Influence of Step Tracking and Heart Rate Monitoring on Student Participation

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Influence of Step Tracking and Heart Rate Monitoring on Student Participation.

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Capstone Project: An Action Research Project

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Abstract

This action research was driven by the teacher’s interest in introducing pedometers and heart rate monitors into the physical education setting. The goal was to see the influence they would have on student participation during class. The researcher used quantitative data collection over a two-week period. Data was collected using an Accusplit Eagle 120XL pedometer for steps and a Polar OH1+ heart rate monitor for heart rate. The research was conducted to analyze the influence pedometers and heart rate monitors have on student participation in PE. The researcher is a K-12 physical education teacher in his twentieth year of teaching. The findings showed that students who wore pedometers during the two-week research period increased their weekly steps from week 1 to week 2. The findings also showed that students who wore the heart rate trackers increased the percentage of time in class in the MVPA zone but with limited data. The research was conducted to impact future physical education classroom practices pertaining to influencing participation.

Keywords: physical activity, pedometer, heart rate monitor, influence, physical education
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INFLUENCE OF STEP TRACKING AND HEART RATE MONITORING ON STUDENT PARTICIPATION.

High school students today do not get the recommended daily amount of physical activity. Children and adolescents ages 6 through 17 years should do 60 minutes (1 hour) or more of moderate-to-vigorous physical activity (MVPA) daily (Youth Physical Activity Guidelines | Physical Activity | Healthy Schools | CDC, n.d.). Fewer than one-quarter of U.S. high school students, 23.2% were physically active for at least 60 minutes on a daily basis, according to the most recent Youth Risk Behavior Surveillance System (YRBSS) report (High School: Physical Activity - State of Childhood Obesity, 2022). In 2017, 51.7% of high school students attended physical education classes in an average week, and only 29.9% of high school students attended physical education classes daily (Center for Disease Control and Prevention). Physical education classes can play a critical role in meeting the 60-minute recommendation. When students are in class though it has been shown that 40.5% of the time in class is spent in the MVPA zone. The proportion of PE spent in MVPA is below the US Centre for Disease Control and Prevention and the UK Association for Physical Education recommendation of 50% (Hollis et al., 2017). The problem is we need to find ways to get students to participate at a higher rate in moderate to vigorous levels of exertion while in physical education classes.

The purpose of this action research project is to test the use of pedometers and heart rate monitors in the physical education setting. Looking at the effect they have on classroom participation. Currently, in my physical education classroom I have 70% of students passing. Classroom participation is usually 65% of the class time for most of the students. Of the passing students, 50% of them pass with the minimum required work and participation. With the introduction of the pedometers and heart rate monitors, I plan to raise the students' participation
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levels during their lessons. The action research will provide opportunities for technology tools to improve instruction, learning for the students, collaboration (teacher and student), and physical activity knowledge.

Research for this literature review was found from Northwestern College DeWitt Library in Orange City, Iowa, Google Scholar, and the ERIC Institute of Education Sciences sites. All scholarly journals included in the literature review have been published within the past 10 years and were peer-reviewed. The authors focus on finding research articles for the literature review included physical education classes as this is the setting for the research. Other focuses for the search were pedometers and heart rate monitors in the physical education setting. These tools will be introduced into the study in the physical education classes. The final focus was on student participation and motivation in the physical education setting and physical activity. An increase in participation and motivation are the goals of the research leading to higher quality physical activity.

The author believes that through the use of pedometers and heart rate monitors in the physical education setting, students will increase their motivation to participate in classroom activities. The pedometers and heart rate monitors will provide the students with concrete data that they can see and use to track their physical activity. Students will have a goal set for each class for steps and heart rate zones that they will be accountable for and have access to throughout the class to track their progress. Students will become more physically active and gain the health benefits that come along with it. According to Duncan, Birch & Woodfield (2012; as cited in Clapham, 2015), both instruments are appropriate to use with children, serve as self-monitoring tools, and are useful in promoting physical activity.
The author has organized the literature review by key themes that will increase participation in physical education classes. The literature review will start with the importance of physical activity and the recommendations for adolescents. Next, the literature review will cover participation and motivation in the physical education classroom. Finally, the literature review will focus on the use of pedometers and heart rate monitors in physical education. Looking at the good and bad associated with the use of them in physical education.

**Review of the Literature**

When we think about health promotion and disease prevention it has been shown that physical activity is one of the most important tools that people can utilize. Even with the well-documented benefits, most people fail to follow the recommendations set forth by health agencies. In the review, we look at the current status of physical activity, participation, and motivation. We will also look at how introducing pedometers and heart rate trackers influences physical activity, participation, and motivation. Studying the research will help guide ways we can improve these three important areas to lead healthier lives.

