January 2012

Second Grade Students' Cognitive Understanding Of Heart Rate Monitors And Pedometers

Carolyn Lee Tozer

SECOND GRADE STUDENTS' COGNITIVE UNDERSTANDING OF HEART RATE MONITORS AND PEDOMETERS

by

Carolyn L. Tozer

Bachelor of Science, University of North Dakota, 2009

A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, ND
December
2011

This thesis, submitted by Carolyn Tozer in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

_____
Chairperson

_____

_____

_____

This thesis meets the standards for appearance, conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

_____
Dean of the Graduate School

_____
Date

PERMISSION

Title	Second Grade Students' Cognitive Understanding of Heart Rate Monitors and Pedometers
Department	Kinesiology
Degree	Master of Science

In presenting this thesis in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my thesis work or, in his absence, by the chairperson of the department or the dean of the Graduate School. It is understood that any copying or publication or other use of this thesis or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my thesis.

Signature _____

Date _____

TABLE OF CONTENTS

LIST OF FIGURES

FIGURE PAGE

ACKNOWLEDGEMENTS

I would like to thank the people that have supported me throughout my education and always kept pushing me to be a better person and to continue growing in my education.

Thank you to my father, Steven Grant. You have taught me to always drive for success in life and education. You are the one who really pushed me to continue with my education when times got tough, and never let me give up. Thank you.

Thank you to my husband, Graeme Tozer. You have been by my side helping me deal with the stresses and frustrations of life throughout the past seven years. You never gave up on me, and that means the world to me. Thank you.

Thank you to my thesis committee, Dr. Dennis Caine, Dr. James Whitehead, and Dr. Thomas Steen. And a special thanks to my committee chairperson, Dr. Jesse Rhoades. The endless hours put into making my thesis what it is today will not be forgotten. Thank you.

ABSTRACT

Childhood obesity has become a significant health problem in the United States (Dietz, 1998, Blair et al., 2007, Robinson, Wadsworth, 2010). In children, obesity is defined as being at or above the 95th percentile for BMI according to age growth charts (Carroll, 2006). There are several approaches to combating the epidemic of obesity. In physical education classes, teachers are using are heart rate monitors and pedometers to assess the students' levels of physical activity (Blair et al., 2007). However, it is uncertain if elementary students better understand the results from the pedometer, or the heart rate monitor. A study of eight-second grade students from an elementary school PE class in North Dakota was conducted in November and December of 2010. This study took approximately two weeks, and consisted of a demographics interview, Interview 1, brief ten-minute lesson on the two devices, four classes with students using the devices, and a second interview. The purpose of this study was aimed at three areas of understanding. The first was the second grade students' ability to distinguish which numbers displayed on the device(s) are high or low numbers. Second, was the second grade students' ability to explain what the results from the tools represented. Third, was the second grade students' ability to explain why they would have received a high or low number on the device in comparison to physical activity levels. The results from this study not only indicate that with little instruction, these second grade students are able to distinguish between high and low numbers, but that they are also able to explain why

they received high or low numbers on the devices after physical activity. However, it seems as though second grade students are still cognitively developing their ability to understand what the results from the tools represent. These findings imply that with little instruction, the use of heart rate monitors and pedometers at the second grade level are appropriate for assessing physical activity.

CHAPTER I

INTRODUCTION

Introduction/Literature Review

The United States is currently experiencing an obesity epidemic (Koplan, Kraak, & Liverman, 2005). Obesity in the United States is becoming an important public health issue in today's world as the number of obese children rises at an alarming rate (Blair et al., 2007, Robinson, Wadsworth, 2010). In 1974, the prevalence of obesity was 5% for children in America. In 2008, obesity was at a startling 15% in United States children (Carroll et al., 2010). In fact, "Obesity is now the most prevalent nutritional disease of children and adolescents in the United States" (Strauss & Pollack, 2008, p. 2845 Dietz, 1998, p. 518).

With regard to the premise that obesity is a "nutritional disease," Blair, Robinson and Wadsworth (2010) argue that obesity is also a direct result from a sedentary lifestyle. It is widely believed that people are lazy because they are obese (Billington, C., Blair, S.N., Brownell, K.D., Chambliss, H.O., & Schwartz, M.B., 2003). However, Blair (2008) has argued that people are obese because they do not get enough physical activity. The American Academy of Pediatrics (2010) and U.S. Department of Health and Human Services (2010) explain that obesity is a combined result of things like high calorie diets and low-energy expenditure. A study of primary aged school children that use modern technology, such as video games, suggested these technologies may have the effect of severely increasing obesity in children (Crawford, Hardus, Vurren, & Worsley, 2003).

Obesity has become such a significant health issue in the United States, that the American Public Health Association (2011) has implemented the Healthy People 2010 plan to decrease obesity and increase physical health in today's youth.

Obesity has been linked to dangerous health risks, such as premature death, high cholesterol levels, heart attacks, shorter life spans, hyperlipidemia, hypertension, and abnormal glucose intolerance. (Dietz, 1998, Beighle et al., 2003). In an effort to address these health problems some schools are trying to deal with obesity in children by measuring physical activity levels (Blair et al., 2007). In response, various schools in the United States have used pedometers as a way to measure physical activity during physical education (Morgan, C.F., Pangrazi, R.P., Beighle, A., 2003). The National Association for Sport and Physical Education has established standards for physical educators to help America's youth accomplish certain physical activity and health standards. These six standards attempt to encourage students to participate in a healthy level of physical activity both in and out of school:

- **Standard 1:** Demonstrates competency in motor skills and movement patterns needed to perform a variety of physical activities.
- **Standard 2:** Demonstrates understanding of movement concepts, principles, strategies, and tactics as they apply to the learning and performance of physical activities.
- **Standard 3:** Participates regularly in physical activity.
- **Standard 4:** Achieves and maintains a health-enhancing level of physical fitness.
- **Standard 5:** Exhibits responsible personal and social behavior that

respects self and others in physical activity settings.

- **Standard 6:** Values physical activity for health, enjoyment, challenge, self-expression, and/or social interaction. (American Alliance for Health, Physical Education, Recreation, and Dance, 2011).

The Center for Disease Control (2011) recommends that children participate in at least 60 minutes of physical activity each day. Schools are able to help increase children's physical activity when they include quality physical education programs. Through this emphasis on quality physical education, schools can help to reduce the risk of children becoming obese or having other health related complications (Centers for Disease Control, 2011).

To combat the obesity epidemic in the Unites States, states throughout the country are incorporating technology in physical education. Examples include, but are not limited to, North Dakota, Illinois, Hawaii, and New York. A school district in North Dakota has incorporated the Physical Education Program (PEP) Grant established by Carol M. White, in an effort to expand technology usage in physical education. The PEP program aimed to, "Expand and improve physical education programs through technology" (SPARK, 2009). A program in New York that was established, "In an effort to prevent obesity and all its deleterious effects among the school's children," is the VITAL (Values Initiative Teaching About Lifestyle) Program (Reynolds, 2010). Dr. William Manger established this program by donating 1,000 pedometers. One of the schools in the program is located in the New York suburbs (Reynolds, 2010). Many school districts throughout the United States have incorporated heart rate monitors and/or

pedometers into the physical education program as a means of reducing obesity in children.

Heart rate monitors and pedometers have been used to measure levels of physical activity in physical education classes throughout the United States for some years now (Cox, Greasley, Kolt, & Schofield, 2006). Many Physical education teachers hope that by measuring the levels of the students' physical activity during physical education classes they will be able to monitor how much exercise students are receiving during their classes (Hardman et al., 2009). It is thought that if a student hits that "magic number," of 11,000 to 16,000 steps per day, that they should be able to achieve a level of physical fitness (Cox et al.).

An extensive amount of research has been conducted on heart rate monitors and pedometers. Validity and reliability have been a major concern with the use of these instruments (e.g. Bates, 2006, Beveridge et al., 2000, Booth, 2002, Ladda et al., 2004, Montgomery et al., 2009). However, these instruments have only been compared to establish which brand, instead which type of instrument (heart rate monitor or pedometer) is more reliable or valid (e.g. Bates, 2006, Beveridge et al., 2000, Booth, 2002, Ladda et al., 2004, Montgomery et al., 2009).

Robinson and Wadsworth (2010), attempted to, "Provide an overview of physical activity recommendations for young children ages three to five, and cost-effective means to assess physical activity through step count pedometers" (p.95). Robinson and Wadsworth (2010) noted the children's behaviors and reactions to each activity. In one activity titled, "Designing a Route," children showed that they understood the relationship of the pedometer count to their activity level. Students were able to relate

low numbers on their pedometers to low levels of activity, and in turn understand why they had low activity levels. In contrast, these children were able to relate high numbers on their pedometers to high levels of activity. They also demonstrated that they understood why they had those high activity levels. Robinson and Wadsworth (2010) concluded, "The preschoolers became more aware of their own activity level and were able to quantify the number of steps that they obtained" (p.95).

It is important to understand which measurement tools are reliable and valid. Additionally, it is important to know which instrument (heart rate monitor or pedometer) is a better device for elementary students to understand the results displayed after different levels of physical activity. This is an important aspect to understand when measuring physical activity levels with heart rate monitors and pedometers. However, it has been neglected in past research. Nevertheless, before we are able to try to understand which tool elementary students better understand, elementary number sense must first be understood.

Chard and Gersten (2001) described that most children begin to understand numbers even before they arrive at elementary school. For example, most pre-kindergarten children understand that eight is bigger than three. However, most children that are younger than five do not understand numbers above ten. This is because numbers above ten generally require basic arithmetic for comprehension. Therefore, the majority of children do not really begin to grasp the concept of numbers greater than ten until they learn arithmetic in the early grades of elementary school. Thus, according to Chard and Gersten (2001), a hypothesis could be formulated that children in grades first through third would better understand the results from a pedometers, while children in

grades fourth and fifth would be able to better understand the results from a heart rate monitor.

According to Piaget, students in the second grade will typically be in the preoperational stage, with some students in the concrete operational stage of thinking (Furth, 1970). The students who are in the concrete operational stage are able to use symbols to represent objects in the environment. According to Payne and Isaacs, the students who are in the concrete operational stage can think in logically and operationally, as well as grasp the concept of conservation. They are able to problem solve and, "Have the ability to mentally modify, organize, or even reverse their thought processes." (p. 34). Piaget also explains that students in physical education should be engaged in ways they have "think," and to increase cognition through motor activity (Furth, 1970). Therefore, students in the second grade may be able to think logically, and understand what pedometer results mean. Additionally, they may be able to know how they received those results.

However, the ability to read the results from a heart rate monitor might be better described as being in the concrete operational stage. Consequently, elementary children would have a tough time with those results. Due to the connection we are trying to make in the current study, which is second grade students' ability to understand heart rate monitors and pedometers, this information will aid this study in the analysis of the results. In return, knowledge gained through this study could help to reduce obesity in childhood.

With regard to the obesity epidemic in children and adolescents in the United States, priority needs to be placed on driving home the message that physical activity

beginning in childhood needs to be taken more seriously (Blair et al., 2007, Robinson, Wadsworth, 2010). It would be advantageous to have children exercise in physical education (Balady et al., 2003). However, the understanding of the importance of the exercise is questionable if students are not able to understand the tools that are being used in measuring their physical activity. Without this key understanding students would not able to relate physical activity during school to physical activity outside of school. Increasing the ability of students understanding the measurement devices both in and out of school could help them to lead a more active lifestyle, which should be the goal of physical education (American Alliance for Health, Physical Education, Recreation, and Dance, 2011).

An example of this would be a student with a low score on a pedometer, who understands because of this low score that they need to get more physical activity whether during physical education class, or outside of physical education class. Similarly, a low time in the target heart rate zone on the heart rate monitor would accomplish the same understanding.

Purpose

The purpose of the current study was to determine which measurement device, second grade students better understand, the heart rate monitor or the pedometer. To this end, the current study sought to answer three questions. First, can second grade students distinguish between high and low numbers displayed on these devices? Second, are second grade students able to explain the results from a pedometer, and heart rate monitor? Finally, are second grade students able to explain why they would have received a high or low number on the device?

It is important to find a device that elementary students can easily understand. With a tool that they are able to understand, they might be able to monitor their own physical activity in a meaningful way. This meaning might be expressed in several ways. First, they will be able to distinguish between high and low levels of physical activity. Second, they will have several ways to assess their exercise. Third, they will be able to differentiate between activities resulting in higher and lower levels of physical activity. Finally, they will be able to apply this knowledge outside of the classroom.

