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Time Efficiency in Computer Assisted Direct Observation of Physical Activity using SOFIT

Trisha Anderson
Brigham Young University - Provo

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TIME EFFICIENCY IN COMPUTER ASSISTED DIRECT
OBSERVATION OF PHYSICAL ACTIVITY
USING SOFIT

by

Trisha Anderson

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

Department of Exercise Sciences
Brigham Young University
August 2005
BRIGHAM YOUNG UNIVERSITY

GRADUATE COMMITTEE APPROVAL

of a thesis submitted by

Trisha Anderson

This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

Date

Susan D. Vincent, Chair

______________________________

Date

Keven A. Prusak

______________________________

Date

Todd Pennington
As chair of the candidate’s graduate committee, I have read the thesis of Trisha Anderson in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

Date     Susan D. Vincent  
Chair, Graduate Committee  

Accepted for the Department

Larry Hall  
Chair, Department of Exercise Sciences  

Accepted for the College

Gordon B. Lindsay, Associate Dean  
College of Health and Human Performance
ABSTRACT

TIME EFFICIENCY IN COMPUTER ASSISTED DIRECT OBSERVATION OF PHYSICAL ACTIVITY USING SOFIT

Trisha Anderson
Department of Exercise Sciences
Master of Science

Having valid and reliable methods for assessing physical activity levels is critical to understanding physical activity patterns. Direct observation is a widely used technique for obtaining contextually rich data on physical activity levels in physical education classes. One major limitation of direct observation is that it is time intensive. The use of digital video editing software programs may lessen the amount of time needed to gather the data. The purpose of this study was to compare the amount of time needed to obtain SOFIT (System for Observing Fitness Instruction Time) physical activity data using the traditional paper and pencil method and using SOFIT with Studio Code digital video editing software (Studio Code, Sportstec International, Camarillo, CA). Six second-grade classes (N = 23) were video taped and observed using both methods to gather SOFIT data. A stop watch was used to determine how long it took to gather the data and it was found that Studio Code took significantly less time (t = 4.91, p < .004) to gather SOFIT
activity data than using the traditional paper and pencil method. Researchers who use
direct observation may decrease the amount of time needed to gather data by using digital
video software.
ACKNOWLEDGMENTS

There have been many people who have supported me in my dream of getting a Master’s Degree. First, I would like to express thanks to Dr. Susan Vincent who has given so much to assist in my undertaking. She has shared so much expert advice and time; it is greatly appreciated. Second, I would also like to give a big thanks to my committee who has freely shared knowledge that has made my work easier. Finally, I would be greatly remiss if I didn’t thank those in my family: my mom and dad, brothers, and sisters who have conferred so much love and support in many ways that my dream is now a reality. This has been a long and difficult path, at times, and I know that without the support of all these associates and family members that I would never have reached my destination.
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USING SOFIT

Trisha Anderson, MS, Susan D. Vincent, PhD
Department of Exercise Sciences
Brigham Young University

Address all correspondence to:
Trisha Anderson
2465 W. 450 So. #4, Springville, UT 84663
Phone (801) 489-1861
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Abstract

Having valid and reliable methods for assessing physical activity levels is critical to understanding physical activity patterns. Direct observation is a widely used technique for obtaining contextually rich data on physical activity levels in physical education classes. One major limitation of direct observation is that it is time intensive. The use of digital video editing software programs may lessen the amount of time needed to gather the data. The purpose of this study was to compare the amount of time needed to obtain SOFIT (System for Observing Fitness Instruction Time) physical activity data using the traditional paper and pencil method and using SOFIT with Studio Code digital video editing software (Studio Code, Sportstec International, Camarillo, CA). Six second-grade classes ($N = 23$) were video taped and observed using both methods to gather SOFIT data. A stop watch was used to determine how long it took to gather the data and it was found that Studio Code took significantly less time ($t = 4.91, p < .004$) to gather SOFIT activity data than using the traditional paper and pencil method. Researchers who use direct observation may decrease the amount of time needed to gather data by using digital video software.
Introduction

Having valid and reliable methods for assessing physical activity levels is critical to understanding physical activity patterns. The literature is replete with research which has validated various methods for assessing physical activity levels. Each method, understandably, has its strengths and weaknesses. Selecting the appropriate method of assessment is dependant on the research question, research setting, and the population being monitored.

One common setting for assessing physical activity levels is in physical education classes. School physical education programs may be the only institutions that can provide almost all children with the opportunity to develop lifelong physical activity patterns (Bar-Or, 1987; Meredith, 1988; Sallis & McKenzie, 1991). Monitoring physical activity in physical education classes can help researchers determine the effectiveness of the teaching process relating to physical activity promotion (Keating, 1999).

Several methods for assessing the physical activity levels of children in the physical education setting have been developed and widely used, including self-report, accelerometers, questionnaire and interviews, pedometers, and direct observation, each with their particular strengths and weaknesses. Self-report questionnaires are easy to administer, but the validity depends on the respondent’s ability to accurately understand the intent of the question and then to recall the information (Aadahl & Jorgensen, 2003). Heart-rate monitoring has been widely used because of its ease of measurement, ability to record values over time, and its reflection of relative stress placed on the heart during physical activity. Limitations to heart-rate data include inaccuracy due to stress, oxygen
4 Time Efficiency in Direct Observation

uptake, and the activity being continuous or not (Eston, Rowlands, & Ingledew, 1998). Pedometers provide a reasonably accurate estimate of distance walked and number of steps taken, and they are inexpensive, reusable, and objective. However, pedometers can not measure the intensity or type of physical activity (Eston et al., 1998). The accelerometer provides a measure of both frequency and intensity of movement, and has the advantage of storing data over a number of days. The disadvantage of accelerometers includes high cost, inability to measure aquatic activities, lack of sensitivity to respond to static activity, and inability to measure the type of physical activity (Dishman, Washburn, & Schoeller, 2001).