**Physical Activity Recommendations**

Physical activity is a crucial part of a healthy lifestyle. Being physically active leads to better health outcomes for those who choose to follow the guidelines and recommendations set forth by health agencies. In this portion of the literature review, we are going to look at the recommendations and current numbers of people being physically active. By looking at the current literature we will be able to see the current status of physical activity among adolescents and adults. This will help pave a path forward to make future recommendations or adjustments to what is currently being done and hopefully improve health outcomes.
When looking for reliable health information the Center for Disease Control (CDC) and the World Health Organization (WHO) are go to sources. According to the CDC’s mission on their website the “CDC looks to increase the health security of our nation. As the nation’s health protection agency, CDC saves lives and protects people from health threats. The CDC conducts critical science and provides health information that protects our nation against expensive and dangerous health threats, and responds when they arise” (Mission, Role and Pledge, 2022). The “WHO is the United Nations agency that connects nations, partners, and people to promote health, keep the world safe, and serve the vulnerable- so everyone, everywhere can attain the highest level of health” (About WHO, n.d.). The CDC collects and analyzes data from the US and the WHO does the same outside of the US. From the information they gather they formulate health recommendations and push them out to the public.

WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person’s work (World Health Organization: WHO, 2022). Per the Centers for Disease Control and Prevention (2022) and the WHO (2022) it is recommended that people in the 6 to 17-year-old range get 60 minutes or more of moderate to vigorous physical activity daily. Over the 60 minutes daily, it is recommended there is a mix of aerobic, muscle-strengthening, and bone-strengthening activities included 3 days a week for each. For Adults over the age of 18, it is recommended to do at least moderate-intensity physical activity for a minimum of 150 to 300 minutes. As cited by Hollis (2017) moderate-to-vigorous activity during adolescence has been positively associated with a host of physiological and psychological outcomes such as cardiorespiratory fitness (Gutin et al., 2005), reduced metabolic disease risk (Ortega et al., 2007), and better mental health (Sabiston et al.,
However, even though the data is out there on the benefits of meeting the recommendations for physical activity, the numbers reported to meet those recommendations are very low. According to a National Center for Health Statistics data brief in 2022, statistical analysis of reported physical activity in 2020 by Elgaddal et al. (2022) showed that only 24.2% of adults 18 and over met the recommended physical activity guidelines. The children and adolescent numbers were almost the same per the CDC (2017) at 24%. The numbers reflect that adults and children in the US are not physically active enough.

Physical inactivity isn’t just a problem in the US. As cited by the WHO (2022) 28% of adults aged 18 and over were not active enough in 2016. It was revealed that high-income countries like the US had a higher percentage, 26% of men and 35% of women, of physically inactive people than low-income countries, 12% of men and 24% of women. In comparison to the resources that the low-income countries have access to versus the high-income countries, I would have thought that high-income countries would have better outcomes. Yet that was not the case and they have increased in the number of people who are insufficiently active by 5% between 2001 and 2016 (WHO, 2022). When looking at the numbers stateside and globally it is a saddening state of affairs. The data shows that there needs to be changes to get people more active to reap the proven benefits of physical activity.

According to the data studied by the CDC (2022), when people are not meeting the physical activity recommendations it has been shown that it can lead to an energy imbalance and increase the risk of becoming overweight or obese, increasing the risk factors for cardiovascular disease (hyperlipidemia, high blood pressure, obesity, and insulin resistance/glucose intolerance), increase the risk for type 2 diabetes, increase the risk for certain cancers (breast, colon, endometrial, lung), and low bone density leading to osteoporosis. In comparison,
according to the data studied by the WHO (2022) it was found that getting the recommended amount of physical activity leads to strengthening our hearts, bodies, and minds. Helps prevent and manage diseases like cancer, diabetes, and cardiovascular disease. It can reduce symptoms of depression and anxiety and even enhances thinking, learning, and judgment skills. When you compare the possible outcomes of choosing an inactive lifestyle versus an active it seems like an easy choice. Yet as we have seen from the reported numbers for physical activity in the US and Globally the majority of people have chosen not to follow the CDC/WHO guidelines for physical activity.

**Participation/Motivation**

Participating in physical activity based on the recommendations set forth by the CDC and WHO is linked to many health benefits, both physically and mentally. Despite knowing the benefits, the majority of people fail to meet the recommendations. In this portion of the review, we are going to look at participation and motivation for physical activity. Focusing on adolescent-aged school students. Focusing on this group will be helpful to gain understanding of what can motivate them to participate in physical activity into and throughout adulthood.

When the CDC (2022) looked at the physical activity behaviors of young people they found that only 24% of kids aged 6 to 17 participate in 60 minutes of physical activity every day. As cited in a study by Miller et al. (2022) it was shown that the physical activity level from childhood to adolescence drops drastically. It was also cited by Miller et al. (2022) that physical activity levels from adolescence have a big influence on the student’s level of physical activity into adulthood. According to Chen et al. (2014) PE can significantly increase total physical activity in youth which has been shown to have a positive influence over a person’s lifetime. However, according to Lee et al. (2007) only 2.1% of high schools offer daily PE. Even those
who do offer it daily still may be missing the mark. It has been shown that only 27% to 47% of class time in physical education classes are spent on physical activity according to a study cited by Miller et al. (2022). According to SHAPE America (2016) the primary goal of physical education classes are to ignite an interest in physical activity that transcends beyond participation during class time. When I look at the numbers and the lack of opportunities for students to be physically active in schools, it shows that we need to find ways to provide students with more opportunities that focus on being physically active.