CHAPTER II

METHOD

The procedures for the current study were developed to address the need for research performed in the area of elementary students' understanding of heart rate monitors and pedometers. The review of literature provided in Chapter One demonstrated that there is a need for a study in this area. The expectation of the current study is to gain more knowledge about second grade students' understanding of heart rate monitors and pedometers. The flow diagram pictured below shows in brief the process of the current study.

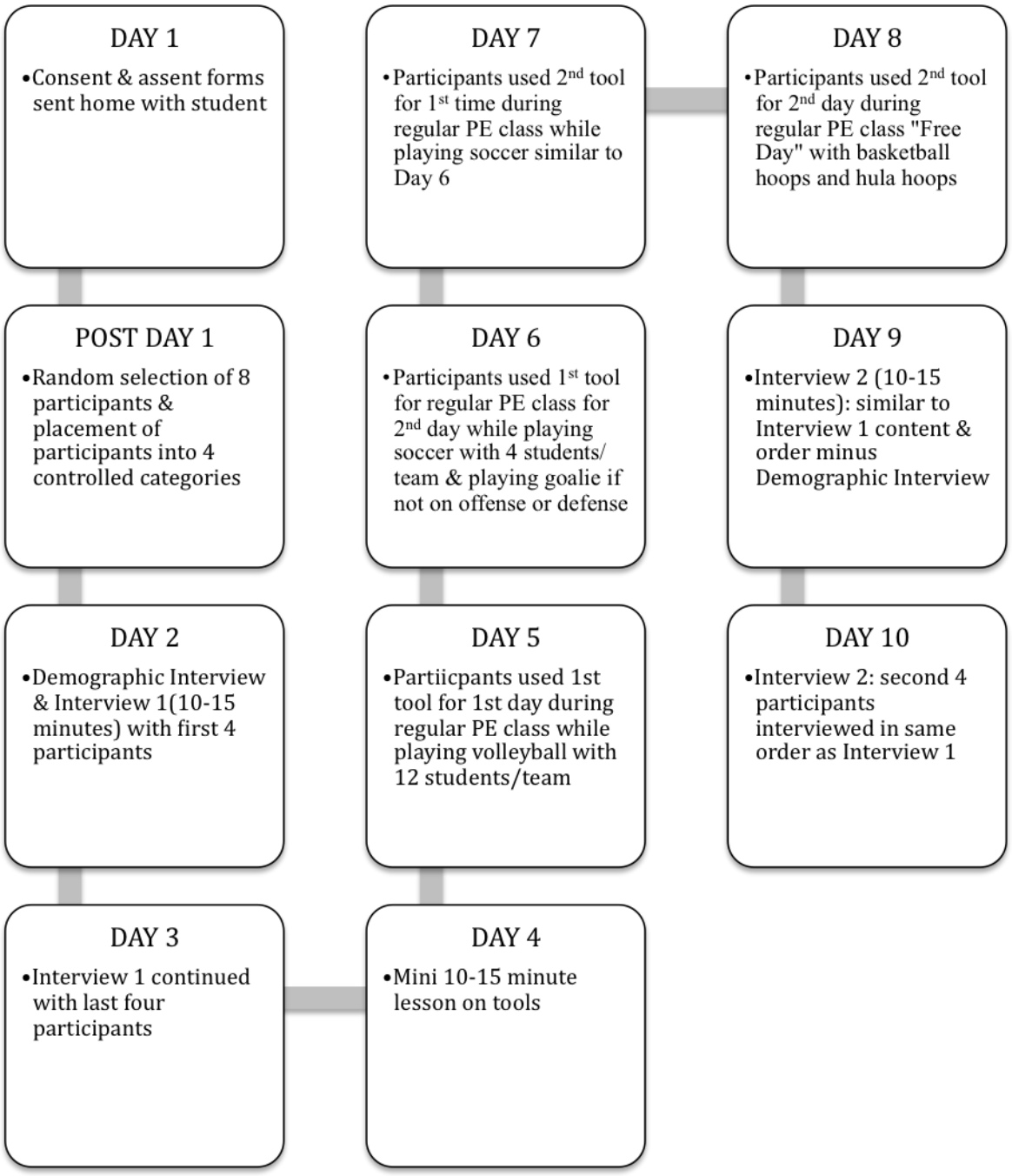


Figure 1. Flow Diagram of Study

Participants

Participants were recruited from a school in North Dakota. All participants completed informed consent and assent documents prior to data collection. The participants consisted of males and females in second grade with pre-operational to concrete operational thinkers (Issacs & Payne, 2008). There were approximately seventy-five eligible students for the sample. Out of these seventy-five, eight participants were randomly selected for participation in this study. Eight participants allowed for two participants in each controlled category. A larger sample would have been ideal, however North Dakota has small communities, and with only second grade students being studied, possible participant selection was minimal. All participants were enrolled and participating in regular physical education classes. The participants used for the study had little to no experience with heart rate monitors and pedometers, which was determined by a Likert questionnaire described later in the chapter. Letter of Consent

Due to this study's focus on second grade students, all participants were under age, and not able to sign a letter of consent. Instead students were asked to sign a letter of assent and their parents were asked to sign an informed consent document. These documents were sent home along with a brief questionnaire (See Appendix C). Of the seventy-five consent and assent forms that were sent home with the students, only sixteen forms were returned. Out of these sixteen returned forms, fifteen had both the assent and consent sections properly filled out and were able to be put in the eligible participant's pool for selection in this study.

The questionnaire asked the participants if they had ever used heart rate monitors and/or pedometers in the past. If their answer was yes, they were asked in what types of

settings they have used those tools (e.g. school, sports, home), and approximately how many times they had used them. The questionnaire also asked the participants if they had ever been given a lesson on heart rate monitors and/or pedometers. If their answer was yes, they were asked by whom they were taught the lesson, and how many times they have had lessons on the device. Finally, the questionnaire asked the participants their physical activity levels outside of physical education class (See Appendix C). After a participant returned the required documents each section of the questionnaire was given a total score by adding up the points from each question within that section (See Appendix C). The points given for each answer were zero points for A, one point for B, two points for C, and three points for D. The maximum score for the tools experience section was thirty-six while the maximum score for the physical activity section was twelve.

After each potential participants' questionnaires were scored, it became apparent that all scores in the tools experience section were well below expected (score of five and below). This, however, was a benefit, because a goal of this study was to select participants with very little if any experience with the physical activity measurement tools. Therefore, according to the potential participants' scores in the tools experience section, all were still eligible for participation in this study.

Subsequently, when scoring the physical activity section on the questionnaire, none of the potential participants had a score lower than six. With a maximum score of twelve in this section, this meant that there were no potential participants in the low physical activity category (score of one to four), only six potential participants in the moderate physical activity category (score of five to eight), and eight potential participants in the high physical activity category (score of nine to twelve). Initially, the

strategy was to select participants from the two extremes: high physical activity category, and low physical activity category. However, due to most potential participants scoring in the moderate or high physical activity category, it was decided to place all potential participants in the same moderate to high physical activity group. Therefore, this would be one variable that was externally controlled.

When selecting the participants after scoring the questionnaires, those with a score of two and below in the tools experience section were put in the pool for participants for the study. There were nine students in the group of minimal tool experience. Out of the nine in that group, all but one had scored a seven or higher in the physical activity section. Therefore, the participants were randomly chosen to participate by the scores on the Likert Questionnaires. All eight of the participants had a score of two and below on the tools experience section, and a score of seven or higher on the physical activity section.

The chosen participants were given a randomly selected participant number via a number written on the back of their questionnaire. From this point forward, any data collection, interviews and groupings were done so by using the participant's number. This helped to prevent any biased interpretations of the results when they were being analyzed.

Instruments/Measures

Pedometers

The pedometers used in this study were the Yamax Digiwalkers. Each participant wore one pedometer on his or her hip for two consecutive physical education classes.

The participants were not encouraged to either look or not look at their pedometers during the physical education class.

Numerous studies have examined the reliability and validity of both heart rate monitors and pedometers (e.g. Bates, 2006, Beveridge et al., 2000, Booth, 2002, Ladda et al., 2004, Montgomery et al., 2009). Additionally, studies have investigated various brands of pedometers, including Walk4Life LS2505 and Yamax SW701, New-Lifestyles, the NL-2000, and the Digi-Walker (Bates, 2006, Ladda et al., 2004).

Scruggs (2007) concluded that the LS2505 was a reliable and valid pedometer to measure physical activity, and that the Yamax pedometer was an invalid tool of measurement. However, Beveridge et al., (2000), found the Yamax pedometer to be a completely reliable and valid tool to measure levels of physical activity with an alpha coefficient of .70. A closer examination of these studies shows that both did not use the same means of comparison. Scruggs (2007) made a comparison between two different types of pedometers. Additionally these pedometers were used and examined as a means of observation for physical activity levels. Beveridge et al. (2000) examination of the Yamax pedometer only compared observation of physical activity, and not another brand of pedometer. These studies represent a conflict in the literature regarding the Yamax pedometer, however one confirms the validity of the LS2505. Bates (2006), however, did confirm the reliability and validity of the Yamax pedometer. Additionally, the review performed by Ladda et al. (2004) also found the New-Lifestyles, the NL-2000, and the Digi-Walker to be accurate pedometers as well.

Heart Rate Monitors

The heart rate monitor that was used to measure levels of physical activity in this study was the EKHO FiT 28. Due to this being a new brand of heart rate monitors there were no studies found to support the reliability or validity of the EKHO FiT 28.

The Polar Advantage XL is one of the more commonly used heart rate monitors in schools within the United States (Scruggs, 2007). Beveridge et al. (2000) studied the Polar Advantage XL and confirmed that this heart rate monitor was both reliable and valid when measuring levels of physical activity with an alpha coefficient of .85. Additionally, Bates (2006) found that most general heart rate monitors were valid, except for the PE3000.

Demographic Interview Used in Study

The demographics interview took place with all students individually being interviewed. Each participant was asked to verbally answer the questions (see Appendix D). The students' name, birth date, and level in school were recorded through field notes.

The research summarized in the previous chapter has explained a lack of results for an appropriate questionnaire of this study. Therefore, it was necessary to develop an interview guide specifically for this study (See Appendix E). The interview guide used in the current study was developed around the three research questions of the current study. Although each question on the interview guide may not directly relate to the three research questions, each of the questions were included to elicit responses regarding the three main research questions.

Interview 1.

The first interview took place with all participants individually and verbally answering questions over a two-day period. The interviews were conducted on the second and third days of the study and lasted approximately ten minutes. They were carried out in a secluded office to prevent distraction (see Appendix E). The interviews were performed over a two-day period to allow for possible adaptations to interview questions when necessary. Half of the participants were interviewed on Day 1 of the study, and the other half were interviewed on Day 2. The order in which participants were given their interviews was chosen at random.

During this interview, the participants were given two pictures. The first picture consisted of a Yamax Pedometer (See Figure 12). The second picture was of the EKHO Heart Rate Monitor and chest band (See Figure 13). The participants were asked to identify the object in the picture, and say what the object does. The students were then given sample data from the instrument pictured, and then they were asked what that data represented. Additionally, they were then asked to explain what the data specifically meant to them. The participants were asked what type of number (low 0-100, medium 200-500, high 500+) they should see after using the pedometer for one class period of physical education. The participants were asked the same sequence of questions for the heart rate monitors. However, due to the diverse data given by the heart rate monitors, the following sequence was followed. First, a random amount of time was given with an arrow pointing up. Second, a random amount of time was given with an arrow pointing down. Third, a random amount of time was given with a line next to it. Participants were asked to identify what these data meant. The last question for heart rate monitors

was also changed to ask if the students should have the highest number with an arrow pointing down, an arrow pointing up, or a line next to the number.

The goal for the first interview was to better understand second grade students' comprehension of physical activity measuring devices. The first area of understanding is the second grade students' ability to distinguish which numbers displayed on the device(s) are high or low. The second area of understanding is the second grade students' ability to explain what the results from the tools represent. Finally, the last area of understanding was the second grade students' ability to explain why they would have received a high or low number on the device in comparison to physical activity levels. These interviews were recorded with an audio recorder for later transcription.

Interview 2.

The second interview took place with all participants verbally answering the questions over a two-day period with individual interviews. Similar to Interview 1, the second series interviews were performed over two days to allow for changes and/or additions to the interview questions if necessary. The same questions and pictures from Interview 1 were used for Interview 2 (see Appendix F). The goal of the second interview was to assess the students' understanding of the tools in the same three areas from Interview 1. The order in which participants were interviewed followed the same schedule as Interview 1. These interviews were recorded with an audio recorder for later transcription.