Direct observation has been viewed as a very valid and reliable method for assessing physical activity levels in children; it is objective and it can provide contextually rich data. It is useful for researchers studying children and for those using ecological and cognitive-behavioral approaches to examine how physical activity is influenced by physical and social environments (McKenzie, 2002). Direct observation utilizes an observer who observes a subject continuously, recording the activity the subject is engaging in. According to Montoye, Kemper, Saris, and Washburn (1996) direct observation can be seen as labor intensive and tedious. It can be time intensive because you can only observe four students at a time. Therefore, obtaining physical activity data on large numbers of children becomes extremely burdensome and perhaps even prohibitive. Researchers might be more likely to use direct observation if the time to obtain the data could be reduced. Another drawback to direct observation is the high cost of the observer’s time. Considerable amounts of time and effort are required to train
observers to become skillful in coding different variables. The reactivity of the children caused by the observer (i.e., changing normal behavior because they are being observed) may also be considered a limitation (Malina, Bouchard, & Bar-Or, 2004). Despite these limitations, direct observation is considered one of the most valid, reliable and objective methods of assessing physical activity (Malina et al., 2004). Direct observation can exceed other methods in gathering physical activity by providing rich data, so it does receive increased attention by researchers (McKenzie, 2002).

Recent technological advances that permit observational codes to be entered, stored, and analyzed by handheld computers make this methodology of assessing physical activity much more useful and appealing. There are several computer packages that allow real time physical activity data to be entered directly into a computer, or allow events to be coded directly from a videotape or digital media file. Some computer packages allow the researcher to define their own codes within the program, and to use buttons that will speed up the process of gathering the data. Data that can be directly entered into a computer reduces error and speeds up the analyses and reporting (McKenzie, 2002). McKenzie goes on to add that videotapes provide permanent samples that can be viewed many times over, by different researchers, and in a setting that is removed from distractions. The invention of digital video, which allows the manipulation of video images, may prove to be an effective tool for gathering direct observation data.

A new software program, Studio Code (Sportstec International, Camarillo, CA), combines a user defined coding system with the digital video footage being analyzed. This software allows the user to define the codes of interest and also to move forward or
backward in time using a “scrubber” (button which advances the video through time) by simply dragging it. Thus, the wait time between coding intervals can be eliminated.

One of the major limitations of direct observation is that it is time intensive. The purpose of this study was to compare the amount of time needed to obtain SOFIT activity data using the traditional paper and pencil method and digital video editing software Studio Code.

Methods

Participants
Twenty-three second-grade students from one class in an elementary school from a large school district in Utah County, Utah, participated. Approval from the school district, the school’s principal, the parents of the participants, the participants themselves, and the Institutional Review Board from Brigham Young University were obtained.

Instruments
SOFIT assesses variables associated with students’ activity levels and opportunities to become physically fit. SOFIT has been widely used in many studies, has been validated, and is a reliable method of direct observation (McKenzie, Sallis, & Nader, 1991; McKenzie, Sallis, & Armstrong, 1994; van der Mars, Darst, Vogler, & Cusimano, 1998; van der Mars, Vogler, Darst, & Cusimano, 1994; Graham, 1992; Pangrazi, & Dauer, 1992; Rink, 1993; Darst, Zakrajsek, & Mancini, 1983; Siedentop, 1991; Siedentop, Tousignant, & Parker, 1982; Stewart, 1989). SOFIT entails observing physical education classes while recording (a) the student’s physical activity level, (b) lesson context, and (c) teacher behaviors (McKenzie et al., 1991).
SOFIT uses a three-phase decision system that examines (a) how active students are, (b) how class time is spent in various tasks and goals, and (c) how teachers spend their time during class. Phase 1 involves making a decision on the activity level of individual students. The engagement level provides an estimate of the intensity of students’ physical activity and uses the activity codes from a previously validated system (McKenzie et al., 1991). Codes 1 to 4 describe the body position of the students (1 = lying down, 2 = sitting, 3 = standing, 4 = walking), and Code 5 (very active) identifies when the students are expending more energy than they would during ordinary walking. Phase 2 involves coding the curricular lesson context at the end of each observational interval (20 seconds). Curricular context codes include general content such as management, or physical education content. If physical education content is occurring, a further decision is necessary to decide if the focus is on knowledge content or motor content. If motor content is occurring, a further decision is necessary to code whether the activity is fitness, skill practice, game play, or other. Phase 3 involves coding the teacher’s involvement during class. Teacher behaviors are classified into one of six categories which are promotes fitness, demonstrates fitness, instructs generally, manages, observes, and off-task.

Direct observation is time intensive because of the observe, record, and wait process. At each 20-second interval the observer watches the subject and records the data, they then have to wait until the next 20-second interval to record the next activity level, and so on throughout the entire lesson. The observer spends a lot of time waiting between the 20-second intervals to record the data. If a tool could be used to eliminate the
wait time it could be very beneficial to observers and researchers, and it could save a lot of time spent in gathering physical activity data. It would also allow for the collection of additional data.

Studio Code is a digital video editing software that combines a user defined coding system (in this case SOFIT) with the digital video footage being analyzed. The main purpose for using Studio Code to obtain SOFIT data is the ability to move forward or backward in time instantaneously using the “scrubber” (button that advances the video through time) by simply dragging it. Thus, the wait time between coding intervals can be eliminated. For example, in Studio Code, the scrubber can be moved precisely, and instantly, 20 seconds forward to record the data. To date there are no studies that have used Studio Code to gather SOFIT physical activity data.