The low participation numbers show the need to find ways to improve participation in physical activity. Motivation is something that is looked at as a way to do this. As cited in a study done by Sulz et al. (2020) students’ motivation in physical education class has been linked to effort, levels of physical activity during class time, intensity of involvement, intention to engage in physical activity during leisure time, and participation in elective physical education. It was also stated that student motivation leads to increased enjoyment, interest, and higher positive affective states during physical education class. The study looked at students’ motivation over 4-months using the self-determination theory (SDT). According to Deci and Ryan (1985, 2000) SDT posits there are three basic needs to which humans strive to satisfy: autonomy (i.e., a sense of choice), competence (i.e., a sense of efficacy), and relatedness (i.e., a sense of social connection). It is theorized that meeting these needs will improve student’s motivation and result in positive outcomes. With these more positive outcomes, they believed students would increase enrollment in elective PE classes. The study showed that it wasn’t effective at increasing the participant’s psychological need satisfaction. However, it did show that females who were in the intervention groups did increase their likeliness to enroll in elective physical education classes.
In other words, meeting the self-determination theory needs of female students seems to increase participation in physical activity in physical education classes.

In a study conducted by Haug et al. (2023), they looked at body-related concerns and participation in physical education. The study involved 2140 secondary students from Norway. Body-related factors looked at were body mass index, health complaints, body perception, and dietary behaviors. They measured motivation with the Perceived Locus of Causality scale looking at three factors (autonomous motivation, controlled motivation, and amotivation). Participation levels were self-reported on a weekly basis as participation in class each week and with how much time they spent in the moderate to vigorous physical activity zone in class. As cited by Haug et al. (2023) when planning high-quality PE classes for adolescents educators should take into account the need for a supportive and motivational climate that is sensitive to body-related issues of students. According to Sabiston et al. (2019), physical education classes could be a place to increase body appreciation. It has been shown by Bevins et al. (2010) that having a good body image is associated with good engagement and physical activity in PE. However, according to Kerner et al. (2017), although it should be obvious that dimensions of body image should be understood and accounted for, they are often ignored and overlooked. This shows that physical education educators need to make it a priority to include this in the planning of their classes to increase motivation to participate in physical activity in class.

**Pedometers**

In today’s physical education classes, educators are looking for ways to add accountability pieces for their students. One of these accountability tools that has been utilized is by using pedometers. Pedometers allow the teacher and students to track how many steps each student takes during class. These can be used to help motivate students to be more active during
class, set goals based on previous data, and have data to track over time to see if they are reaching any goals they set for themselves. They also provide the educator with concrete data to have conversations with students and as accountability pieces when having those conversations. It adds another piece to the puzzle of educating students about being active and staying healthy. According to Froberg et al. (2019) without monitoring mechanisms, it is challenging for physical education teachers to get a notion of the extent to which lessons are providing physical activity, evaluate the effectiveness of efforts to increase physical activity, and determine whether students are reaching the recommended 50% moderate to vigorous physical activity target. Thus raising good reasons to incorporate step trackers into the class setting.

A study by Fromel et al. (2021) looked at the physical activity levels of adolescents aged 12-18 in 143 Czech and 99 Polish schools. They took step count data from 4911 students who were part of teaching practice and another 1827 students in a normal school setting. In both settings, they used pedometers to track student’s steps. As cited in the study they have seen a decrease in physical activity, not enough vigorous physical activity, and insufficient compensation for educational strain by physical activity in the Central European region. Even though they have seen a decrease in physical activity and the benefits physical activity provides, there still is a struggle for physical education to improve its academic position when compared to core subjects. This is not just a problem in Central Europe but a problem in the US as well. An article from the Harvard School of Public Health about preventing obesity in 2016 said “according to the U.S. Government Accounting Office, which reviewed the most recent national data, physical education instruction time has decreased in the U.S., and only 4 percent of elementary schools, 8 percent of middle schools, and 2 percent of high schools in the U.S.
offered daily physical education (or its equivalent) in 2006 (Staying Active Throughout the School Day, 2016). The trends in instructional time since have remained steady.

In the study by Fromel et al. (2021), they had an objective of identifying the real average step counts of the students in the study. This would allow them to come up with recommendations on how to improve their PE programs. According to the study boys with PE lessons in the school averaged about 749 steps per school hour and girls averaged 627 steps per school hour. On days without PE, boys averaged 371 steps and girls averaged 370. In looking at this data the steps per hour are similar when boys and girls did not have a PE class but boys had a significantly higher amount of steps than girls on PE days. It is recommended that students achieve 2000 steps per PE lesson and 11,000 steps of physical activity daily. In Fromel’s study, he found that boys in the study averaged 2390 steps per class and girls averaged 1851 steps per class. Through this the boys were able to achieve 21.7% and girls 16.8% of their recommended daily steps during a PE lesson. This shows the impact that PE classes have on students achieving their daily recommended steps. On PE days they can achieve 45% or more of their steps as opposed to 27% on non-PE days.

Tracking steps is a great start for tracking student’s activity but it doesn’t necessarily tell us the activity zones that students are participating in. In a study done by Hartwig et al. (2019), they were developing and validating a system capable of providing feedback on PE lessons for moderate to vigorous physical activity (MVPA) using each student’s steps. In the study, they took 492 students and had them wear an ActiGraph GT3X+ and Yamax Digi-Walker SW pedometer. They were looking at the accuracy of the low-priced Yamax pedometers to the pricey ActiGraph GT3X+’s. The ActiGraph monitors connected to an app that generated each user’s MVPA. It was determined that “there was a strong correlation between step counts and
accelerometer-determined %MVPA and quantile regression equations showed good validity for translating step counts to %MVPA” (Hartwig et al., 2019). During the study, they also created a spreadsheet with the formulas used that calculate students’ steps into their %MVPA. This helps with another piece of data the educator can share with the students and show them what % zone they were in during class.

