Studies have shown student activity in PE class averages less than 50% in MVPA
- Physical activity habits track into adulthood
- Flipped learning matches more learning styles
- Obesity remains a major problem and leads to a wide range of other health issues and diseases
- Flipping the classroom has been shown effective at increasing student achievement, understanding, and enjoyment
- The pandemic demonstrates the need for alternative strategies

YES! Sample Flipped Items

- Students get used to checking online sources for daily announcements and assignments such as rules, league schedules, instruction videos on skills, etc. that will be needed in class. Discussion boards can be used for questions and suggestions. You can even vote on fitness activities!
- After watching a video on perfect pushups and what muscles are affected, students create their own perfect pushups video with narration to explain the exercise, its benefits, and perfect technique. (This meets standards of synthesis and application)
- Students can share with a classmate and critique proper form, looking for positive aspects and areas needing improvement.
- Create Personal Fitness Plans for each student with goals and and google forms online. Students can study videos, discuss the FITT principle and progression and overload, then design their own plans. Tons of resources are already online to help explain these principles in interesting formats. Students can use their plan to make changes to improve their health.
- Other flipped options include voting for fitness activities, posting schedules, discussion boards, quizzes, demonstration of skills/fitness, and countless resources to reduce management in class in order to apply movement skills more under supervision.

Defining the Problem

- The aims of the project were:
  - What relationship exists between the flipped classroom and physical activity?
  - Does the flipped classroom approach in physical education elicit positive perceptions toward physical education and physical activity?

To answer these the title of the study was:

Flipping the PE Classroom to Increase Physical Activity

Methods/Participants

- I received approval from administration to use flipped learning in two of my classes. 50 Participants agreed to participate.
- Explanation of the study and permission forms went home for signatures
- No students were excluded from the study
- All students were in boys PE classes ages 12-15
- The high school allowed us to use polar F7 watches that measure physical activity levels such as MVPA.

Methods/Equipment and Measurements

- Nixa High School provided polar F7 Bluetooth heart monitor wristwatches and chest-bands for students to wear during class.
- Students were taught how to wear and use the equipment by practicing before the intervention to test all the equipment and their understanding of the functions.
- A portable coat rack was used to wheel out the chest-bands each day and a rack was built to hold the watches when not being used.
- Disinfectant wipes and spray were used by students between classes to maintain hygiene.
- During the intervention heart rates were recorded on the watches and minutes were categorized as either MVPA or non-MVPA

Procedure

- Each day during class students would put on a chest-band and pick out their numbered watch and push a start button to begin continuous heart monitoring
- At the end of class, they were asked to stop the watch, sanitize the equipment and hang it up.
- This occurred every day for about one month. Two days set a baseline, two weeks of traditional PE class, and two weeks of flipped PE
- The two classes alternated for flipped vs. traditional. One class started flipped and the other traditional, then they switched.
- Surveys of perceptions were given at the end of each two-week period and an exit survey at the completion

Results and Significance

- Daily heart rate values were recorded in a log matching the watch numbers and class period
- Students in flipped learning averaged more minutes of MVPA per class period than traditional PE **(32.9% traditional, 42.6% flipped, +10%) This is a big deal and demonstrates the potential impact teachers and technology can have upon MVPA.**
- The increases were statistically significant, meaning extremely low likelihood of happening by chance and more likely to happen as the result of the intervention
- Students responded to end of unit surveys positively toward flipped learning, although not significantly higher
- Students responded to end of intervention survey positively
- Flipped PE can be designed to meet more standards and satisfy guidelines of best practices.
- Correlation of grades to MVPA were NOT part of this intervention

General Recommendations

- If flipped learning is accessible PE teachers should consider using it to impact MVPA, motivation, and enjoyment in their classes. As an alternative strategy it may reach learners in new and different ways that better meet their learning style in modern times
- Flipped PE should be an option for students to select in the future
- PE teachers should seek increased training on how students engage with internet resources and how those can be used to promote physical activity habits and enjoyment
- School Districts need to train teachers to utilize flipped learning and internet resources more effectively
- Application and technology companies should strive to further develop useful resources for teachers and students to engage physical education topics in meaningful ways
- School technology departments should meet with teacher groups to better understand their needs to create, post, and develop flipped learning units

Action Plan and Discussion

- View/discuss the curriculum used for the study
- What are your comments and concerns?
- Do you have any experience with flipped learning?
- During curriculum and collaboration meetings let's devise a plan to incorporate flipped learning and monitor MVPA changes
- Discuss which units you feel might work well with flipped learning
- Break into groups of 3-4, each group develop outlines for specified units for further development and sharing among department

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