Procedures

The researcher for this study gathered all the data and coded it. The researcher was trained on how to code SOFIT prior to the study and met the .85 reliability criteria to be considered a trained SOFIT observer (McKenzie, Strikmiller, Stone, Woods, Ehlinger, Romero, et al., 1994). The second grade class (N = 23) was videotaped for six different lessons. Across all six lessons a total of twenty-three randomly selected students were observed for their physical activity level and the lesson context. Teacher behavior was not coded in this study. This study coded the SOFIT physical activity data using two methods: (a) the researcher coded a lesson from the videotape using the traditional paper and pencil method with four randomly selected students, and (b) a week later the researcher coded the same lesson and students using Studio Code software. A crossover
design was used in this study to remove the possibility of an order effect. Three lessons were coded paper and pencil first and Studio Code second and the other three lessons were coded Studio Code first and paper and pencil second (see Table 1). Prior to any coding, the video taped lesson was uploaded to the computer. Both the paper and pencil method and the Studio Code method were collected while viewing the video on the computer.

**Paper and Pencil Method.** While gathering data on the videotaped class using the traditional paper and pencil method a tape with a prerecorded “record” prompt (an audible signal) was used to let the researcher know when the 20-second interval occurred to gather the physical activity and lesson context data. The data was gathered using the SOFIT recording sheets, and a stop watch was used to record how long it took to gather the needed data on the entire lesson.

**Studio Code Method.** The Brigham Young University physical education pedagogy lab has many Macintosh computers and a variety of software available for students and teachers to use. Studio Code is part of the software that is available and it utilizes a user defined coding system. Two of the most common uses include analyzing good teaching methods and evaluating athletic competitions. Studio Code has the potential to analyze video of many different settings. In this study Studio Code software was used to assess physical activity in the direct observation setting.

While gathering the data using Studio Code the researcher used the time line on the computer to determine the 20-second intervals. At the 20-second recording interval the data was gathered on the computer using the SOFIT codes which were defined within
the Studio Code software. After recording the data the scrubber was moved forward to the next 20-second recording interval. This moving of the scrubber forward in time eliminated the wait time in between the recording intervals. A stop watch was used to record how long it took to gather the needed data on the entire lesson.

A second trained SOFIT observer simultaneously coded two separate lessons with the researcher during the data collection, one using the paper and pencil method during the first week, and one using the Studio Code method during the second week. This was done to ensure that the researcher was coding the lessons accurately. This is standard procedure to ensure accuracy in coding what is being seen. The reliability criteria is set at .85 and has been validated with other studies (McKenzie, Strikmiller, Stone, Woods, Ehlinger, Romero, et al., 1994).

**Design and Statistical Analysis**

Three main analyses were performed. First, interrater reliability between the researcher and a second trained SOFIT observer was calculated, using intraclass correlations, to determine if the researcher was reliable in coding the data. Second, intrarater reliability was calculated, using intraclass correlations, between the paper and pencil method and the Studio Code method to ensure that the researcher was consistent in coding the data using both methods. Finally, a dependent *t* test was used to determine if significant differences existed between the amounts of time it took to code using the two methods. Time to code was the dependent variable. The independent variable was the method of coding (paper and pencil or Studio Code).
Results

Intraclass correlations were used to calculate the interrater reliability between the researcher and the second trained observer gathering data on the same lesson, simultaneously. The reliability scores ranged from $R = .88$ to $R = .91$. Two lessons were analyzed, one lesson was coded using the traditional paper and pencil method, and the other lesson was coded using the Studio Code method.

Intraclass correlations were also used to calculate the intrarater reliability to evaluate the consistency of the researcher in gathering the physical activity and lesson context data using the two methods. Initially, the intraclass correlations between the paper and pencil and Studio Code methods ranged from .398 to .916 and were unacceptable (see Table 2). This was unexpected considering the interrater reliability was good. After further investigation it was realized that the 20-second interval as dictated by the prerecorded tape for use with the paper and pencil format was slightly off from the 20-second intervals which were used on the Studio Code time line. This slight shift in the 20-second intervals caused the researcher to code a different point in time in the lesson for each method. This resulted in coding of different behaviors and lesson context which made the intraclass correlations between the two methods unacceptable. Therefore, to determine if this was the cause of the unacceptable reliability and to resolve this issue, the researcher repeated the coding of all six paper and pencil lessons. To ensure that the same 20-second intervals were being used as were used during the Studio Code lesson; a research assistant watched the Studio Code time line and verbally prompted the observer for each 20-second interval. The observer recorded the data using paper and pencil. Time to code
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the six lessons was also gathered for analysis. Once the six lessons were recoded correctly the intrarater reliability was acceptable and intraclass correlations ranged from .836 to .988 (see Table 2). The majority of the correlations between the two methods were considered acceptable, indicating that similar data was obtained using both methods.

Since the interrater reliability and the intrarater reliability were acceptable, the time to code the data was then analyzed. The mean and standard deviation for time to code the data with the traditional paper and pencil method was 29.17 ± 1.05 minutes. The mean and standard deviation for time to code the data with Studio Code was 20.48 ± 4.19 minutes. The dependent $t$ test on the time to collect SOFIT data indicated that the Studio Code method was significantly faster than the traditional paper and pencil method ($t = 4.91$, $p < .004$).

Discussion

Interrater Reliability

The need for high levels of reliability and validity in gathering data in a physical education class setting has previously been established (Silverman & Zotos, 1987). van der Mars (1989) suggests that the goal of any observation made in a physical education setting should be an accurate reflection of what really happened. As humans we need to be objective in making accurate reports of what is observed. Therefore, it is extremely important that researchers and physical education teachers use tools that ensure the methods used in direct observation are valid and reliable. Most major organizations and well known professionals involved in the endorsement of physical activity, such as the
Centers for Disease Control and Prevention (CDC), the American College of Sports Medicine (ACSM), and the Surgeon General, have all plainly stated that developing valid and reliable measures of physical activity is a high priority (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al., 1995).