A determining factor for some educators on what tracking tool to use is price and what their budget looks like. In the study, the two items used were the Yamax pedometer which cost around $13 compared to the more high-tech ActiGraph accelerometer which costs around $350. The study demonstrated the accuracy of the affordable Yamax pedometer and using the formulas created are good tools to determine the student’s %MVPA for each class. Allowing educators with a limited budget to afford the less expensive trackers and still expect good results. The trackers allow the educator to provide feedback to the student on their activity. It also allows the educator to evaluate their lessons and see if they are achieving the goal of students being in the 50% MVPA zone during class time. However, in a study by McCaughtry et al. (2008), they experienced some issues with students shaking their pedometers to achieve higher step counts. This would cause the %MVPA scores to be higher than what the student achieved. Knowing this shows the importance of educating the students on how to properly use the equipment and monitoring them closely to ensure they are using the equipment properly.

Heart Rate Trackers

Along with pedometers, heart rate monitors are a good tool for physical education classes. The use of heart rate monitors in the PE setting can help students monitor and track the intensity of their activity in class. As cited in a study by Hartwig et al. (2019) physical education
INFLUENCE OF STEP/HEART RATE TRACKING

recommends that school students engage in MVPA for at least 50% of the PE lesson time. With the help of heart rate monitors educators can provide data to the students to help them understand where they are at with this in class and connect it to the health benefits associated with it. Providing this understanding can lead to higher motivation in students and more engagement in the PE setting.

When introducing heart rate monitors into the physical education setting we want to make sure the data collected is accurate. According to a survey by the American College of Sports and Medicine, wearable fitness trackers were listed as the top fitness trends in 2016, 2017, 2019, and 2020 (Chow and Yang, 2020). Photoplethysmography (PPG) is one of the newer less invasive wearables that track heart rate. In a study conducted by Damasceno et al. (2022) and cited in the article by Mckeown (2022), they looked at how accurate a PPG sensor was compared to an electrocardiogram (ECG). The PPG works by detecting the increase and decrease of blood volume. These are wearables that can be worn on the wrist or forearm and avoid the need for chest straps. The PPG readings were compared to ECG readings for heart rates as the ECG has been confirmed as an accurate way to calculate heart rate in a clinical setting.

In the study by Damasceno et al. (2022), they used 28 males in the age range of 18 to 32. The participants wore a Garmin 735XT heart rate monitor and were connected to an ECG machine. Readings were taken every 20 seconds with both devices while participants were at rest for 10 minutes. After the rest period, they had the participants walk or run for 20 minutes. According to Damasceno et al. (2021), the study found a strong correlation between the ECG and PPF monitor at rest (r=93) and during exercise (r=96). The study shows that PPG technology would be an accurate tool to use to track student’s heart rates in class at rest and during activity. Despite those results, a study conducted by Boudreaux et al. (2018) as cited by Chow and Yang
(2020), had participants use 8 different fitness trackers, and an increase in exercise intensity reduced the accuracy of heart rate measurement. With this knowledge, it would be important to study the accuracy of different PPG devices to find the most accurate ones.

In a study by Racette et al. (2015), they looked at the influence of Physical Education on MVPA. They did this over a three-year period from 20011 to 2014 collecting HR data from 81 students from 4 urban schools in St. Louis, Missouri. The study had the students where Polar E600 heart rate monitors throughout the school day. Heart rate information was collected and split up into days with PE and days without PE. The data was then compared against each other. The data showed that during PE days students were able to get 44.4 minutes of activity in the MVPA zone compared to 30.6 minutes without PE. This shows that PE classes play an important role in students being able to achieve the recommended 60 minutes per day of MVPA. Without the heart rate monitors to gather the data of the participant’s heart rate it would be hard to determine the amount of time in MVPA. However, in a study by Garcia-Ceberino et al. (2022), they compared the rates of perceived exertion (RPE) from students to heart rate data from monitors of students in class to see if the RPE method lines up closely with the HR data. The study showed that the RPE could be used as a suitable alternative for planning and monitoring the intensity of students in PE classes. From the studies, heart rate monitors provide more concrete data for determining the amount of time in MVPA during class. If such devices are not available, having students use the RPE scale for their activities could be an alternative.

**Conclusion**

Research on physical activity recommendations shows many health benefits from achieving the recommended amount of physical activity throughout the day. Per the Centers for Disease Control and Prevention (2022) and the WHO (2022) it is recommended that people in
the 6 to 17-year-old range get 60 minutes or more of moderate to vigorous physical activity daily. As cited by Hollis (2017) moderate-to-vigorous activity during adolescence has been positively associated with a host of physiological and psychological outcomes such as cardiorespiratory fitness (Gutin et al., 2005), reduced metabolic disease risk (Ortega et al., 2007), and better mental health (Sabiston et al., 2013; Biddle, 2011). So hitting this mark is an important way to promote a healthy lifestyle into and throughout adulthood.