Procedure

Prior to beginning the study, permission from the IRB and the school district was obtained. Data in the current study were collected between November 29 and December 21, 2010 with students from a North Dakota elementary School.

Initially consent, assent, and questionnaire forms were distributed to all students in second grade who were currently enrolled and participating in physical education classes. The researcher introduced herself and the study to the students' homerooms, where she distributed the forms. Only those students who returned a signed consent and assent form were eligible to participate in the study.

Once the eight participants were selected, through the questionnaire scoring method described previously, they were divided into four groups. The participants were first divided into two groups: high physical activity (score of 7-10), and maximum physical activity (score of 12). Next, each group (high PA and maximum PA) was split so there were two participants from the high physical activity group and two participants from the maximum physical activity group starting with heart rate monitors, and two participants starting with pedometers. Therefore, this process resulted in a total of four control groups used in this study: high physical activity with pedometer first, high physical activity with heart rate monitor first, maximum physical activity with pedometer first, and maximum physical activity with heart rate monitor first. Random selection was used to determine which participants from each group used the heart rate monitors first, and which students used the pedometers first.

Interview 1

On day one of the study four randomly selected participants were each given an oral demographic/interview 1, which took approximately fifteen minutes to complete. Following the demographic questions, students were given their first interview. Day two of the study consisted of the first interview for the last four participants.

During day two the participants began by being given a brief ten to fifteen minute lesson, by the researcher, on the pedometer and heart rate monitor. This lesson consisted of how to wear and operate the pedometers and heart rate monitors, how to read the results from the tools, and what the results represent. This included explaining what a target heart rate zone is, and what types of activities would make someone be in their target heart rate zone.

Beginning on day three, the tools were used for the first time. Each participant wore the heart rate monitor or pedometer for two consecutive physical education classes before switching. While using the heart rate monitors and pedometer, the participants were involved in their ordinary physical education classes. The first day using the tools the participants played games of volleyball. There were about twelve students per team. The second day with the tools the participants played soccer with four people per team. However, if a student wasn't playing offense or defense, they were playing goalie. The third day with the tools the participants played soccer in the same manner as the second day with the tools. The fourth and final day with the tools, the participants had a "free day" where they could play with basketballs and/or Hula Hoops. After each physical education class the participants were asked to look at their device. They were then asked to explain why they were getting those numbers on their devices and what types of activities would increase or decrease those numbers. Once all participants had used each

device for two physical education classes, the participants were given a second interview, orally.

Interview 2

The second interview lasted approximately ten minutes on days nine and ten of the study. Each participant was asked the same questions from the first interview. The first four participants who were interviewed on Day 1, of the study were interviewed on the first day for the second interview. The last four participants to be interviewed for the first interview were interviewed on the second day of the second interview. Once the second interview was completed for each participant, data collection was complete.

Data Analysis

When analyzing the data in the current study, inductive reasoning was used. Constant comparative and open coding was both a part of this inductive reasoning process. Open coding was used by keeping an open mind to generalizations and theories in the analysis of the current study. This allowed the researcher to take specific observations of the data, and to place them into more specific categories. The inductive reasoning allowed for more of a skeptical bottom-up approach to the data, versus having pre-selected themes and a top-down approach like deductive reasoning.

Performing all interviews over a two-day period completed the constant comparative aspect of inductive reasoning. Because there were eight participants in this study, four were interviewed on day one of the first interview, while the other four were interviewed on day two of the first interview. The same schedule was followed for the second interview. By performing half of the interviews on the first day, and half on the

second day, the researcher was able to go back and look at what was done during the first set of interviews, and make any adjustments as needed.

This process was also used during the coding of the data. All data were coded, and then re-coded to ensure correcting coding. Open coding was used during the current study to allow for emergent themes. An important part in inductive reasoning is finding common themes in the data. These themes become the categories for common responses. By using open coding, the themes of responses were not being forced into pre-formed categories that might not necessarily be appropriate. Instead, open coding allowed for the themes to come from common responses from the participants to the questions during the interviews. The themes were developed after all interviews took place, while noting common responses during the interviews.

Trustworthinesss

It is important to notice possible threats to ensure validity within the study. Because this was a study that involved interviews, there was the chance of interviewer intimidation. Because the participants had never met the interviewer before, they were put into an unfamiliar situation. To eliminate the possible interviewer intimidation, the participants were given a comfortable place to sit while being interviewed. They were also told that if at any time they did not know an answer, or did not want to answer a question, it was okay. Ensuring that the participants felt comfortable, and that there was no interviewer intimidation, hopefully eliminated the possibility of different responses during interviews due to intimidation instead of learning.

Some techniques to guarantee trustworthiness in a qualitative study are triangulation and peer debriefing (Lincoln & Guba, 1985). Performing member checks is

also another form of ensuring trustworthiness in a study (Patton, 2002). Both peer debriefing and member checking were used in this study.

Triangulation

Triangulation is the process of identifying possible outliers in the data (Jones, 1985). This was used in the current study to prevent any outliers from negatively influencing the data. The process of triangulation was used in the current study to compare participants' answers to interview questions within the same data set. Asking all participants the same questions, at several points throughout their interviews, did this. By making sure to ask all participants the same questions, all outliers could be identified during the data analysis if there was only one or two of the eight participants who had different responses to a question from the rest of the participants. By asking participants the same questions in various ways throughout the interviews, we were able to confirm the participant's answers as being their real answers to each question.

Peer Debriefing

To check the common tendency in qualitative interviewing towards personal bias, I used the strategy of peer debriefing. I arranged for another graduate student in my program to serve as my peer debriefer. I met with her several times during the study, and I shared with her my interview strategies and questions, and data analysis. I asked for her to look for any signs that my biases might have influenced my sense of what I heard the participants tell me. Out of the three times that we met, she said that she did not seem to see signs of bias. Peer debriefing allowed for the determination of an honest and accurate assessment of data and conclusion. Additionally, peer debriefing allows for a measure of

bias control (Lincoln & Guba, 1985). Performing this peer debriefing contributed to the credibility of this study.

Member Checks

Member checks were performed within this study as suggested by Patton (2002). Participants were given a chance to review their answers and make any changes they felt necessary. This was completed by asking the same question two or three times during each interview to the participants. This allowed for them to respond they same way they had the first time to the question, or to change their answer. Performing the member checks during both sets of interviews was a crucial piece to establishing trustworthiness in this study (Patton, 2002).

Negative case analysis

A negative case occurs when the data do not quite fit with the rest of the data. Patton (2002) refers to negative case as outliers. Following the typical practice in qualitative research, I looked carefully for outliers during the analysis of this study. The procedure I used is as follows. Questions asked during the interviews were not only questions that would support the research questions, but would also identify any outliers. Having questions that would identify any outliers would also help to objectively analyze those outliers.

Contextual Journal

Every day during the study a contextual journal was being used. Observations of the interview area, physical education classroom area, and participants were recorded daily. Keeping this contextual journal allowed for the inclusion of transferability

(Lincoln & Guba, 1985). Transferability in this study hopefully will lead to other physical educators taking the data and results from this study and applying it to their own context.

CHAPTER III

RESULTS

This was a study of second grade students enrolled and participating in physical education in an elementary school in North Dakota. The participants in the study were all given pseudonyms to maintain anonymity. For the purpose of the current study, the pseudonyms will be used throughout the results for each participant; these pseudonyms are George, Harry, Macy, Amanda, Holly, Brandy, Derek, and Ginger. These pseudonyms have no direct relationship to the names of the actual participants.

Research Question 1

Second grade students' ability to distinguish between high and low numbers displayed on the device(s). During the first interview, all eight of the participants were able to communicate that a number below 100 on a pedometer was considered to be a low number during physical education class. Additionally, all eight participants were able to communicate that a number above 500 was considered to be a high number during physical education class. Throughout the second interview, all eight participants were again able to distinguish 100 as being a low score and above 500 as being a high score on a pedometer after a physical education class. The ability of the participants to distinguish this basic concept of high versus low numbers was important to establish that second grade students have this basic understanding of numbers.

Research Question 2

Second grade students' ability to explain what results from a tool represent. The first tool that the participants were questioned about was the pedometer. During both the first and second interview, all eight of the participants were able to explain that the number displayed on the pedometer represented the number of steps taken while wearing the pedometer. When asked, Ginger stated, "You took 925 steps." This statement was echoed throughout the interview data among all eight participants.

Entertaining a more complex concept, the participants were asked what the number being displayed on the pedometer represented, or meant to them. During the first interview, six out of the eight participants were able to recognize 925 on the pedometer as being a good number. However, one participant thought the 925 on the pedometer was a low number. Given this question, Harry stated, "Bad, cause you usually get like 5000." Additionally, one participant failed to give an answer as to what the number on the pedometer represented, or meant to them. During the second interview, all eight of the participants were able to recognize 925 on the pedometer was good. Five of the eight participants went on to explain that 925 steps on the pedometer during physical education class meant that you were getting healthy. Two participants explained that the 925 on the pedometer meant that you were being active. Macy's response to the question was, "500 and up…because then you're staying healthy…because you would be like moving around in gym and then you would stay healthy." Figure 2 below indicates the participants' comprehension of pedometers in both interviews during the study.

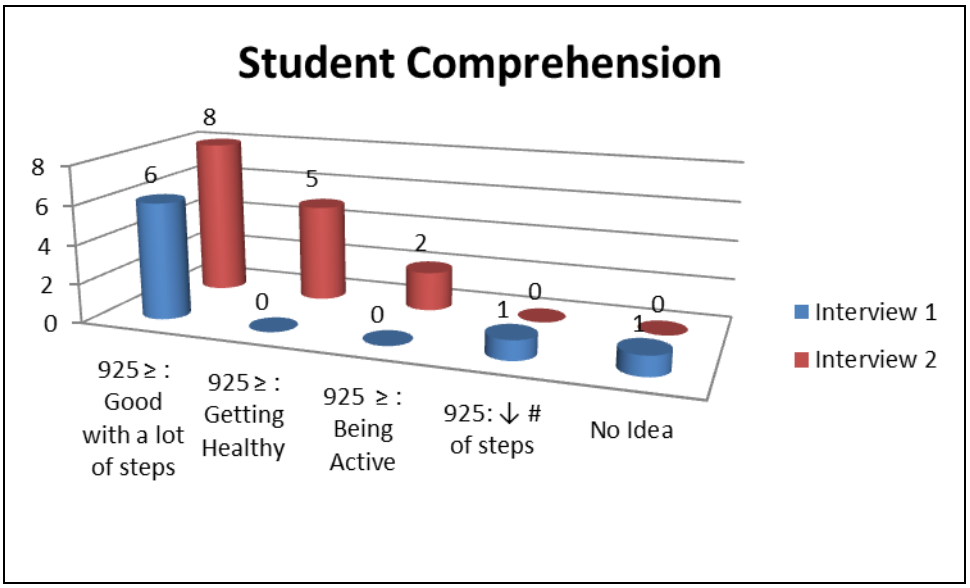


Figure 2. Number of Participants' Interpretation of 925 on Pedometer

During each interview, participants were asked which would be better, a high or low number on a pedometer after physical activity. As shown in Figure 3 below, during the first interview, all eight of the participants were able to correctly state that you should have a high number on the pedometer after physical activity. Further, during the second interview, all eight of the participants were again able to correctly identify that you should have a high number on the pedometer after physical activity. When asked if it would be better to be below 200, above 500, or between 200 and 500 after physical education class, Holly stated, "Above 500…cause then it means you're getting healthy."