McKenzie (2002) suggests that to ensure the accuracy of the physical activity data gathered in direct observation methods the researcher needs to be involved in observer training. The extent to which the recorded data reflects the actual occurrence of physical activity behaviors is largely dependent on the skills of the observer. Therefore, it is important to plan for observer monitoring and retraining during the data collection process. This was accomplished in this study with the high interrater reliability scores of $R = .88$ to $R = .91$ during the entire data collection period.

*Intraclass Reliability*

Reliability is a measure of consistency, and is used as a measure of the quality of collected data. In direct observation reliability refers to the level of agreement between trained observers or it can also refer to the correspondence between codes in two or more data collection methods. Reliability analyses are important in checking for consistency through the duration of a study (McKenzie, 2002).

Once the discrepancy between the coding intervals of the two methods was resolved, this study showed that intraclass correlations were very strong between the traditional paper and pencil method and the Studio Code method, suggesting that the researcher was reliable in coding the data. It also indicates that Studio Code can be an acceptable method for obtaining reliable physical activity data while benefiting from its
time saving advantage. This is the first study to use Studio Code in gathering direct
observation physical activity data and it has shown great promise.

Since the intrarater reliability intraclass correlations did not show consistency the
first time the data was coded using a crossover design, the researcher recoded the six
paper and pencil lessons again. Therefore, this study was not a true crossover design.

Results of the *t* -test indicate that using Studio Code did make a significant
difference (*t* = 4.91, *p* < .004) in the amount of time it took researchers to gather physical
activity data in a physical education class. There was an average 8.69 minute (29.8%)
decrease in time between gathering the data using Studio Code and paper and pencil.
When evaluating many lessons, decreasing the time by almost a third can save
researchers a considerable amount of time. Additionally, using digital video analysis can
also reduce the number of trained observers needed to code the data. Research assistants
who do not need to be trained in coding methods could be in the field video taping the
lessons and trained observers could be in the lab coding the data on computers.

Keating (1999) suggests that data collection in physical education classes may be
improved by using computers. If SOFIT is going to be used in numerous studies, then the
time invested to change the method to a computerized format may be worth it. Most
studies right now use paper and pencil to gather the data. With the development of new
software, such as Studio Code, researchers have the potential to overcome some of the
intensive time commitment limitation of direct observation. Additionally, with the current
availability of computers, it is possible that other direct observation methods may be
converted to a computer format. Results of this study indicate that using a computer format of SOFIT maintains appropriate levels of validity and reliability while reducing the time needed to gather the data.

*Recommendations for Future Researchers*

First, when using the Studio Code method the researcher would advance the scrubber forward in time to code the data every 20 seconds. While skipping the 20 seconds forward the researcher found that the instructions from the physical education specialist, and the pattern of behavior of the students were more difficult to follow, making it harder to make an objective determination in coding this particular aspect. This resulted in the researcher having to periodically move the scrubber back a few seconds before the 20-second interval to better understand the context of the physical activity and lesson context. It is recommended that in future studies researchers advance the scrubber to about 3 seconds prior to the 20-second record interval in order to better understand the context.

Second, as was indicated in the results section, having the same exact 20-second intervals for both methods was critical. Future researchers must be careful to ensure that they use the same 20-second intervals for recording the data. Having a research assistant verbally prompt the researcher when to code during the traditional paper and pencil method, based on the 20-second intervals on the Studio Code time line, was effective and appropriate for overcoming this limitation.

Third, given Studio Code’s ability to use any coding system determined by the user and the results of this study which found a reduction in time to gather SOFIT data it
is reasonable to expect similar results with other direct observation tools (i.e. SOPLAY-System for Observing Play and Leisure Activity in Youth, BEACHES-Behaviors of Eating and Physical Activity for Children’s Health: Evaluation System, etc.) (McKenzie, 2002).

Fourth, the researcher in this study was a novice at gathering SOFIT data. It is expected that if trained SOFIT researchers had enough repetition using Studio Code to gather SOFIT data the researcher would get faster and would, therefore, save even more time in gathering the data.

Fifth, one of the drawbacks of using Studio Code is that it is expensive. This study was conducted in the context of a physical education pedagogy lab which had access to a variety of software programs. The cost of obtaining Studio Code software may be prohibitive for some researchers.

The final recommendation is intended for the Studio Code software developers. The researcher found that it would have been helpful if Studio Code were to include a feature that allows the user to select an interval of time when an audible beep would sound indicating it was time to record. This audible beep would make it possible for the researcher to know when to code without the use of a researcher assistant or without having to watch the timeline so closely to know when it is time to record. Additionally, adding a user determined automatic jump interval which would instantly move the scrubber forward in time would improve the process of data collection.
Conclusion

The results of this study indicate that using digital video editing software, such as Studio Code, can save the researcher a significant amount of time in gathering direct observation physical activity data in physical education classes. A decrease of 29.8% in time to analyze the data saves valuable time for researchers who are evaluating large numbers of youth. Having research assistants video tape the lessons also means needing less trained observers for coding. While more studies are needed to evaluate the methods and techniques used in this study and to confirm its results, there is potential for overcoming a major limitation of direct observation.
References


Meredith, M. D. (1988). Activity or fitness: Is the process or the product more important for public health? *Quest, 40,* 180-186.