Although the recommendations and benefits are clear when the CDC (2022) looked at the physical activity behaviors of young people they found that only 24% of kids aged 6 to 17 participate in 60 minutes of physical activity every day. Physical education has been shown to increase a student’s physical activity which can influence their physical activity habits into adulthood. Knowing this has led to educators looking for ways to help increase motivation to participate in physical education. Incorporating technology into the classroom has seemed to be a way to do this. Pedometers and heart rate monitors have been shown to provide positive results from the research. According to Fromel et al. (2021), it is recommended that students achieve 2000 steps per PE lesson and 11,000 steps of physical activity daily. As cited in a study by Hartwig et al. (2019) physical education recommends that school students engage in MVPA for at least 50% of the PE lesson time. Including pedometers and heart rate monitors in the physical education setting has a positive effect on students being more motivated to participate in class. Resulting in them coming closer to hitting the recommendations for daily physical activity, steps per class, and being in the MVPA zone while in class.

**Methods**

**Research Questions**
Influence of Step/Heart Rate Tracking

The questions that were looked at through the research were related to what type of effect using fitness trackers had on student’s participation in physical education:

- How does incorporating pedometers affect student step count (participation) in physical education?
- How does incorporating heart rate monitors affect student’s %MVPA zones (participation) in physical education?

Setting

The school in which the research was conducted is located in Southeast Iowa. The program is a 9-12 alternative school program for the district. The socioeconomic breakdown of the students in the program ranges from lower middle class to below the poverty line. There are 50 students in the program. 68% of the students qualify for Free and Reduced Lunch. The demographic breakdown of the program is as follows: 70% Caucasian, 14% mixed race, 10% African American, and 6% Latino/Hispanic.

Two classes of physical education took part in the research. Each class was offered to take part in the research by wearing a step tracker and/or a heart rate tracker during class. The classes took place in the gymnasium of the school. The fourth-period class was working through a volleyball unit. The whole gymnasium was used for the lessons and games. The fifth-period class was working through a basketball unit. They completed their lessons and games using half of the gymnasium.

Participants

There were ten students in the fourth-period class for volleyball. Students chose if they wanted to participate in the project. Of the ten students eight participated in the research. All eight students chose to use a pedometer as the mode to track their steps. None of the students
wanted to use the heart rate trackers. The participants in this class consisted of one senior, three juniors, three sophomores, and one freshman. Two participants were male and six were female. Student’s activity data from the tracker they chose was used to show how active they were during the time of the study, helping answer the research questions.

There were nine students in the fifth-period class for basketball. Like the fourth-period class, students chose if they wanted to participate in the project. All nine of the students chose to participate in the research. All nine students chose to wear a pedometer for step tracking. Four of the students also volunteered to wear a heart rate tracker as well. The participants in this class consisted of five juniors, one sophomore, and two freshmen. All nine participants were male. Student’s activity data from the tracker they chose was used to show how active they were during the time of the study, helping answer the research questions.

**Variables**

The independent variables are the pedometers the students wore during class and the heart rate monitors the students wore during class. These were the independent variables because the participants in the research could choose which type of tracker they wanted to use during class.

The dependent variables in the research were the student’s participation and activity level during the physical education classes. Students were able to be observed during the lessons and games as they participated in volleyball during the fourth-period class and basketball in the fifth-period class.

**Plan for Data Collection**

For the fourth-period class, the participating students will be equipped with Accusplit Eagle AC 120 XL pedometers to track their steps during the volleyball lessons and games. The
pedometers will be zeroed out by the researcher before handing them over to the students to wear. Classes will be 47 minutes long and consist of a 10 to 15-minute skills lesson followed by a 25 to 30-minute game of volleyball. At the end of the class, the students will bring the pedometers to the researcher at the table and show the number of steps they achieved during the class. The data will be written on a data sheet and then into a spreadsheet on the computer after class. During week 1 the students will not be given any guidance except to just wear the pedometer and turn it in at the end of class. During week 2 the results of week 1 will be discussed with them from the previous week. They will then be given the goal of trying to get at least 2000 steps in during their class time. According to Fromel et al. (2021), it is recommended that students achieve 2000 steps per PE lesson. Students will be observed during the class period to make sure they were not inappropriately using the pedometers to achieve more steps than they were taking. In a study by McCaughtry et al. (2008), they experienced some issues with students shaking their pedometers to achieve higher step counts. With this knowledge, I believe this is something to look out for.

For the fifth-period class, the students will follow the same procedures as the fourth-period class while wearing the pedometers. The only difference is the students will participate in 10 to 15 minutes of a basketball skills lesson and then a 25 to 30-minute game. Four students will also be allowed to wear a heart rate tracker during class. The students who choose to use the trackers will download the Polar Beat app to connect to the trackers. The placement will be done by the researcher to ensure it was placed correctly and that it was not secured too tight on the forearm. Students will start the app once connected and then stop the app at the end of class. They will show the app to the researcher and the time in each heart rate zone will be recorded on a data sheet and then entered into a spreadsheet on the computer. During week 1 the students will not
be given guidance on the results they achieved. In week 2 the results of week 1 will be discussed with them and they will be given the goal of increasing their time in the higher heart rate zones in class. In a study by Van Klaveren (2017) he found results that suggest after using a HRM for a total of eight days, the students in the study showed an increase in HR, total time, and percentage of time in MVPA. This is something I am looking for with the research.