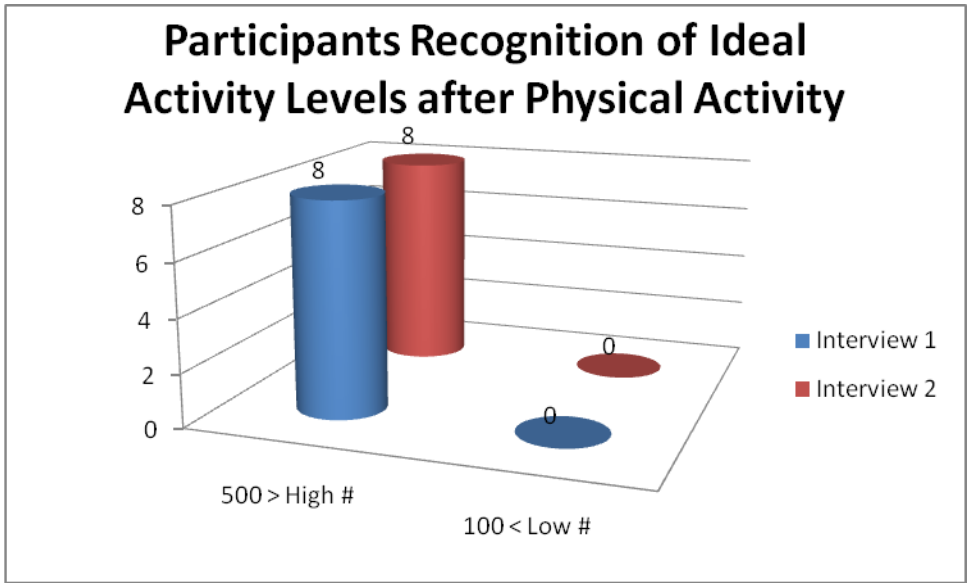


Figure 3. Participants' Recognition of Ideal Activity Level after Physical Activity

The second tool that the participants were interviewed about was the heart rate monitor. During the first interview, two of the eight participants were able to recognize the device as a heart rate monitor. For example, when asked what the object was, George stated, "A heart rate monitor…it monitors your heart." Interestingly the same two were the only participants during the first interview that were able to explain that a heart rate monitor monitors your heart rate/beats. During the second interview, all eight of the participants were able to recognize the device correctly as a heart rate monitor. Seven of the participants were able to explain that a heart rate monitor monitors your heart rate/beats. Brandy responded,

> It is a heart rate monitor…it tells you if you're in the zone, above the zone, or below your zone…it measures the number of heart beats, or, it takes your heart beat and then tells you how many minutes you were above then, or below your zone.

The response was echoed throughout participant responses, and are displayed in Figure 4 below.

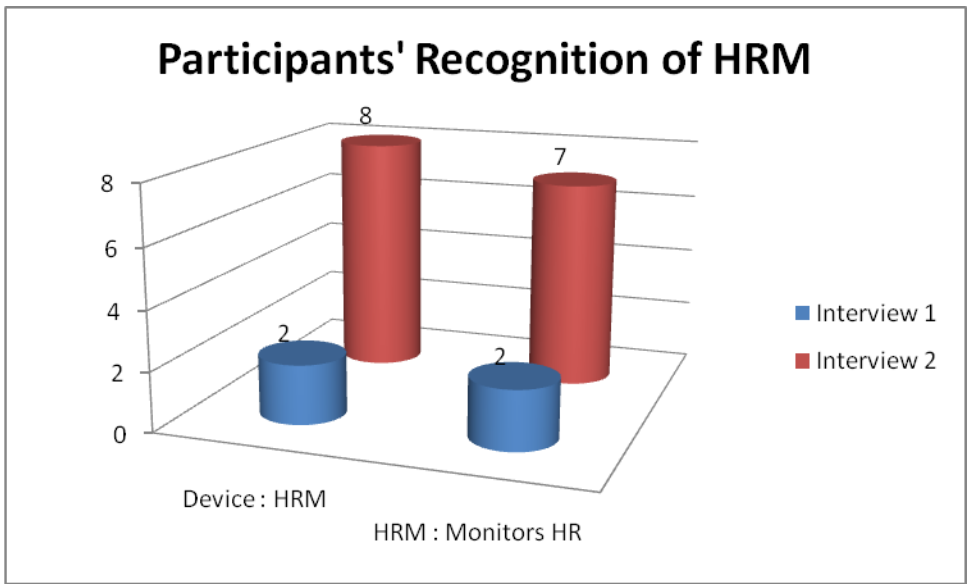


Figure 4. Participants' Recognition of Heart Rate Monitor

Throughout interviews, participants were asked to think in greater complexity about the heart rate monitors. They were asked what the different times meant and what different display symbols meant. During the first interview, no participant was able to distinguish what the different symbols next to the numbers on the heart rate monitor represented. Four of the participants couldn't even venture a guess as to the meaning of the symbols. Yet, two of the other participants thought the arrow up meant you ran longer than the time displayed, and the arrow down meant you ran less than the time displayed. These results are seen in below in Figure 5. When asked what an arrow pointing up, down, and a line on the device meant, Macy responded, "It was counting up…it means that is was going down…it means it stopped." However, in the second interview, six of the eight participants were able to explain that an arrow up meant you were above the target heart rate zone for the amount of time displayed, an arrow down

meant you were below the target heart rate zone for the amount of time displayed, and seven of the participants were able to explain that a line next to the number meant you were in your target heart rate zone for that amount of time. Holly responded to the question, "It means that you're staying healthy and above the zone…you took a great amount of steps, and you're staying healthy cause you're in the zone…that means you're below the zone."

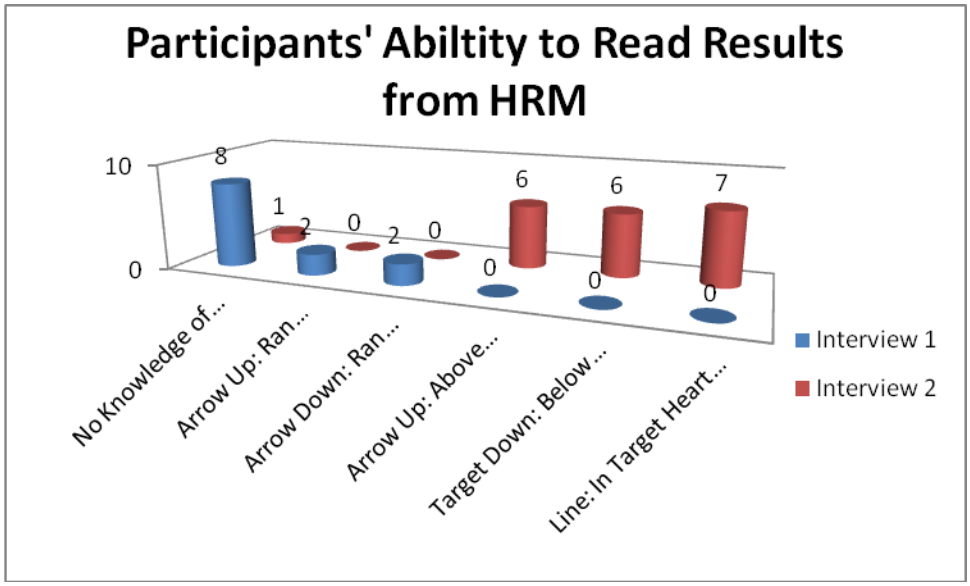


Figure 5. Participants' Ability to Read Results from Heart Rate Monitor

Thinking in an even more complex manner during the second interview, six of the participants were able to relate the target heart rate zone areas with personal health and different activity levels. When asked what an arrow up on the heart rate monitor meant, and what types of activities would result in an arrow up, Ginger stated, "That's how long you were above the zone…probably activities where you run a lot, like again soccer, basketball, and stuff…cause when you run a lot, your heart beats faster, and you're more healthy cause you move a lot." When given the questions of what an arrow down on the heart rate monitor meant, and what types of activities would result in an arrow down,

Ginger replied, “That means you were below the zone…that means you’re not, like, exactly where you want to be at…probably volleyball…cause you don’t move very much.” When asked what a line represents and what types of activities would result in the a line being displayed, Ginger responded,

> How long you were in the zone…that’s where you’re supposed to be, and it means like you’re moving how much you’re supposed to be, and you’re as healthy as you’re supposed to be…probably soccer and tennis…cause you’re moving a lot more so you can stay as healthy as you’re supposed to be.

Two of the participants explained that being above the target heart rate zone was both good and bad result after physical activity. They explained that it is good because you are being active and getting healthy, but it is bad because you might be overdoing it while you exercise. George explained,

> Good and bad…like if you’re above the zone, like you’re above what you usually should be…the good part is that you’re staying healthy, and the bad part is that you don’t want to be too high…like you’ll waste all your energy and get tired, and not want to do anything else.

Yet another participant explained that being above the target heart rate zone is only bad, because you are also overdoing it while exercising. When asked, Harry stated, “Kind of bad…cause you don’t want to get too fast with it…cause I don’t know.” Three participants explained that being above the target heart rate zone is good because you are being very active, and therefore, getting healthy. Amanda replied, “It’s good…because then you were moving around a lot and you’re staying healthy.”

When given the question about the arrow pointing down next to the time, six of the participants were able to explain that it meant you were below your target heart rate zone for the amount of time displayed. Five of those six participants were also able to go further and explained that being below the zone meant you were either inactive or not being active enough, and therefore, you were not getting healthy. When asked about the meaning of the arrow pointing down, Amanda stated, "That you were below the zone for that many minutes…it's bad…because that meant that you were just standing there and not moving around, and then you won't get healthy."

The next questions dealt with a line next to the time displayed on the heart rate monitor. Seven of the participants explained that it meant you were in your target heart rate zone for the amount of time displayed. Four of those seven participants recognized that being in the target heart rate zone meant you were getting healthy while exercising. Ginger explained, "That's where you're supposed to be, and it means like you're moving how much you're supposed to be, and you're as healthy as you're supposed to be." Five of those participants explained that when you are in your target heart rate zone that you are being active. Explaining further, Holly stated, "That means you're in the zone…because you took a great amount of steps…you want to be above or in during exercise. You want a lot of steps to stay healthy." Two of those participants went as far to explain that when you are in your target heart rate zone that you are exercising at the correct rate. Brandy's response, "Cause if you're below your zone, then you're not being active and you won't stay healthy. But if you're above your zone, then you might overdo it, and that's not good either." Interestingly, however, one of the seven participants explained that being in the target heart zone was bad, and meant that you were not active.

When asked, Amanda stated, “Bad because you wouldn’t be moving around a lot, and just walking around.” All results explained above can be seen below in Figure 6.

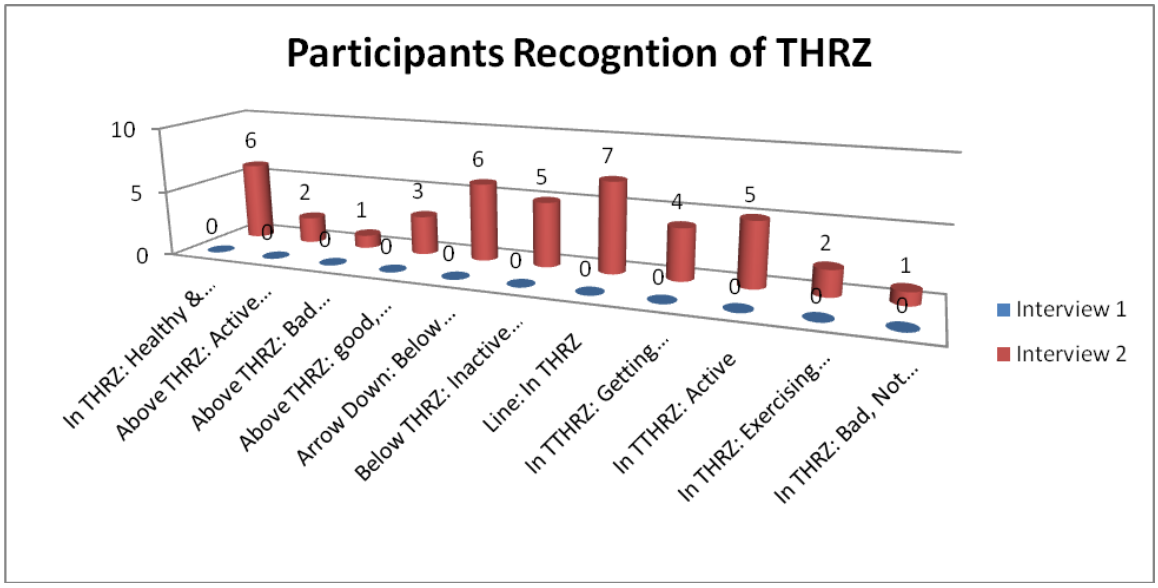


Figure 6. Participants’ Recognition of Target Heart Rate Zone

Participants were also asked during interviews if they should want their largest amount of time to be while they were above, below, or in their target heart rate zone after physical activity. During the first interview, two participants stated that you should be above your target heart rate zone. Four of the participants stated that you should be in your target heart rate zone. Two of the participants did not have any knowledge as to which area they should have the most time after physical activity.