Table 1. Cross Over Design Table

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<td>Studio Code</td>
</tr>
<tr>
<td>Lesson 2</td>
<td>Paper and pencil</td>
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</tr>
<tr>
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<td>Paper and pencil</td>
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</tr>
<tr>
<td>Lesson 4</td>
<td>Studio Code</td>
<td>Paper and pencil</td>
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<tr>
<td>Lesson 5</td>
<td>Studio Code</td>
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<tr>
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<td>Studio Code</td>
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Table 2. Intraclass Reliability between Paper and Pencil and Studio Code Methods

(Reliability Statistics)

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Appendix A

Prospectus
Chapter 1

Introduction

Young people are at risk for becoming less physically active as they grow older (U.S. Gov. Healthy People 2010, 2000). Therefore, encouraging moderate and vigorous physical activity among youth is necessary. Since children spend most of their time in school, the kind and amount of physical activity encouraged in schools are important components of a fitness program and a healthy lifestyle.

Schools are an effective vehicle for providing physical activity and fitness instruction because they reach most children (Sallis, McKenzie, & Alcaraz, 1997). Participation in school physical education ensures a minimum amount of physical activity and provides a platform to teach physical activity strategies and activities that can be continued into adulthood. Findings suggest that the quantity and, in particular, the quality of school physical education programs have a significant positive effect on the health-related fitness of children by increasing their participation in moderate to vigorous activities (McKenzie, Nader, & Strikmiller, 1996). Sallis and Patrick (1994) have shown that spending 50% of physical education class time in physical activity is an ambitious but feasible target. The National Association for Sport and Physical Education (NASPE) introduced in 1998 the first-ever physical activity guidelines for children ages 5-12. They recommended a minimum of 30 minutes of physical activity every day. That first recommendation has since been revised to include 60 minutes to several hours of physical activity every day (National Association for Sport and Physical Education, 2004). Being active at least half of the physical education class period on at least half of
the school days would provide a substantial portion of the physical activity time recommended (Sallis & Patrick, 1994). It has been recommended that adolescents engage in moderate physical activity for at least 30 minutes on 5 days in a week’s period of time (U.S. Gov. Healthy People 2010, 2000).

To assess this goal of 50% of class time spent on physical activity students must be measured. Instruments designed to measure physical activity, lesson context, and teacher behaviors in physical education programs need to produce reliable and valid scores in the populations in which they are used. To a large degree, research on data collection instruments is the fundamental basis of research on physical activity and fitness in physical education programs. Instruments that produce reliable and valid data are needed to assess research implementation, and to document whether the intervention had lasting effects.

Dishman & Buckworth (1996) have suggested that the prevalence of physical inactivity in the United States is partially explained by not having well-designed, clearly understood interventions promoting a physically active lifestyle. Contributing to this lack of understanding is that few studies use validated measures for physical activity behavior. Most major organizations and influential people involved in the promotion of physical activity, such as the Centers for Disease Control and Prevention (CDC), the American College of Sports Medicine (ACSM), and the Surgeon General, have clearly stated that developing valid and reliable measures of physical activity is a high public priority (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al., 1995).
Several methods for assessing the physical activity levels of children in the physical education setting have been developed including: self-report, accelerometers, questionnaires and interviews, pedometers, and direct observation. All of these instruments have strengths and weaknesses. Self-report instruments have many limitations related to estimating time and recalling information often resulting in inaccurate reporting. The accelerometer does not provide data in activity contexts for intensity and duration and can be very expensive. Questionnaires and interviews are not very useful for children below the fourth grade because of recall ability about frequency, intensity and duration of their physical activities (McKenzie, 2002). Pedometers provide an effective measure of total physical activity but can not show the intensity or the type of physical activity (Easton, Rowlands, & Ingledew, 1998). Direct observation is where an investigator observes a subject continuously and records the activity participated in (Malina, Bouchard, & Bar-Or, 2004). Direct observation is particularly important in assessing the physical activity levels of children. Rowlands, Ingledew, and Eston (2000) said the use of direct observation has been supported by recent meta-analysis, which found that the size of the relationship between body fat and physical activity in children depended on the type of activity measure used. One of the observational tools used to gather physical activity levels of children in physical education classes is SOFIT (System for Observing Fitness Instruction Time) which has been validated and used in many research studies (Keating, 1999; McKenzie, et al., 1996; McKenzie, Sallis, & Nader, 1991; Pope, Coleman, Gonzales, Barron, & Heath, 2002; Rowe, Schuldheisz, & van der
Mars, 1997). One major criticism of direct observation methods is that it is time intensive because you can only observe four students at a time. Researchers might be more likely to use direct observation if the time to obtain the data could be reduced.

Purpose of Study

One of the major limitations of direct observation is that it is time intensive. The purpose of this study is to compare the amount of time needed to obtain SOFIT activity data using traditional direct observation methods and digital video editing software (Studio Code, Sportstec International, Camarillo, CA).

Null Hypothesis

The time needed to gather SOFIT activity data using Studio Code will not be significantly less than the time needed to gather SOFIT activity data using the traditional direct observation method.

Hypothesis

The time needed to gather SOFIT activity data using Studio Code will be significantly less than the time needed to gather SOFIT activity data using the traditional direct observation method.

Definitions

SOFIT- System for Observing Fitness Instruction Time. A direct observation tool which assesses physical activity, lesson context, and teacher behavior in physical education programs.

Studio Code- Combines a user defined coding system (in this case SOFIT) with the digital video footage being analyzed.
Assumptions

1. The students will behave normally with the video camera in the room.
2. The researcher will be consistent in coding the data twice.

Delimitations

This study will be delimited to third grade students.

Limitations

The researcher will collect all SOFIT data using both the traditional methods and Studio Code.