The research will take place over two weeks. Students who wore the pedometers during each day of the two weeks of class will have the steps achieved written down on the datasheet. The data will then be entered into a spreadsheet. For students who wore the heart rate trackers, they will start the app at the beginning of class and then at the end. They will present the information on the app and their data will be written on the data sheet and then entered into a spreadsheet. The goal is for each student to have a minimum of two days of data for each week. Data for week 1 will be totaled by person and by class. An average will be found. The same will happen for week 2. The data from week 2 will be compared to week 1 looking at what the influence was of using the pedometers and heart rate trackers.

Data collected each day on the data sheet was stored in the teacher’s desk which was locked each day. The room in which the desk was located was locked at all times when the researcher was not in the room. The computer for which the data was entered was password protected and locked in the researcher’s room whenever the researcher was out of the room.

**Plan for Analyzing Data**

The data that will be collected from the pedometer and entered into the spreadsheet will be totaled and averaged by the number of days they participated in week 1 and then week 2. Week 2’s results will then be compared to week 1’s results to see the impact the pedometers had on the student’s step counts during class. The same procedure will be done for the heart rate tracker
information that will be entered into the spreadsheet. Instead of steps being the main data, the heart rate tracker data will look at how much percentage of time the students spent in the MVPA zone during the class. Data from week 1 and 2 will be averaged for each week. Week 2 will then be compared to week 1 to see what impact the heart rate trackers had on students’ time in the MVPA zone. A dependent sample T-test will also be used to compare the data for both steps and heart rate. According to the National University Academic Success Center the dependent samples t-test is used to compare the sample means from two related groups (LibGuides: Statistics Resources: Dependent Samples T-Test, 2024). Both sets of scores come from the same people, trying to find a change from one measurement to the other. This is a good test for the step and heart rate tracking data collected and compared in the research as it is compares week 1’s student data with week 2’s student data. All involved the same students throughout the 2 weeks of research.

**IRB**

An application for IRB approval was submitted to and approved by the Northwestern College Institutional Review Board, Orange City, Iowa for this action research. Informed consent forms will be discussed with the students and sent home with the students who agree to participate in the research. They will obtain parent/guardian signatures and return them before the research begins. At the end of the research, the participants will be given the debriefing form and reminded that at any time they wish to have their data excluded from the study they could do so by using the contact info on the debrief form. Approval from the building principal was also received to conduct the research project in the physical education classes.

**Data Collection**
Data collection for this research was quantitative. Data was collected by students wearing a pedometer or heart rate sensor. The collection took place during two class periods each week. There was a two-week window for the research in which the step and heart rate data were collected to be analyzed. After the research has finished, the data will be analyzed by looking at the step counts for each student who wore a pedometer and % of the time in the MVPA zone for those who wore a heart rate monitor.

In the fourth-hour class, the students who chose to participate in the research were equipped with a pedometer. The pedometer was zeroed out by the researcher before handing it to the participant and observing them place the pedometer. This was to ensure it was placed correctly to get accurate results. Students then participated in a 10 to 15-minute volleyball skill lesson and a 25 to 30-minute game. The pedometer tracked their steps during class time. At the conclusion of class, the students brought over the pedometer, took it off, and told the researcher their steps for the day. The researcher wrote down the steps on the data sheet and confirmed what they were told by looking at the pedometer screen (Table 1). Once the researcher was done with classes the data was entered into a spreadsheet to be calculated for analysis after the research was completed.

In the fifth-hour class the students who chose to participate in the research with a pedometer, the pedometer was zeroed out by the researcher. Then observed them place the pedometer on them to ensure it was placed correctly for accurate results. For the students who agreed to wear the heart rate sensors, they were handed the sensor after they put on the pedometer. The researcher observed them placing it on their forearm and checked the tightness of the strap to ensure it was placed correctly. Once confirmed it was placed correctly the researcher had the student open the Polar Beat app to ensure connection of the device to the app.
Once the connection was confirmed then the student would choose to start on the app to start tracking their heart rate data. The students would then participate in a 10-15 minute basketball skills lesson and a 25-30 minute game. The pedometer and heart rate sensors tracked their data as they participated in the activities. At the end of class, the students returned the pedometer and told the researcher the steps they achieved. The number was written down (Table 1) and confirmed with the number of steps on the pedometer. The students who wore the heart rate trackers returned the tracker and showed the heart rate data that was collected in the app. The data was written down on the datasheet by the researcher (Table 2). Once the researcher returned to the office the data was entered into a spreadsheet to be calculated for analysis after the research was completed.

**Table 1**

*Steps Data*
### Table 2

*Heart Rate Data*

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Findings

Data Analysis

Of the students participating in the research, only those with two days of pedometer and heart rate data collected for week 1 and also two days of data collected for week 2 were included in the data analysis. The fourth-period class included five out of the eight students who participated using pedometers. The fifth-period class included eight out of the nine students who participated with pedometers and three out of the four students who agreed to also wear the heart rate monitor. The participants whose data were excluded did not meet at least 2 days a week of data collection for both week 1 and week 2.
Fourth-period step data collected over the 2-week research period in Chart 1 below showed that all students who met the threshold for data collection each week increased their step count on average 555 steps from week 1 to week 2. The average steps in week 1 were 1969 and went up to 2525 for week 2. The week 1 range was 865 steps and week 2 was 604. A dependent groups t-test was run and revealed that there was a statistically significant difference in week 1 steps (\(M=168.8, \text{SD}=326.44, n=5\)), as compared to the week 2 steps (\(M=2524.2, \text{SD}=254.89, n=5\)) following the explanation and goals set from week 1 to week 2 with the students (\(p=0.0059348424, p>0.001\)). The data in Chart 2 below showed a frequency of 2 for the amount of steps increased in the range of 251 to 500 for the participants.