Interestingly, all participants during the second interview were able to give an answer as to which area they should have their most time after physical activity. Two participants stated that you should be either above or in your target heart rate zone for the most amount of time. Four participants stated that you should be in your target heart rate zone for the most amount of time during physical activity. For example Macy responded, “No arrow I’m guessing…because that probably means that you’re in the heart rate

zone…so you stay healthy." One participant explained that you should have your most time while you are above your target heart rate zone. Derek stated, "Um, with an arrow up…because, I forgot." All results described above are shown in Figure 7 below.

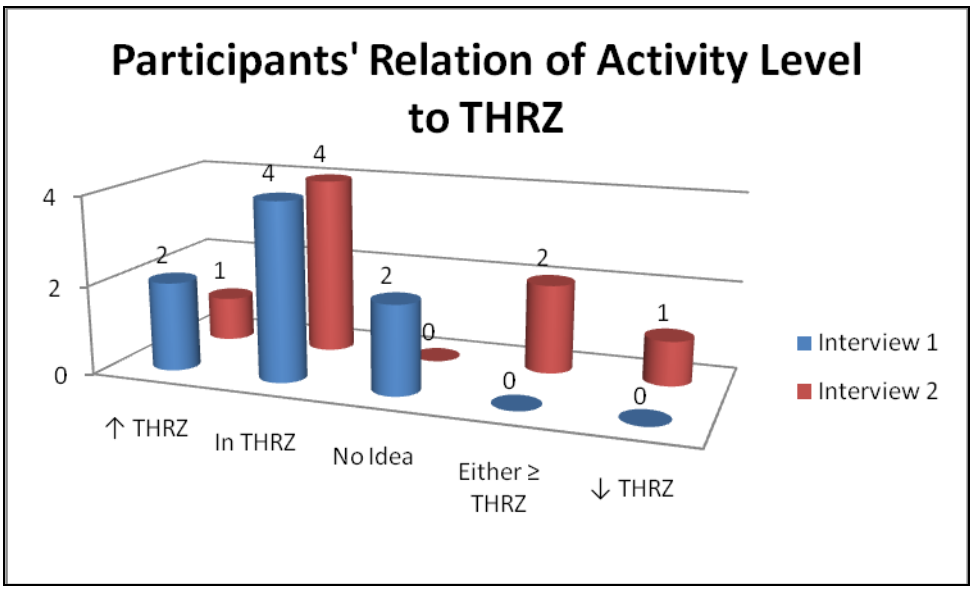


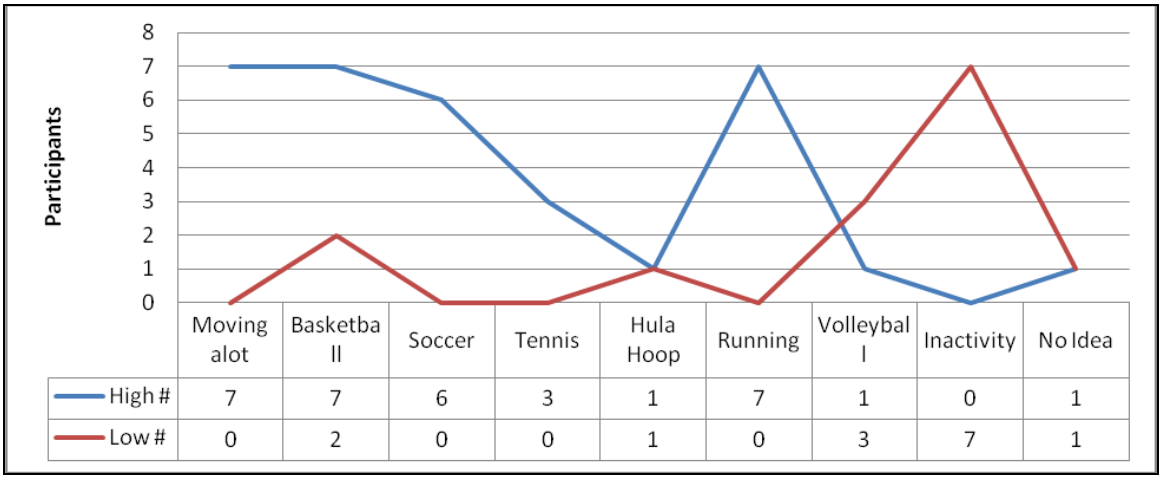
Figure 7. Participants' Ability to Relate Activity Level to Target Heart Rate Zone

Research Question 3

Second grade students' ability to explain why they would have received a high or low number on the device in comparison to physical activity levels. The first questions during both interviews dealt with pedometers. During the first interview, the participants were asked why they might receive a high number on a pedometer after physical activity. All eight of the participants associated a high number on a pedometer with being active. Seven of those participants explained that a high number on a pedometer is associated with running a lot while wearing the device. Common sports associated with a high number on a pedometer were running a lot, basketball, and soccer. Ginger's explained, "Kickball, soccer, and like basketball, and just a lot of moving around and stuff." These responses were echoed throughout the participant data. Further, volleyball and tennis

were each mentioned by two participants as being associated with high numbers on a pedometer after physical activity.

When the participants were asked why they might receive a low number on a pedometer after physical activity, seven of the participants associated it with being inactive or sitting around. Harry responded, "Cause you were not taking very many steps and moving a lot…cause you're not moving a lot." Additionally, two of the participants went on further to explain that while playing sports where there are more people on a team, you will be less active and receive a lower number on the pedometer. Both of these participants gave volleyball as an example of that situation. For example, Amanda explained, "Volleyball and tennis…because in volleyball you have more than one person on your team, so you don't have to move around a lot." Further, although seven of the participants were able to associate a low number on a pedometer with being inactive, one participant explained that tennis would give a low number on the pedometer. Additionally, one participant explained that the basketball game called Horse would give a low number on a pedometer. Derek responded, "Um, playing like horse, or lightning." Responses for participants' reasoning can be seen below in Figure 8.



	Moving alot	Basketball	Soccer	Tennis	Hula Hoop	Running	Volleyball	Inactivity	No Idea
High #	7	7	6	3	1	7	1	0	1
Low #	0	2	0	0	1	0	3	7	1

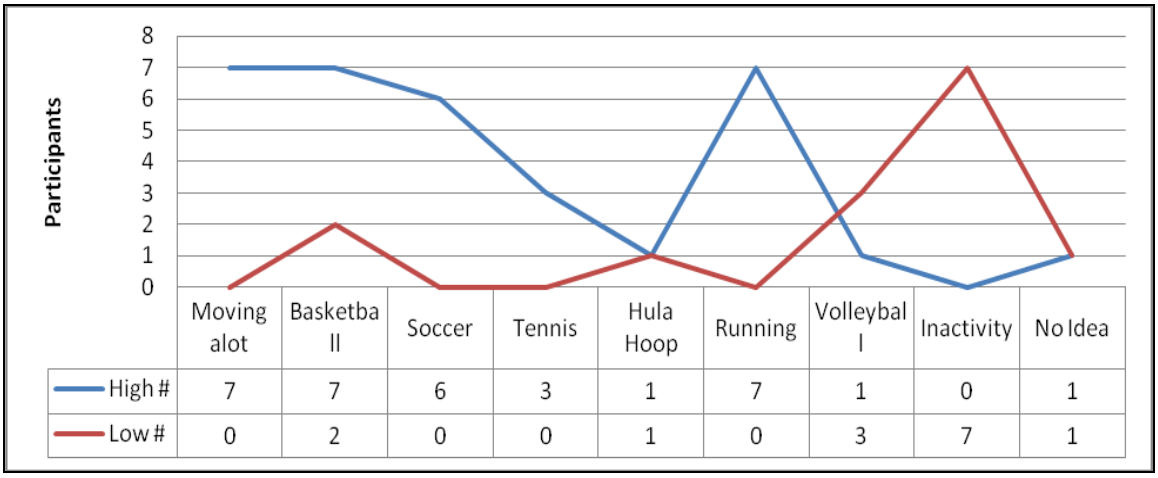
Figure 8. Participants' Reasoning for Results on Pedometer in Interview 1

Six of the participants during the second interview were able to associate a high number on a pedometer with running. The results described in this paragraph can be seen below in Figure 9. Seven of the participants associated a high number with being active while wearing the pedometer. Only one participant did not associate the high number on the pedometer with a specific activity level. Common sports associated with a high number on a pedometer were basketball, soccer, tennis, and sports where you run a lot. Brandy explained, "Soccer, basketball, track, sports that you, like run and play lots." Only one participant associated a high number on the pedometer with volleyball. George related, "Soccer, basketball, volleyball, baseball." While Holly, associated hula hooping with a high number if you jump a lot while using it. When asked why one might receive a low number on a pedometer after physical activity during the second interview, seven participants associated it with being inactive or staying in one place for a large amount of time. Again, only one participant did not associate a low number on a pedometer with a specific activity level. A common sport associated with a low number on the pedometer was volleyball. These participants explained that there are a lot of people per team in volleyball, and therefore you don't move much. Brandy explained,

> Some activities that'd give you a low number is kind of like, maybe volleyball cause you're not really moving around a lot unless it's just a couple feet though, and same thing with like pin dodgeball. If you have a lot of people you can't really move around a lot cause there's so many people.

Although seven of the participants were able to recognize that a low number on the pedometer meant low or inactivity, three participants associated basketball with a low number on the pedometer. George stated, "Um, like just standing in one place and

playing basketball." Similar to the first interview, Holly mentioned that hula hooping would result in a high number on a pedometer if you jumped a lot, and that it would give you a low number if you kept your feet still.



	Moving alot	Basketball	Soccer	Tennis	Hula Hoop	Running	Volleyball	Inactivity	No Idea
High #	7	7	6	3	1	7	1	0	1
Low #	0	2	0	0	1	0	3	7	1

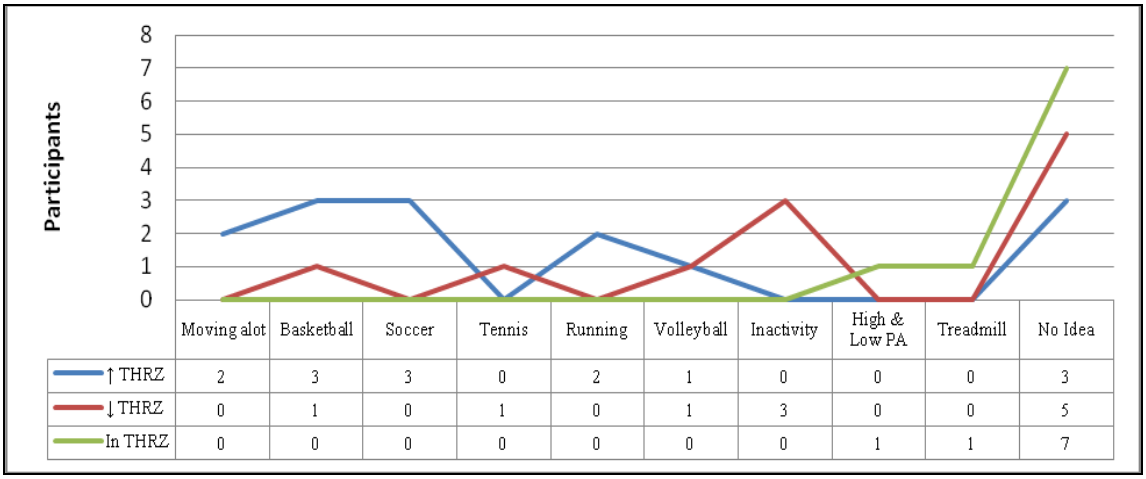
Figure 9. Participants' Reasoning for Results on Pedometer in Interview 2

Next, the participants were asked why one might receive a large amount of time above the target heart rate zone on a heart rate monitor. Three of the eight participants, during the first interview were unsure why they would receive a large amount of time above the target heart rate zone. Two participants associated it with being active and moving a lot. Two students connected those results with running a lot. George responded, "Like activities that have lots of movement…it'd be basketball, soccer and volleyball." Two participants associated a large amount of time above the target heart rate zone with playing basketball or soccer. Yet another two students associated time above time above target heart rate zone with volleyball.

The participants were questioned about why one might receive a large amount of time below the target heart rate zone during the first interview. Five participants were unable to make a connection with activity level and that result on the heart rate monitor. Three participants associated that result with little movement and/or standing/sitting

around. Macy stated, "When you're just, like standing around." There were no common sports associated with a large amount of time spent below the target heart rate zone.