Significance of the Study

This study will evaluate if using digital video editing software, such as Studio Code, can decrease the time needed to code physical activity data using SOFIT direct observation method when compared to the traditional paper and pencil methods. SOFIT is a reliable, valid instrument that assesses physical activity by direct observation, but can be time consuming. It can be time consuming because you are only able to observe four students at a time. Studio Code is a software program that can be used for direct observation which may save time in gathering data. This is significant because one of the major limitations of direct observation techniques is that they are time intensive. Finding a way to decrease the time needed to gather data can improve this limitation for researchers thus increasing the amount of data collected.
Chapter 2

Review of Literature

Introduction

Researchers in physical education and exercise science have said that all Americans, no matter the age, should be involved in physical activity at various levels of intensity on a regular basis (Meredith, 1988). This same message has also been echoed by government reports outlining health objectives for the nation (U.S. Gov. Healthy People 2010, 2000).

As the focus on health-related physical education increases, promoting physical activity in school physical education programs can lead to the development of physical fitness and lifelong physical activity.

School physical education programs may be the only institutions that provide most children with the opportunity to foster lifetime physical activity patterns (Bar-Or, 1987; Meredith, 1988; Sallis & McKenzie, 1991). Physical education specialists, given time and facilities, have the potential to play an important part in public health by promoting student participation in physical activity and helping students to establish a habit of regular involvement in physical activity for a lifetime. A number of studies have indicated that the physical activity patterns in adulthood are strongly linked to physical activity habits established in children (Blair, 1992; Corbin, 1987). In addition, the positive health benefits of regular participation in physical activity for individuals of all ages are well established (Keating, 1999).
To learn more about the current role of physical activity leading to the development of physical fitness in school physical education programs and how these programs can increase their impact on public health, physical activity behaviors need to be accurately measured. To a large degree, research on data collection instruments is the fundamental basis of research on physical activity and fitness in physical education programs. To determine the status of the teaching process relating to physical activity in physical education classes, it is necessary to have instruments that produce reliable and valid data (Keating, 1999). Instruments that produce reliable and valid data are needed during the implementation phase of a study, as well as to document whether the intervention had lasting effects.

Tools that have been utilized for measuring physical activity in the physical education setting include self-report questionnaires, heart rate monitors, pedometers, accelerometers, and direct observation. Self-report questionnaires are feasible and easy to administer, but the validity depends on the respondent’s ability to accurately remember the data (Aadahl & Jorgensen, 2003). Heart rate monitoring has been widely used because of its ease of measurement, ability to record values over time, and its reflection of relative stress placed on the heart during physical activity. Heart rate data may not be accurate due to stress, oxygen uptake, and the activity being continuous or not (Eston, et al., 1998). Pedometers provide a reasonably accurate estimate of distance walked and number of steps taken, and they are inexpensive, reusable, and objective. However, pedometers cannot show the intensity or type of physical activity (Easton, et al., 1998). The accelerometer provides a measure of both frequency and intensity of movement, and
has the advantage of storing data over a number of days. The disadvantage of accelerometers includes high cost, inability to measure aquatic activities, lack of sensitivity to respond to static activity, and inability to measure the type of physical activity (Dishman, Washburn, & Schoeller, 2001).

Direct observation is an important tool in the assessment of physical activity because it uses an objective method and it can provide contextually rich data on the setting in which activity occurs. It is particularly useful for researchers studying children and for those using ecological and cognitive-behavioral approaches to examine how physical activity is influenced by physical and social environments (McKenzie, 2002). However, Montoye, Kemper, Saris, and Washburn (1996) have found that direct observation can be viewed as labor intensive and tedious. Another drawback to direct observation is the high cost of the observer’s time. Considerable amounts of time and effort are required to train observers to become skillful in coding different variables. The reactivity of the children caused by the observer (ie. changing normal behavior because they are being observed) may also be considered a limitation. Despite these limitations, direct observation is considered a valuable method of assessing physical activity (Malina, Bouchard, & Bar-Or, 2004). Recent technological advances that permit observational codes to be entered, stored, and analyzed by handheld computers make this methodology of assessing physical activity much more useful and appealing (McKenzie, 2002).

The focus of this study is to improve the process of conducting and using direct observation in assessing the physical activity of children in the physical education setting. McKenzie (2002) recommends that direct methods of assessing physical activity
including observations and motion sensors be used when investigating levels of physical activity.

**SOFIT**

The System for Observing Fitness Instruction Time (SOFIT) assesses the variables associated with students activity levels and opportunities to become physically fit. SOFIT involves the observation of physical education classes while recording the students physical activity levels, curriculum variables, and teacher behaviors (McKenzie, Sallis, & Nader, 1991).

SOFIT is a momentary time sampling and an interval recording system designed specifically to quantify factors believed to promote health-related physical activity. SOFIT uses a three-phase decision system that examines 1) how active students are, 2) how class time is spent in various tasks and goals, and 3) how teachers spend their time during class.

Phase 1 involves making a decision on the activity level of individual students. This is made by observing preselected students (one at a time) and determining their level of physical activity (or active engagement level) periodically (every 20 seconds) throughout the class time. The engagement level provides an estimate of the intensity of a students physical activity and uses the activity codes from a previously validated system (McKenzie, et al., 1991). Codes 1 to 4 describe the body position of the students (1 = lying down, 2 = sitting, 3 = standing, 4 = walking), and Code 5 (very active) identifies when the students are expending more energy than they would during ordinary walking.
Coding is based on the observed activity of the target students at the moment the observation interval ends.