Chart 1

*Period 4 individual student steps week 1 vs week 2*

![Chart 1](image1.png)

Chart 2

*Period 4 step frequency chart*
Fifth-period step data collected over the 2-week research period in Chart 3 below showed that all students who met the threshold for data collection each week increased their step count on average by 873 steps from week 1 to week 2. The average steps in week 1 were 3181 and went up to 4054 for week 2. The week 1 range was 1648 steps and week 2 was 2022. A dependent groups \( t \)-test was run and revealed that there was a statistically significant difference in week 1 steps (\( M=3181, \ SD=694.81, \ n=8 \)), as compared to the week 2 steps (\( M=4053.5, \ SD=632.09, \ n=8 \)) following the explanation and goals set from week 1 to week 2 with the students (\( p=0.0012002679, \ p>0.001 \)). The data in Chart 4 below showed a frequency of 4 for the amount of steps increased in the range of 1000+ for the participants.

**Chart 3**

*Period 5 individual student steps week 1 vs week 2*
Chart 4

*Period 5 step frequency chart*
INFLUENCE OF STEP/HEART RATE TRACKING

Fifth-period heart rate data collected over the 2 week research period in Chart 5 below showed that all students who met the threshold for data collection each week increased their percentage of time in the MVPA heart rate zones for class by 6%. The average time of class spent in the MVPA zone in week 1 was 74% and increased to 80% for week 2. The week 1 range was a 6% increase in class time in MVPA for heart rate and week 2 was 14%. When a dependent groups $t$-test was run it revealed that there was not a statistically significant difference in week 1 % in MVPA for class time (M=0.74, SD=0.032, n=3), as compared to the week 2 % for class time (M=0.81, SD=0.073, n=8) following the explanation and goals set from week 1 to week 2 with the students (p=0.1216899343, p>0.10). The data in Chart 6 below showed a frequency of 2 for the amount of steps increased in the range of 6 to 10% for the participants.

Chart 5

*Period 5 individual % time in MVPA week 1 vs week 2*

Chart 6
The data analysis above it showed that the data from pedometer use in periods four and five had a statistically significant difference in steps from week 1 to week 2. Each student was able to increase their steps throughout the study period. When looking at the data analysis for the heart rate trackers used in period five it did not show a statistically significant difference in the data collected. All students increased their time in the MVPA but it was a small sampling of three students included in the data collection.

**Discussion**

**Summary of Major Findings**

The action research study shows that the use of pedometers in the fourth and fifth-period classes led to an increase in the steps achieved for each student from week 1 to week 2. All the students who gathered enough data to qualify increased their steps. On average students increased their step count by 555 steps in period 4 and 873 steps for period 5. According to Fromel et al. (2021), it is recommended that students achieve 2000 steps per PE lesson. The data
showed that in week 2 all participants were able to achieve this. Through the use of pedometers and goal setting for the students, it can be said that the study showed a positive impact on student’s motivation to participate in the PE activities provided. As cited by Gu et al. (2018) practitioners should be aware that goal-directed action can contribute to school students’ PE-related achievement motivation, motor competence, and achieving the recommended 60 min of moderate-to-vigorous physical activity.

The other area observed was the use of heart rate monitors by 3 students during the fifth-period class time. Through the data collection, it showed that all three students increased the amount of time in class they spent in the MVPA zone from week 1 and week 2. The increase came during week 2 with the participants averaging a 6% increase in time spent in the MVPA zone. As cited by Hartwig et al. (2019) physical education recommends that school students engage in MVPA for at least 50% of the PE lesson time. All students who participated were above 50% and raised their percentage in week 2 of the study. The heart rate data was paired with a goal after week 1. The data showed a positive impact on student’s motivation while participating in the PE activities provided.

Using pedometers and heart rate tracking devices will allow educators to concrete data. According to Bassett et al. (2010), pedometers provide an accurate, objective, and low-cost method of measuring walking and other ambulatory activities. This will influence teaching and assessment, both for the students, and the lessons planned and taught by the educator. The information can be shared with students to show engagement through their activity data and used to set goals for improvement throughout the year. Using the heart rate trackers with the students would also allow educators to incorporate the different zones of fitness that go with the % of MVPA. Knowing the zones allows educators and students to set goals based on their desired
fitness outcomes. For educators, the data collected from both trackers can be a good tool to assess how much activity there is during the PE lessons. This will help to assess the students and the lessons being taught. With the goal of students being in the MVPA zone 50% of class time, we now have a way to track this information. This will be helpful to allow educators to tweak the lessons showing students spending less time in the zone. It is also useful to motivate students to achieve a better grade by being more active.