Participants were asked why one might receive a large amount of time in the target heart rate zone during the first interview. Seven of the participants were unable to associate activity level with that result on the heart rate monitor. One participant associated being in the target heart rate zone with having the right amount of activity. Macy answered, "When you're in between." One participant associated it with walking far. When asked, Holly stated, "That means you walked a lot of miles." Another participant associated being in the target heart rate zone with going on a treadmill. Harry responded, "I don't know, going on a treadmill." The results explained above can be seen in Figure 10 below.



	Moving alot	Basketball	Soccer	Tennis	Running	Volleyball	Inactivity	High & Low PA	Treadmill	No Idea
↑ THRZ	2	3	3	0	2	1	0	0	0	3
↓ THRZ	0	1	0	1	0	1	3	0	0	5
In THRZ	0	0	0	0	0	0	0	1	1	7

Figure 10. Participants' Reasoning for Results on HRM Related to Target Heart Rate Zone (THRZ) in Interview 1

The participants were asked why one might receive a large amount of time above the target heart rate zone during the second interview. Two participants associated it with being very active. Four of the participants associated those results with running. When asked, Harry stated, "Moving a lot, like tennis, basketball; things that you get really like

into it, running and basketball." Tennis, basketball, and soccer were common sports associated with being above the target heart rate zone. Two participants were unable to make the connection between activity level/type, with being above the target heart rate zone.

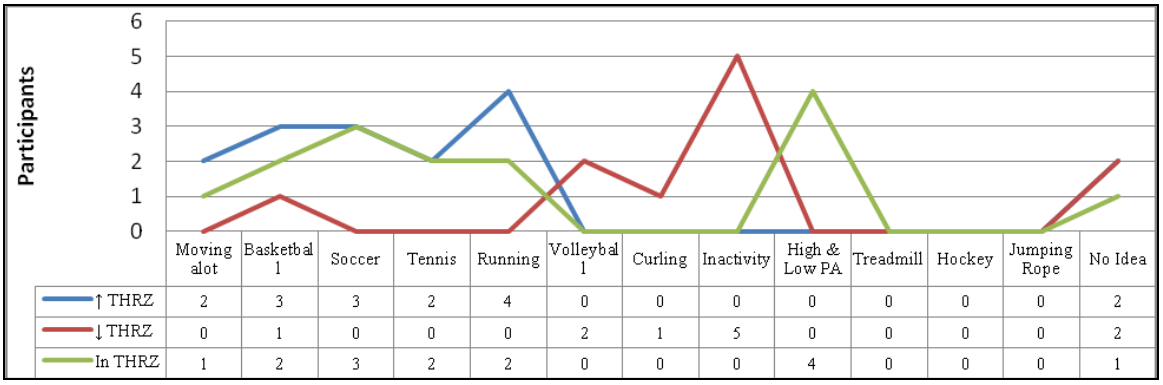
In response to the question of why one might receive a large amount of time below the target heart rate zone during the second interview, four participants specifically associated it with little movement or inactivity. Three participants associated those results with sitting or standing around. Two participants associated being below the target heart rate zone with volleyball. Ginger replied, "Probably volleyball…cause you don't move very much." One participant associated being below the target heart rate zone with curling and basketball. Two participants were unable to make a connection between activity level/type, with being below the target heart rate zone.

During the second interview, the participants were questioned why one might receive a large amount of time in the target heart rate zone. Four participants were able to associate it with being quite active, but not too active, or under-active. Brandy answered,

> It means you were in your zone…you want to be in your zone…cause if you're below your zone, then your not being active and you won't stay healthy. But if you're above your zone, then you might overdo it, and that's not good either…basketball, soccer, activities you run a lot and stuff in, but ones your not gonna run, run, run, run, run all the time will make you in your zone.

One participant associated being in the target heart rate zone with just being active. Two participants associated running, basketball, and tennis with being in the target heart rate

zone. Three participants associated soccer with being in the target heart rate zone. One participant associated being in the target heart rate zone with hockey, and one with jumping rope. Figure 11 below displayed the results explained above.



	Moving alot	Basketbal l	Soccer	Tennis	Running	Volleybal l	Curling	Inactivity	High & Low PA	Treadmill	Hockey	Jumping Rope	No Idea
↑ THRZ	2	3	3	2	4	0	0	0	0	0	0	0	2
↓ THRZ	0	1	0	0	0	2	1	5	0	0	0	0	2
In THRZ	1	2	3	2	2	0	0	0	4	0	0	0	1

Figure 11. Participants' Reasoning for Results on HRM Related to Target Heart Rate Zone (THRZ) in Interview 2

CHAPTER IV

DISCUSSION

This chapter explains how the results of the three research questions in the previous chapters have emerged, and how they were answered through data collection. The first research question explored: Second grade students' ability to distinguish which numbers displayed on the device(s) are high or low numbers. The second research question examined: Second grade students' ability to explain what the results from the tools represent. The third research question analyzed: Second grade students' ability to explain why they would have received a high or low number on the device in comparison to physical activity levels. This chapter will conclude with limitations of the current study, and recommendations for further research.

Research Question 1

Second students' ability to distinguish which numbers displayed on the device(s) are high or low numbers. Data gathered indicate that all participants were able to delineate between a high number and a low number on pedometers. Based on the research presented in the literature review, children in second grade are typically beginning to understand the difference between high and low numbers with numbers that involve two or more digits (Gersten & Chard, 2001). The results from the current study seem to confirm Gersten and Chard's (2001) conclusions about elementary students'

number sense. Therefore, these suggest that second grade students should be able to comprehend the differences in large numbers from instrumentation. With the success of the participants being able to differentiate between high and low numbers on tools containing more than two digits, we are able to imply that second grade students are able to read the numbers on the pedometers and heart rate monitors. Making sure that second grade students can first read the numbers displayed on the devices and delineate between high and low numbers is the first step in second grade students' success at reading and interpreting the results.

Research Question 2

Second grade students' ability to explain what the results from the tools represent. Data in the current study indicated that these second grade students were able to connect a high number on the pedometers with high physical activity (see, Figure 2). During the first interview, no participants were able to make the connection between a high number on the pedometer, and being active or getting healthy. However, during the second interview there were two participants who associated being active with a high number and five participants associated a high number with getting healthy. This illustrates that with even a ten-minute lesson and two days of experience with pedometers, second grade students should able to make the connection between activity level and benefits associated with a high number on a pedometer. Additionally, Figure 3 shows that all eight of the participants were able to recognize that a high number on the pedometer is ideal after physical activity. This cross-confirms the results that these second grade students were able to associate a high number on the pedometer with high amount physical activity.

The participants in the current study, however, had a harder time reading the heart rate monitors. During the first interview only two participants were even able to identify the heart rate monitor (see Figure 4). Additionally, the majority of the participants were not able to correctly identify the heart rate monitors. In fact none of the participants were able to correctly identify what the different arrows and lines meant when looking at the results on the heart rate monitor (see Figure 5).

During the second interview, seven of the participants were able to correctly identify the heart rate monitor. Additionally, seven participants were able to correctly identify the results displayed in the target heart rate zone. Further, six participants were able to correctly identify the results displayed above and below the target heart rate zone (see Figure 5). Similar to the pedometers, these results seem to affirm that with a ten to fifteen-minute instruction and two days experience with the tool, second grade students could be able to correctly read the results from heart rate monitors.

Having students able to correctly relate high and low numbers on both the pedometers and heart rate monitors is essential in having them understand physical activity. If they are able to correctly identify a high physical activity with a high number on a pedometer, they are able to recognize that high activity time or intensity results in more steps. If they are able to correctly identify a large amount of time in or above the target heart rate zone, they too are able to make the connection of those results with high activity time or intensity. Making this vital connection with types and time of physical activity with results on heart rate monitors and pedometers is another step closer to second grade students understanding what types of activities will result in high and low activity when engaging outside of school.

Another important aspect of dealing with heart rate monitors is the comprehension of the target heart rate zone. Not a single participant was able to correctly identify this during the first interview. However, in the second interview, five of the participants were able to explain that the target heart rate zone is where you want your heart rate to be when exercising. This complex concept was grasped by just over half of the participants in the second interview. This lends support to the notion that with a ten-minute instruction and two days experience, second grade students could be able to correctly identify what it means to be in a target heart rate zone. Due to about half of the participants being able to comprehend the meaning of a target heart rate zone, our evidence suggests that it is okay to begin to incorporate heart rate monitors in second grade physical education.

Moving further from just identifying a target heart rate zone, the participants were asked to explain what it means to be above, below, or in the target heart rate zone. Additionally, they were asked which placement would be ideal after physical activity. In the first interview not a single participant was able to identify the different areas related to a target heart rate zone. However, when asked where they should be after physical activity, two participants stated you should in above the zone, two chose below the zone, and four correctly stated you want to be in the zone. The participants lacked the ability to identify the different zones, but yet possessed ability to infer where you should be after physical activity in relation to the zones. This comparison infers that although second grade students may not be able to answer A, they are able to use the information in the question portrayed to infer where they should be in relation to a target heart rate zone.

During the second interview, there was quite a turnaround for number of participants who understood the meaning of a target heart rate zone. Five of the participants were able to correctly identify a target heart rate zone. Seven of the participants were able to recognize you either want to be in or above your target heart rate zone after physical activity (See Figure 7). This evidence suggests that these second grade students are able to understand your health will benefit the most when you spend the most time in or above your target heart rate zone. Some participants were able to dig a bit deeper and explain that being above your target heart rate zone means you are exercising too hard, but being below means you are exercising too low. This is a bit more complex of a concept that a few participants were able to explain. The participants that were able to make this connection are most likely in Piaget's concrete operational stage, where subjects are able to process and retrieve information like adults (Furth, 1970). Similar to the results mentioned above, seeing these results is encouraging in showing us that it is not too early to start incorporating heart rate monitors in second grade physical education.

Research Question 3

Second grade students' ability to explain why they would have received a high or low number on the device in comparison to physical activity levels. The first set of questions during both interviews was aimed at this concept in relation to the pedometer. During the first interview all eight of the participants explained that being active/moving a lot gives you a high number on the pedometer. Other common associations were made with high activity sports. When asked about a low number, most participants were able to associate low or no activity. According to these results (see Figure 8), the participants

were clearly able to understand why you would get a high or low number on the pedometer when compared to physical activity.

When the participants were asked this same question in the second interview, the results were similar to those in the first interview (see Figure 9). During the second interview, seven of the participants explained that a high number on a pedometer would be a result of being active/moving a lot. Again, most participants were able to associate high activity with a high number on a pedometer, and a low number with no or little activity.

When asked about a low number on the pedometer during the second interview, seven of the participants explained that being inactive/staying in one place for a long period of time would give you low results. When taking a look at the responses for the connection between type of activity and results on a pedometer, the results suggest that second grade students are able to correctly associate activities with high results on the pedometers. However, it seems as though second grade students are mostly capable of associating activity level with low results on the pedometer, but further research in this area would be needed.

The other tool that participants were asked to associate results from with activity levels was the heart rate monitor. During both interviews participants were asked what types of activities would make them be above, below, or in the target heart rate zone. The associations with the heart rate monitor were not quite as clear as those made with the pedometers.

When asked about the heart rate monitors during the first interview, it was quite clear that these second grade students had little to no knowledge about heart rate

monitors. There were minimal correct associations with activity levels and target heart rate zones. However, this was not the case in the second interviews.

The participants were asked the same questions in the second interview. The results were quite different from the first set of interviews (see Figure 11). While associating activity type with being above the target heart rate zone, most participants were able to associate it with very high activity levels. When comparing activities to being below the target heart rate zone, the majority of the participants were able to associate low or inactivity with being below the target heart rate zone. When comparing activities with being in the target heart rate zone, most of the participants were able to associate it with being active. Two participants were able to associate it with being not too active, or too little activity. Because six to seven, of the eight participants, were able to correctly identify activities that could potentially give results above, below, and in the target heart rate zone, it seems safe to conclude that second grade students do have the capability of making the connection between type of activity and the different results on the heart rate monitors. Although the results did not receive 100% of the participants making the correct associations between activity type and heart rate monitor results, 75-88% of the participants did make the correct correlation. This allows us to conclude that although not all second grade students are able to make the correlation, the majority of elementary students are able to make this important connection with a little instruction and experience with the tool.

After an overall analysis, the data indicated that these second grade students have the ability to distinguish between high and low numbers. The data in the current study also implied that these elementary students do have the ability to explain what the results

from the pedometer and heart rate monitor represent. Finally, the evidence of the current study indicated that with little instruction and experience with the tools, these second grade students have the capability to explain why they would have received a high or low number on the device in comparison to physical activity levels.