In the validation study (McKenzie et al., 1991) the five-level physical activity coding system was compared to the heart rates of 19 children, 4 to 9 years old, who wore the UNIQ Heart Watch (Computer Instruments, Hempstead, NY) while they participated in a variety of specified activities. Average heart rates ranged from 99 beats per minute lying down to 153 beats per minute being very active. Energy expenditure values for the categories, calculated from obtained heart rates using values for children (Bar-Or, 1983), ranged from .029 to .144 kcal/kg/min. Both heart rates and estimated energy costs increased with each activity category, thereby supporting the validity of the SOFIT student activity coding categories. An additional validation for the SOFIT activity intensity scale was obtained with a sample of fifth-grade boys ($n = 30$) and girls ($n = 39$) (McKenzie, Sallis, & Armstrong, 1994). Concurrent validity was measured as the correlation between SOFIT energy cost estimates and mean accelerometer counts during physical education and recess ($r = .74, p < .001$). However, this validity estimate is limited, because energy cost was calculated directly from the observed categories.

Phase 2 of the decision sequence involves coding the curricular lesson context at the end of each observational interval (20 seconds). A decision is made whether class time is being allocated for general content (such as management) or for actual subject matter (physical education) content. If substantive physical education content is occurring, an additional decision is necessary to decide whether the class focus is on knowledge content (coded as either general knowledge or physical fitness knowledge) or
on motor content (physical activity). If motor content is occurring, a further decision is necessary to code whether the context is one of fitness, skill practice, game play, or other.

In a study by McKenzie, et al., (1991) 88 physical education lessons were coded using third-, fourth-, and fifth-graders. Three trained physical education specialists and 20 classroom teachers taught the 88 lessons to 24 different classes, ranging in size from 23 to 34 students. Correlations among lesson context categories, selected student activity, and teacher behavior categories were examined. Time allowed for management correlated positively with the amount of time students spent standing and negatively with the amount of time they spent walking, being very active, and engaging in moderate to vigorous physical activity (MVPA). Class time allocated to fitness activities correlated positively with the amount of time students spent walking, being very active and engaging in MVPA and negatively with the amount of time spent standing. Class time spent in skill development activities correlated positively with the amount of time students spent standing and negatively with the amount of time they engaged in MVPA.

Phase 3 of the decision sequence involves coding the teacher’s involvement during class. Teacher behavior is classified into one of six categories. The first behavior category, promotes fitness, is directly related to student involvement in fitness activities, and is coded when the teacher prompts or reinforces learners for physical fitness engagement. The second category, demonstrates fitness, identifies when the teacher models fitness engagement. The remaining four categories, instructs generally, manages, observes, and off-task, are only indirectly related to student fitness opportunities but
provide important information on how teachers spend their time during class (McKenzie, et al., 1991).

A study by van der Mars, Darst, Vogler, & Cusimano (1998) looked at Phase 3 of the SOFIT tool. Eighteen certified elementary physical educators, 8 female and 10 males participated. Each class included a 7-10 minute health-related physical fitness activity. Class size ranged from 24 to 31 students. Behaviors of the students and teachers were videotaped, with the gym divided into sectors for easy movement coding. Each of the teachers wore a wireless microphone to capture verbal communication. It was found that teachers spent an average 7.7% of their time in the center with the remaining 92.3% in peripheral sectors. During the lesson teachers averaged 7.79 sector changes a minute, with a mean length of stay 8.7 seconds. The feedback observed from the teachers occurred at a mean rate of 3.73 per minute. Teachers actively promoted fitness 40.66% of the time, and modeled 31.56% of the lesson. The remaining time was spent on managerial tasks (24.46%). The correlations between the teachers’ supervisory patterns and the students’ physical activity levels provide support for previous research findings in physical education (van der Mars, Vogler, Darst, & Cusimano, 1994) and in the professional literature in physical education teacher education (e.g., Graham, 1992; Pangrazi & Dauer, 1992; Rink, 1993).

The lesson context and teacher behavior categories of SOFIT were derived from codes and definitions commonly used in both physical education teacher training and pedagogical research (Darst, Zabrajsek, & Mancini, 1983; Siedentop, 1991; Siedentop,
Tousignant, & Parker, 1982; Stewart, 1989). In this study we will only be looking at the physical activity level of the participants involved.

**Studio Code**

The invention of digital video, which allows the manipulation of video images, may provide an effective application of SOFIT analysis. A new program, Studio Code (Sportstec International, Camarillo, CA), combines a user defined coding system (in this case SOFIT) with the digital video footage being analyzed. This software allows the user to define the codes of interest and to move forward or backward in time using a “scrubber” (button which advances the video through time) by simply dragging it. Thus, the wait time between coding intervals can be eliminated. For example, in Studio Code, the scrubber can be moved precisely, and instantly, 20 seconds forward to record the data. Studio Code allows the researcher to define a custom lead time at the 20 second interval to capture what happens just prior to the interval and a custom lag time to capture what happens just after the interval. By providing a 2-second lead and lag time, 5 seconds can be captured to allow the researcher to code the interval and create an instance. This custom lead time (2 seconds before), and lag time (2 seconds after) allows for a key stroke to capture the desired moment in video form. Multiple instances can then be arranged and previewed continuously without the time between. Analysis can then be made on the video with just the instances of interest. Additional analyses of different students can easily be made, up to and including the whole class. By reducing the amount of wasted time, coupled with the ability to code more students. Researchers may gain a
more accurate picture, in a time efficient manner, of the activity rates within a physical education class. No studies have been conducted using Studio Code.

With the current interest in physical activity of children in physical education it is important that teachers modify school physical education programs to ensure that maximum physical activity is provided. Before we can know of the success of interventions in classes it is necessary to document that the interventions can be measured in a manner that can be understood and used. The SOFIT instrument has been shown to be very reliable in gathering data on physical activity, and coupled with the Studio Code software, time may be utilized more efficiently.
Chapter 3

Methods

This chapter describes the methods used to test the hypothesis that Studio Code will decrease the time it takes to gather data in direct observation of physical activity.

Participants

Twenty four second-grade students from one class in an elementary school in Alpine School District will be asked to participate. Approval from the school principal, the parents of the participants, the participants themselves and the IRB (Institutional Review Board) from Brigham Young University will be obtained (see Appendix A-1).