**Limitations of the Study**

The size of the classes in the study was rather small with 5 students having qualifying data for the research on steps in fourth and 8 students in fifth period. Also, in fifth-period I had only 3 students who gathered the required data for heart rate tracking. More students would have provided more data to compare the results with and provided better confirmation of the results for the research. Another limitation of the study was it was only conducted over two weeks. A better situation would be to have the research conducted over a longer time frame to see if the newness of using the trackers wore off, rather than just a one-week change. Finally, my fourth-period class consisted of one male and the rest females who collected the required data. The fifth-period class was all male participants. I would have liked to have a more even split to compare the data of male versus female participation using the trackers.

**Further Study**

A future step for this research would be to use the pedometers and heart rate trackers over a longer period of time such as a longitudinal study. According to Caruana et al. (2015), longitudinal studies employ continuous or repeated measures to follow particular individuals over prolonged periods of time. They also stated that since data is collected for given individuals within a predefined group, appropriate statistical testing may be employed to analyze change
over time for the group as a whole, or for particular individuals. I think it would be beneficial to track data of students throughout a full quarter at a minimum and up to a full year. This would provide data throughout the year on the influence these tools have in regard to motivation to participate. Enabling the researcher to see if the short-term gains that were shown in the student’s participation would last over longer periods of time

Another area for future research would be to study the different types of activities done in physical education. Looking at different ways to structure classes to get students working in the MVPA zone for at least 50% of the class time. Depending on the unit you are teaching would factor in the types of things done during the lesson. As shown in a study by Costa et al. (2018) they looked at the differences in HR for basketball lessons and gymnastics. They found that there was a significant difference in the heart rates of students between the two sports lessons. With the basketball lessons reaching higher HRs. With this being the teacher would need to be more creative with the lessons that are not as physically active to add more movement for the students to reach the physical activity recommendations.

The final area of future research would be to incorporate a system of step and heart rate monitoring that would display live results for students. This would allow me to see if knowing the data in real-time would increase the number of students being more active. In theory, this would provide students with opportunities to adjust their activity level. This would be based on the live results being displayed. If there are predetermined steps or minutes in the MVPA zone for class they would know what they would need to do to achieve the goals for the day before class has ended. In a study done by Stockel and Grimm (2021), they looked at the real-time benefits of heart rate feedback in physical education. They found that in their study the level of physical exertion was higher in the group with real-time feedback than the group without. Also,
the students with real-time feedback reported enjoying the activity more than the other group. This shows that real-time feedback can be beneficial in the classroom in increasing participation.

**Conclusion**

Physical activity is a crucial part of a healthy lifestyle. The literature review showed that according to the Centers for Disease Control and Prevention (2022) and the WHO (2022), it is recommended that people in the 6 to 17-year-old range get 60 minutes or more of moderate to vigorous physical activity daily. Data has shown that a small percentage of children, adolescents, and adults meet the physical activity recommendations of the CDC and WHO. Only 24.2% (Elgaddal et al., 2022) of adults met the guidelines in 2020 and 24% (CDC, 2017) of children and adolescents met the guidelines in 2017. It was shown in a study by Miller et al. (2022) that the physical activity level from childhood to adolescence drops drastically and that physical activity levels have a big influence on physical activity levels into adulthood. The problem that needs to be solved is finding ways to get students to participate at a higher rate in gym classes and at more moderate to vigorous levels of exertion.

Physical education classes can be beneficial for students to gain skills and habits to lead a more physically active lifestyle. But according to data in the literature review of the time students are in physical education classes only 27 to 47% of class time is spent on physical activity (Miller et al., 2022). In a study conducted by Hartwig et al. (2019), they recommended that students spend at least 50% of the class time in the moderate to vigorous physical activity zone. When this is the recommendation it is important to have tools that can help us determine if this is happening in the classroom.

Two such tools that were looked at are pedometers and heart rate monitors. In the study by Hartwig et al. (2019), they were able to determine that pedometers were very accurate in their
step counts when compared to an accelerometer. According to Fromel et al. (2021), it is recommended students achieve 2000 steps per PE lesson. Using the pedometers provides the data needed to track this. The second tool was the PPG-style heart rate monitor. In the study by De Oliveira Damasceno et al. (2021), they showed that the PPG heart rate trackers showed similar readings to ECG’s when tracking heart rate for workouts. This information indicates we will be able to gather accurate information on heart rate to guide decisions in the classroom and with students.

The purpose of this action research was to introduce the use of pedometers and heart rate monitors in the physical education setting. The goal was to see what type of influence step tracking and heart rate monitoring would have on student participation. A quantitative study was used to compare the impact of the pedometers and heart rate monitors on student participation from week to week. Data was collected for two weeks from two different classes. Each class had its week 2 data compared to its week 1 data to see the impact the devices had.

Data analysis revealed that the pedometers had a statistically significant difference in the findings from data collected and compared from week 1 to week 2 but the heart rate data showed there was not a statistically significant difference from week 1 to week 2. Both tools showed an increase in the data collected from week 1 to week 2. The findings confirm that incorporating pedometers into the physical education setting could have a positive influence on student participation. I believe the heart rate trackers would as well but would need to gather more data to confirm this. Incorporating both tools into the classroom setting in the future will help drive more accountability in the classroom. As a benefit for the students, it will show them where they are and where they still need to go to reach the goals in the class. As an educator, it can help me
assess student’s activity levels. Also, I can look at how physically active my lessons are, with the goal of at least 50% of our time in class being in the MVPA zone using the data collected.
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