Thusly, by increasing physical activity awareness in children we will be helping with the current problems of children and adolescents being obese (Flass, 2010). The gap between the children in the United States who are obese, and the amount of obese children in other countries is amazing. The United States has 14% more overweight children than the next highest area with overweight children. The United States also has 2% more obese children than the next highest area with obese children (Baur, Lobstein, & Uauy, 2004). It is unforgiving that child obesity has risen from 5% in 1974 to 15% in 2002 of all United States children aged two to nineteen years (Anderson, & Butcher, 2006). By using tools like the pedometers and heart rate monitors, which have been shown to be accurate measurements of physical activity (Pluto, Reis, Tudor-Locke, & Williams, 2002), we will also be helping to increase physical activity in youth (Esteon, Ingledew, & Rowlands, 1998).

Limitations

Like all research, the current study has its limitations. The first, and probably the largest limitation of the current study, was the number of the participants. There were eight participants in the current study due to the small population where the study was conducted in North Dakota. This study is highly contextualized due to the small participant size. Therefore, we are very sure what happened with the students' results within the current study, and school in which they are enrolled. However, we can only

infer that second grade students in other areas of the U.S. would have similar results to the students in the current study. The second limitation of the current study was that the researcher conducted the interviews. This could possibly have led to biased responses by the participants. There may also have been biases by the researcher, due to being a physical educator. Third and finally, because the current study is a qualitative study all results have to be interpreted. This is a limitation because there is no specific value that indicates significant results for the study. Instead, the possibility of subjectivity comes into play due to the data needing to be interpreted.

Areas for Further Research

After extensive research performed on this topic, it seems as though this is the first time that a study has been performed to look into second grade students understanding of the results from heart rate monitors and pedometers. As such, there is a need for further research in this area. First, it would be helpful to have a longitudinal study performed in the same manner as the current study. This was performed with only a ten to fifteen minute instruction time for each tool, and only two days to use each tool. Second, although this study did demonstrate positive results for all three-research areas, the same study with more participant exposure to the tools could help to support data in the current study. Third, it could be beneficial to repeat this study due to difficulty with the heart rate monitors. During the current study, the heart rate monitors had a hard time picking up the participants' heart rates. The reason for this was that these heart rate monitors were made for adults, consequently, the bands that go around the chest are quite large, and often didn't fit the participants. In an effort to adapt for this shortcoming,

participants wrapped the elastic band around their chest twice to get the heart rate monitor to fit snug around their chest.

The final recommendation would be to repeat the current study with a larger participant population in a more urban setting. The current study was highly contextualized, we are only sure of what our participants know. Therefore, we can only infer what students in other settings and populations would know. By repeating this study with a larger participant population in a more urban setting, it would hopefully help to support the conclusions of the current study.

APPENDICES

APPENDIX A

LETTER OF CONSENT

Elementary Students' Cognitive Understanding of Heart Rate Monitors and Pedometers

Carolyn Tozer

701-777-4337

Physical Education, Exercise Science, and Wellness

STATEMENT OF RESEARCH:

A person who is to participate in the research must give his or her informed consent to such participation. This consent must be based on an understanding of the nature and risks of the research. This document provides information that is important for this understanding. Research projects include only subjects who choose to take part. Please take your time in making your decision as to whether to participate. If you have questions at any time, please ask.

WHAT IS THE PURPOSE OF THIS STUDY?

You are invited to be in a research study about heart rate monitors and pedometers in physical education because your child is enrolled in an elementary level physical education class.

The purpose of this research study is to investigate whether elementary students in grades first through fifth better understand the results from heart rate monitors or pedometers. If one tool's results are better understood by the students, then that tool will hopefully be used more than the other in physical education classes. This will allow the physical education programs to invest in equipment that will be the most useful for the students.

HOW MANY PEOPLE WILL PARTICIPATE?

Approximately eight children will take part in this study at Jonesburg Elementary School. This study is being completed through The University of North Dakota.

HOW LONG WILL MY CHILD BE IN THIS STUDY?

Your child's participation in the study will last no longer than three weeks. Your child will need to visit with the principal investigator three times in a classroom located inside Jonesburg Elementary School. Each visit will take about ten to fifteen minutes.

WHAT WILL HAPPEN DURING THIS STUDY?

The study will begin with a demographic and pre-test interview of each participant in a classroom at Jonesburg Elementary. This interview will take approximately fifteen minutes. During this interview each participant will be asked if they have ever used heart rate monitors or pedometers in the past, and if so how many times. They will also be asked questions revolving their understanding of the numbers represented on the heart rate monitors and pedometers.
On the second day of the study the participants will be given a brief five-minute lesson on how the pedometers and heart rate monitors work. The participants will also be taught how to self-apply the devices. After the lesson is complete and the participants have put on a sterilized heart rate monitor or pedometer, they will take place in their regular physical activity class. The participants will use the devices for a total of four class periods of physical education.

On the sixth and final day of the study the participants will finish with a post-test interview in a classroom at Jonesburg Elementary. This interview will consist of almost identical questions to the pre-test interview. The questions will again revolve around the participants' understanding of the numbers represented on the heart rate monitors and pedometers.

The participants are free to skip any questions that he/she would prefer not to answer during the demographic interview, pre-test interview, and post-test interview.

WHAT ARE THE RISKS OF THE STUDY?

There are no foreseeable risks to participating in this study.

Sometimes children experience frustration with a survey. We are taking every precaution to make this experience, which will be conducted through interviewing, a pleasant experience for your child.

If, however, your child becomes upset by questions, he/she may stop at any time or choose not to answer a question. If he/she would like to talk to someone about his/her feelings about this study, he/she is encouraged to contact the school counselor.

WHAT ARE THE BENEFITS OF THIS STUDY?

Your child may not benefit personally from being in this study. However, we hope that, in the future, other people might benefit from this study because more appropriate tools will be used in physical education classes to teach students about physical activity levels.

WILL IT COST ME ANYTHING TO BE IN THIS STUDY?

You will not have any costs for your child being in this research study.

WILL I BE PAID FOR MY CHILD PARTICIPATING?

You will not be paid for your child being in this research study. Your child will not be given extra credit for being in this research study.

WHO IS FUNDING THE STUDY?

The University of North Dakota and the research team are receiving no payments from other agencies, organizations, or companies to conduct this research study.

CONFIDENTIALITY:

The records of this study will be kept private to the extent permitted by law. In any report about this study that might be published, your child will not be identified. Your child's study record may be reviewed by Government agencies and the University of North Dakota Institutional Review Board.

Any information that is obtained in this study and that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of data being kept in a locked cabinet or password protected file inside a locked office. All documents containing the participants' names will be kept in a separate locked cabinet or password-protected file inside a locked office.

If we write a report or article about this study, we will describe the study results in a summarized manner so that your child cannot be identified.

The interviews in this study will be recorded only for audio. The subjects and their parents/guardians have the right to review/edit the recordings. The University of North Dakota Institutional Review Board, Government agencies, and the research investigators will have access to the recordings. After five years of being kept in a lock cabinet in a locked office, the recordings will be erased and destroyed.

IS THIS STUDY VOLUNTARY?

Your child's participation is voluntary. You or your child may choose not to participate or may discontinue your child's participation at any time without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will not affect your current or future relations with the University of North Dakota.

You will be informed by the research investigator*[s]* of this study of any significant new findings that develop during the study, which may influence your willingness to continue to participate in the study.

CONTACTS AND QUESTIONS:

The researchers conducting this study are Carolyn Tozer and Dr. Thomas Steen. You may ask any questions you have now. If you later have questions, concerns, or complaints about the research please contact Carolyn Tozer at 701-777-4337 or her adviser, Dr. Thomas Steen at 701-777-4343.

If you have questions regarding your rights as a research subject, or if you have any concerns or complaints about the research, you may contact the University of North Dakota Institutional Review Board at (701) 777-4279. Please call this number if you cannot reach research staff, or you wish to talk with someone else.

Your signature indicates that this research study has been explained to you, that your questions have been answered, and that you agree to take part in this study. You will receive a copy of this form.

Subjects Name: _____

Subjects Name of Parent/Legal Guardian _____

_____ _____

Signature of Subject's Legal Parent/Guardian Date

I have discussed the above points with the subject or, where appropriate, with the subject's legally authorized representative.

_____ _____

Signature of Person Who Obtained Consent *Date*

APPENDIX B

LETTER OF ASSENT

Elementary Students' Cognitive Understanding of Heart Rate Monitors and Pedometers
Carolyn Tozer

We are doing a research study; a research study is a special way to find out about something. We are trying to find out if elementary students understand pedometers or heart rate monitors better.

If you want to be in this study, we will ask you to do several things. We will ask you to participants in two different interviews that each take ten to fifteen minutes. Next, we will ask you to listen to a five-minute lesson about heart rate monitors and pedometers. Finally, we will ask you to use the heart rate monitors and pedometers for a total of four physical education classes.

Not everyone who is in this study will benefit. A benefit means that something good will happen to you. We don't know if you will benefit. But we hope to learn something that will help other people some day.

When we are done with the study, we will write a report about what we found out. We will not use your name in the report.

You do not have to be in this study. It is up to you. If you want to be in the study, but change your mind later, you can stop being in the study.

If you want to be in this study, please sign your name.

Your name (printing is okay) Date

I certify that this study and the procedures involved have been examined in terms the child could understand and that he/she freely assented to participate in this study.

Signature of Person Obtaining Assent **Date**

APPENDIX C

LIKERT QUESTIONNAIRE

Elementary Students' Cognitive Understanding of Heart Rate Monitors and Pedometers

Mrs. Carolyn L. Tozer

Dr. Jesse Rhoades

QUESTIONNAIRE PAMPHLET

Parents, please help your child fill out this form to the best of both your knowledge regarding physical activity levels and experience with pedometers and heart rate monitors. All questions are pertaining to your child.

1. Have you ever used pedometers in the past? (circle only one)
   A. Never
   B. 1 to 5 times
   C. 6 to 10 times
   D. More than 10 times

2. In what types of settings have you used pedometers in the past? (circle all that apply)
   A. Doesn't apply
   B. At home/with family
   C. In sports
   D. School/Classroom

3. Have you ever been given a lesson on pedometers in the past? (circle only one)
   A. Never
   B. 1 to 5 times
   C. 6 to 10 times
   D. More than 10 times

4. If you were given a lesson on pedometers, who gave you the lesson? (circle all that apply)
   A. Other
   B. Parent
   C. Coach

D. Teacher

5. Have you ever used heart rate monitors in the past? (circle only one)
   A. Never
   B. 1 to 5 times
   C. 6 to 10 times
   D. More than 10 times

6. In what types of settings have you used heart rate monitors in the past? (circle all that apply)
   A. Doesn't apply
   B. At home/with family
   C. In sports
   D. School/Classroom

7. Have you ever been given a lesson on heart rate monitors in the past? (circle only one)
   A. Never
   B. 1 to 5 times
   C. 6 to 10 times
   D. More than 10 times

8. If you were given a lesson on heart rate monitors, who gave you the lesson? (circle all that apply)
   A. Other
   B. Parent
   C. Coach
   D. Teacher

Physical activity is defined as, "Any activity that causes your body to work harder than normal" (Alexander, 2006).

9. How many days a week do you participate in physical activities outside of class? (circle only one)
   A. 0
   B. 1 or 2
   C. 3 or 4
   D. 5 or more days

10. How long does your physical activity usual last each time? (circle only one)
    A. Doesn't apply
    B. 20-30 minutes
    C. 31-60 minutes
    D. More than 60 minutes

11. What types of activities do you participate in for your physical activity outside of class? (circle all that apply)
    A. Doesn't apply
    B. Playing on the playground, hopscotch, jump rope
    C. Playing pick up sports with friends (tag, capture the flag, football, soccer)
    D. Organized sports teams (includes registration to team and a coach)

APPENDIX D

DEMOGRAPHIC INTERVIEW QUESTIONS

1. What is your birth date? _____ (record in month/day/year)
2. What is your level in school? _____ (1-5)
3. Sex (circle male or female)
4. What is your height? _____ (record in ft. & inches)
5. What is your weight? _____ (record in pounds)

APPENDIX E

INTERVIEW 1 QUESTIONS

1. What is the object in Picture A (refer to appendix G)?
2. What does the object in Picture A (refer to appendix G) do?
3. If the object in Picture A (refer to appendix G) shows you a number of 925, what is that number representing?
4. When you see a number on the object of Picture A (refer to appendix G), what does that number mean to you?
5. What type of number should you see after using the object in Picture A (refer to appendix G) for an entire physical education class? (low 0-200, medium 200-500, high 500 and up)
6. What types of activities would give you a high number on the object in Picture A (refer to appendix G)?
7. What types of activities would give you a low number on the object in Picture A (refer to appendix G)?
8. What is this (refer to actual object from appendix G)?
9. What does this do (refer to actual object from appendix G)?
10. There is a number displayed of ……. on this, what does that number represent (refer to actual object from appendix G)?