Instruments

The selected class will be videotaped for six different lessons. Once videotaped, the lesson will be analyzed using both SOFIT paper and pencil method and SOFIT using Studio Code digital video editing software. A tape with prerecorded 20 second intervals will be used during the paper and pencil method to indicate that start and finish of the 20 second observe and record intervals. Data will be collected on SOFIT coding sheets (see Appendix A-2). The physical activity level and the lesson context will be the focus of the data to be gathered and measured.

The Studio Code software will be used to observe the same selected class. The video will be downloaded onto a computer using real time. Subsequently, the scrubber will then be moved forward every 20 seconds and the data will be recorded. The scrubber is a button that can move the video forward or backward in time almost instantaneously.
Procedures

The researcher for this study will gather all the data and code it. The researcher will participate in a training session on how to code SOFIT prior to this study and will meet the .85 reliability criteria to be considered a trained SOFIT observer. From the one class that will be observed and videotaped for six different lessons, twenty randomly selected students will be observed for their physical activity level, and the lesson context data will be gathered. This study will code physical activity data using two methods: 1) the researcher will code from a lesson from the videotape using the traditional method of paper and pencil with four of the randomly selected students, and 2) a week later the same researcher will take the same recorded video, upload it to a computer, and while watching the same students will gather the activity data using the Studio Code software. These four randomly selected students will be used as a trial period because it is anticipated that the researcher gathering the data will get faster.

After four students have been coded the method of coding (traditional paper and pencil or Studio Code), will be reversed so that the researcher will be more objective in gathering the data from the video. In all, 20 students will be observed (see Table 1).

Design and Statistical Analysis

A stopwatch will be used to determine the amount of time it takes to code each student using both methods. Time to code is the dependent variable. The independent variable is the method of coding (traditional paper and pencil or Studio Code). A dependent t test will be used to determine if significant differences exist between the time to code using the traditional paper and pencil method compared to the time it takes to
gather the same data using the Studio Code method. Intraclass reliability analysis will be conducted on the codes from traditional paper pencil methods and Studio Code methods. This will determine if the researcher is being consistent using both methods.
References


Meredith, M. D. (1988). Activity or fitness: Is the process or the product more important for public health? *Quest, 40*, 180-186.


Table 1 Data Collection Schedule

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<thead>
<tr>
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<th>Week 1 Method of Coding</th>
<th>Week 2 Method of Coding</th>
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<td>Paper and pencil</td>
<td>Studio Code</td>
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<td>Lesson 5</td>
<td>Studio Code</td>
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<tr>
<td>Lesson 6</td>
<td>Studio Code</td>
<td>Paper and pencil</td>
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</table>
Appendix A-1

Parent Form
Dear Parent/Guardian,

Young people are at a greater risk for becoming less physically active as they grow older which can lead to unhealthy lifestyles. Therefore, encouraging moderate and vigorous physical activity among youth is necessary. Since children spend most of their time in school, the type and amount of physical activity in which children are engaged in schools is an important component of a fitness program and a healthy lifestyle.

Participation in school physical education ensures a minimum amount of physical activity and provides a platform to teach physical activity strategies that can be continued into adulthood. As your child’s physical education teacher and a graduate student I am conducting a study to help researchers use their time more effectively in gathering data on physical activity in physical education classes.

Your child’s participation will involve being videotaped as a class in six different class periods. This video will then be reviewed by me, Miss Trish Anderson, to determine physical activity levels of the students. Your child will also be wearing a pedometer during the videoed physical education classes. A pedometer is a simple device that hooks on the waistband of your child’s pants or shorts and measures vertical movement, counted as steps. The pedometer is another way we will determine physical activity levels. The pedometer step counts will be compared to activity levels gathered by direct observation.

Your child’s participation in this study is voluntary. There are very minimal risks for your child (minor skin irritation from wearing the pedometer). If some irritation from the pedometers occurs they can be hooked to a belt that will go around the waist and they will not be hooked to the pants. If you choose not to let your child participate, or if you or your child choose to withdraw at any time, it will not affect your child’s grade or standing in school in any way.

There is no direct benefit to your child for participating, however, the indirect benefit may be a better understanding of children’s activity levels that will assist physical education teachers in their efforts to promote and measure physical activity. The results of this project may be published in a journal and/or presented at a professional conference. Your child’s name or identity will not be revealed. In order to keep this confidential, only a code number will identify your child in this project. Documents that link your child’s name with this code number will be kept separate and secured from the completed data forms. Following the study the videotaped lessons will also be kept in a secured place.

If you have any questions concerning this research study or your child’s participation, feel free to contact myself, Miss Trish Anderson at 227-8727 or ande215@alpine.k12.ut.us. You may also contact Mr. Brad Davies at 227-8727, principal of Orem Elementary. If you have questions regarding your child’s rights as a participant in this research study, you may contact Dr. Renea Beckstrand, IRB Chair, 422-3873, 422 SWKT, renea_beckstrand@byu.edu.

Sincerely,

Trish Anderson
Physical Education Teacher

(Please Initial) page 1 of 2

See other side
Child’s name________________________ Teacher’s name________________________ Grade level____

My parent/guardian has given permission for me to take part in a project using pedometers and being videotaped in physical education class. I am taking part because I want to. I know that I can stop at any time, and that it will be OK if I do.

____________________________
Child’s signature

Parent Consent

Please answer the following questions:

Child’s birthday: _____/_____/______ Child’s age: ______

month      day      year

Child’s gender: Male    Female

I give my consent for my child to participate in the above study.

____________________________
Signature

____________________________
Date
Appendix A-2

SOFIT Coding Sheets
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