11. What does the number mean to you that is shown on the screen (refer to actual object from appendix G)?
12. When you use this tool for an entire physical education class, should you see a low number of 0-200, a medium number of 200-500, or a high number above 500 (refer to actual object from appendix G)?
13. Why might you get a high number on this (refer to actual object in appendix G)?
14. How can you get a high number on this?
15. How can you get a low number of this?
16. Why might you get a low number on this (refer to actual object in appendix G)?
17. What is the object in Picture B (refer to appendix H)?
18. What does the object in Picture B (refer to appendix H) do?
19. If the object in Picture B (refer to appendix H) shows you a number of 12:21 with an arrow pointing down, what does that represent?
20. Why might that be displayed on your object?
21. What does that number mean to you?
22. If the object in Picture B (refer to appendix H) shows you a number of 12:21 with an arrow pointing up, what does that represent?
23. Why might that be displayed on your object?
24. What does that number mean to you?
25. If the object in Picture B (refer to appendix H) shows you a number of 12:21 with nothing next to it, what does that represent?
26. Why might that be displayed on your object?
27. What does that number mean to you?

28. Should you see your biggest number on the object in Picture B (refer to appendix H) with an arrow pointing down, an arrow pointing up, or nothing next to it?
29. What is a target heart rate zone?
30. What is this (refer to actual object from appendix H)?
31. What does this do (refer to actual object from appendix H)?
32. There is a number displayed of ……. with an arrow pointing down on this, what does that number represent (refer to actual object from appendix H)?
33. What types of activities might give you this display?
34. What does that mean to you (refer to actual object from appendix H)?
35. There is a number displayed of ……. with an arrow pointing up on this, what does that number represent (refer to actual object from appendix H)?
36. What types of activities might give you this display?
37. What does that mean to you (refer to actual object from appendix H)?
38. There is a number displayed of ……. with nothing next to it, what does this number represent (refer to actual object from appendix H)?
39. What types of activities might give you this display?
40. What does that mean to you (refer to actual object from appendix H)?
41. Should you see your biggest number on this (refer to actual object from appendix H) with an arrow pointing up, down, or no arrow?
42. How can you get a big number with an arrow pointing up?
43. How can you get a low number with an arrow pointing up?
44. How can you get a high number with an arrow pointing down?
45. How can you get a low number with an arrow pointing down?

46. Why is it good to get the most time with no arrow next to it?

APPENDIX F

INTERVIEW 2 QUESTIONS

1. What is the object in Picture A (refer to appendix D)?

   _____

2. What does the object in Picture A (refer to appendix D) do?

   _____

3. When you used the object in Picture A (refer to appendix D), you got an average number of (insert student's average result here), what is that number representing?

   _____

   _____

4. When you see your number of (insert student's average result here) on the object of Picture A (refer to appendix D), what does that number mean to you?

   _____

   _____

5. What type of number should you see after using the object in Picture A (refer to appendix D) for an entire physical education class? Circle one (low 0-200, medium 200-500, high 500 and up)
6. What is the object in Picture B (refer to appendix E)?

   _____

7. What does the object in Picture B (refer to appendix E) do?

   _____

8. When you used the object in Picture B (refer to appendix E), you got an average number of (insert student's average result here) with an arrow pointing down, what does that represent?

   _____

9. What does that number mean to you?

   _____

10. When you used the object in Picture B (refer to appendix E), you got an average number of (insert student's average result here) with an arrow pointing up, what does that represent?

    _____

11. What does that number mean to you?

    _____

12. When you used the object in Picture B (refer to appendix E), you got an average number of (insert student's average result here) nothing next to it, what does that represent?

    _____

    _____

13. What does that number mean to you?

    _____

14. Should you see your biggest number on the object in Picture A (refer to appendix E) with (circle one) an arrow pointing down, an arrow pointing up, or nothing next to it?

PICTURE A: Consumer Research Incorporated (2010)

Figure 12. Pedometer

PICTURE B

(TheRelax.com, 2011) (Equipment RX, 2010)

Figure 13. Heart Rate Monitor

REFERENCES

Alexander, D.R. (2006). *What is physical activity?*. Retrieved from http://www.medhelp.org/medical-information/show/730/Physical-activity

American Academy of Pediatrics, (2010). Active healthy living: prevention of childhood obesity through increased physical activity. *American Academy of Pediatrics*, *117*(5).

American Alliance for Health, Physical Education, Recreation, and Dance, (2011). Moving into the future. *National standards for physical education, 2nd edition*. Retrieved from http://www.aahperd.org/naspe/standards/nationalStandards/PEstandards.cfm

American Public Health Association, (2011). Action plan: healthy people 2010 objectives for prevention and control of childhood obesity. Retrieved from http://www.apha.org/programs/resources/obesity/obesityactplan.htm

Anderson, P.M., & Butcher, K.F. (2006). Childhood obesity: trends and potential causes. *The Future of Children*, *16*(1), 19-45.

Bates, H. et al. (2006). Daily physical activity for children and youth: A review and synthesis of the literature. Retrieved from ERIC.

Baur, L.D., Lobstein, T., & Uauy, R.P. (2004). Obesity in children and young people: a crisis in public health. *The International Association for the Study of Obesity*, *1*, 4-85.

Beighle, A., Morgan, C.F., & Pangrazi, R.P. (2003). Using pedometers to promote physical activity in physical education. *JOPERD--The Journal of Physical Education, Recreation & Dance, 74*.

Beveridge, S., Watson, D., & Scruggs, P. (2000). Validation of the Yamax pedometer to assess the intensity of physical activity of fifth-grade children during a physical education class. *Measurement in Physical Education & Exercise Science*, 4(2), 137.

Billington, C., Blair, S.N., Brownell, K.D., Chambliss, H.O., Schwartz, M.B. (2003). Weight bias in health professionals specializing in obesity. *Obesity Research,* 11(9), 1033.

Blair, S.N., Ingle, S., Leary, S.D., Mattocks, C., Ness, A.R., Reilly, J.J., Riddoch, C., et al. (2007). Objectively measured physical activity and fat mass in a large cohort of children. *MedScape Today*, *4*(3).

Blair, S. (Producer). (2008, march 26). Dean's hour [Audio Podcast]. *Exercise is Medicine*.

Booth, M., Okely, A., Chey, T., & Bauman, A. (2002). The reliability and validity of the Adolescent Physical Activity Recall Questionnaire. *Medicine & Science in Sports & Exercise*, 34(12), 1986-1995.

Carroll, M.D., et al. (2006). Prevalence of overweight and obesity in the United States; 1999-2004. *The Journal of The American Medical Association, 295*(13), 1549-1555.

Carroll, M.D. et al. (2010). Prevalence of high body mass index in us children and adolescents, 2007-2008. *The Journal of the American Medical Association, 303*(3), 242-249.

Centers for Disease Control and Prevention, (2011). *How much physical activity do children need?*. Retrieved from http://www.cdc.gov/physicalactivity/everyone/guidelines/children.html

CDC, Initials. (2011). *Nutrition, physical activity, and obesity*. Retrieved from http://www.cdc.gov/healthyyouth/npao/

Chard, D.J, Gersten, R. (2001). Number sense: rethinking arithmetic instruction for students with mathematical disabilities. *LD Online.* Retrieved from http://www.ldonline.org/article/5838.

Child Development Institute, (2011). Language development in children. Retrieved from http://www.childdevelopmentinfo.com/development/language_development.shtml

Consumer Research Incorporated (2010). [picture illustrates the Yamax Pedometer] . Retrieved from http://www.consumersearch.com/pedometers/compare

Cox, M., Schofield, G., Greasley, N., & Kolt, G.S. (2006). Pedometer steps in primary school aged children: a comparison of school-based and out-of-school activity. *Journal of Science and Medicine in Sport*, *9*, 91-97.

Crawford, D., Hardus, P.M., Vurren, C.L., & Worsley, L. (2003). Public perceptions of the causes and prevention of obesity among primary school children. *International Journal of Obesity*, *27*, 1465-1471.

Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood

predictors of adult disease. *Pediatrics: Official Journal of the American Academy of Pediatrics, 101*, 518-525. doi:10.1542

Esteon, R.G., Ingledew, D.K., & Rowlands, A.V. (1998). Validity of heart rate, pedometry, and accelerometry for predicting the energy cost of children's activities. *The American Physiological Society*, 362-371.

EquipmentRx (2010). [picture illustrates EKHO Heart Rate Monitor band]. Retrieved from http://www.equipmentrx.com/index.php?main_page=product_info&cPath=9_33&products_id=295

Flavell, J.H. (1977). *Cognitive development*. Englewood Cliffs, NJ.: Prentice-Hall, Inc.

Flass, T. (2010). Obesity in children. *McKesson Health Solutions LLC, 2010*(1),

Furth, H.G. (1970). *Piaget for teachers*. Englewood Cliffs, NJ.: Prentice-Hall, Inc.

Guba, Y.S., & Lincoln, E.G. (1986). But is it rigorous? trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation*, *30*, 15-25.

Hardman, C.A., Horne, P.J., & Rowlands, A.V. (2009). Childrens' pedometer-determined physical activity during school-time and leisure-time. *Journal of Science and Fitness*, *7*(2), 129-134.

Isaacs, L.D., & Payne, V.G. (2008). *Human motor development*. New York, NY: McGraw-Hill.

Koplan, J.P, Kraak, V.I., & Liverman, C.T. (2005). Preventing childhood obesity: health in balance. Washington, D.C.: *The National Academies Press*.

Ladda, S., Keating, T., Adams, D., & Toscano, L. (2004). Including technology in

instructional programs. *Journal of Physical Education Recreation and Dance JOPERD, 75*(4), 12.

Martinek, T.J., Zaichkowsky, L.B., & Zaichkowsky, L.D. (1980). *Growth and development*. St. Louis, MS: C.V. Mosby Company.

Montgomery, P. G., Green, D. J., Etxebarria, N., Pyne, D. B., Saunders, P. U., & Minahan, C. L. (2009). Validation of heart rate monitor-based predictions of oxygen uptake and energy expenditure. *Journal of Strength & Conditioning Research, 23*(5), 1489-1495. doi:10.1519/JSC.0b013e3181a39277

National Council of Teachers of Mathematics, Initials. (2000-2010). Understanding a child's development of number sense. *Illuminations*, Retrieved from http://illuminations.nctm.org/Reflections_preK-2.html

Patton, M. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Pluto, D., Reis, J.P., Tudor-Locke, C., & Williams, J.E. (2002). Utility of pedometers for assessing physical activity. *Sports Mecidine, 32*(12), 795-808.

Reynolds, C. (2010, March 3). Pedometer craze hits Southampton elementary school. *Southampton News*. Retrieved from http://www.27east.com/news/article.cfm

Robinson, L.E., & Wadsworth, D.D. (2010). Stepping toward physical activity requirements: integrating pedometers into early childhood settings. *Early Childhood Education Journal*, *38*, 95-102.

Scruggs, P. (2007). A Comparative Analysis of Pedometry in Measuring Physical

Activity of Children. *Medicine & Science in Sports & Exercise,* 39(10), 1837-1846.

Scruggs, P. (2007). Middle School Physical Education Physical Activity Quantification: A Pedometer Steps/min Guideline. *Research Quarterly for Exercise & Sport*, 78(4), 284-292.

SPARK, Initials. (2009). *2010 pep grant information*. Retrieved from http://www.sparkpe.org/grants/pep-grant-info/

Strauss, R.S., & Pollack, H.A. (2011). Epidemic increase in childhood overweight, 1986 1998. *The Journal of American Medical Association, 286*(22), 2845-2848.

TheRelax.com (2011). [picture illustrates EKHO Heart Rate Monitor]. Retrieved from http://www.therelax.com/accessories/heart-rate-monitors.html

U.S. Department of Health and Human Services, Initials. (2010). *Nutrition and weight status*. Retrieved from http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=29