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VALIDATION AND DESCRIPTIVE ANALYSIS OF THE SYSTEM FOR OBSERVING DANCE ACTIVITIES IN THE CLASSROOM ENVIRONMENT (SODANCE)

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VALIDATION AND DESCRIPTIVE ANALYSIS OF THE SYSTEM FOR OBSERVING DANCE ACTIVITIES IN THE CLASSROOM ENVIRONMENT (SODANCE)

DISSERTATION

A dissertation submitted in partial fulfillment
of the requirements for the degree of Doctor of Philosophy in the
College of Education
at the University of Kentucky

By
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Lexington, Kentucky

Director: Dr. Heather Erwin, Professor of Kinesiology and Health Promotion

Lexington, Kentucky

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ABSTRACT OF DISSERTATION

VALIDATION AND DESCRIPTIVE ANALYSIS OF THE SYSTEM FOR OBSERVING DANCE ACTIVITIES IN THE CLASSROOM ENVIRONMENT (SODANCE)

The first part of this study sought to validate the System for Observing Dance Activities in the Classroom Environment (SODANCE) based off the System for Observing Fitness Instructional Time (SOFIT). Female students age 11-17 years (N=42) participated in an activity protocol of SOFIT activities and common dance activities to validate appropriate coding categories. Each student wore a heart rate monitor and accelerometer while participating in the activities lying, sitting, standing, walking, running, single leg balances, leg swings, pirouettes, and leaps. Heart rate, maximum heart rate percentage, heart rate reserve percentage, vertical axis accelerometer counts, and vector magnitude accelerometer counts for each activity were classified as light, moderate, or vigorous. Ultimately heart rate reserve data was determined to be the best indicator of physical activity. The chi squared test was used to determine if there were significant differences in the proportion of subjects whose heart rate reserve data classified the activity as light vs. moderate vs. vigorous. Based upon the heart rate reserve data, each activity was assigned a SODANCE activity code of 1-5. The dance activities were coded as single leg balances 4, leg swings 4, pirouettes 5, and leaps 5.

The second part of this study aimed to use the SODANCE instrument to collect data about the physical activity levels, time spent in MVPA, time spent in different lesson contexts, and frequency of teacher promotion of activity. Four different secondary (grades 6-12) dance technique classes (ballet or contemporary) at a public performing arts school were each observed four times using the SODANCE instrument. Students engaged in MVPA 40.62% of the time. Percentages of time spent in SODANCE lesson contents are as follows: *management* 9.53% (n=280), *knowledge* 22.29% (n=655), *fitness* 6.94% (n=204), *technique* 44.04% (n=1294), *choreography* 17.19% (n=505), and *other* 0.0% (n=0). Percentages of teacher interaction are as follows: *promotes in-class activity* 27.67% (n=813), *promotes out-of-class activity* 0.27% (n=8), and *no promotion* 72.06% (n=2117). These data suggests that dance technique classes offer equitable or more MVPA than physical education classes, but still short of the national recommendations.

KEYWORDS: Dance, Dance Education, Physical Activity, SODANCE, SOFIT

__Meredith Sims______________________

Student's Signature

_April 22, 2013______________________

Date

VALIDATION AND DESCRIPTIVE ANALYSIS OF THE SYSTEM FOR OBSERVING DANCE ACTIVITIES IN THE CLASSROOM ENVIRONMENT (SODANCE)

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For my family – Terry, Janet, Kathryn, Brad, and Allison

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Part I Validation of the System for Observing Dance Activities in the Classroom Environment (SODANCE)

Dance is a marginalized subject in education (US Department of Education's National Center for Education Statistics [NCES], 2012). There are few public K-12 schools that offer standalone dance classes. As of the 2009-10 school year, only 3% of elementary schools in the US offered dance as its own course, a major decrease from 20% in the 1999-2000 school year (NCES, 2012). Dance is reportedly included as part of the physical education curriculum in 44% of elementary schools and as part of the music curriculum in 37% of elementary schools. Additionally only 12% of public secondary schools offered dance as a specific course in the 2008-09 school year (NCES, 2012). It is unclear the types of dance being offered and how many schools included in these statistics are performing arts-based programs.

There is limited research on the student benefits of dance education with much of it citing abstract concepts such as creativity and expression. Most dance education advocates cite the artistic aspect of dance as the main reason to include dance in school curriculum. Organizations like the National Dance Education Organization offer advocacy packets, but nearly all of the material revolves around creativity and self-expression (National Dance Education Organization, 2012). While these are important and necessary components of dance, one aspect of dance that is understudied and potentially undervalued is the positive health outcomes involved. With the current obesity epidemic in the U. S. (Ogden & Carroll, 2010), administrators may be more convinced to incorporate dance into the school curriculum if evidence-based research were available demonstrating positive health benefits of dance. It would be beneficial to present research providing evidence that in addition to creativity and self-expression, dance also provides meaningful physical activity of moderate to vigorous (MVPA) intensity, facilitating a whole mind/body experience.

There is limited research concerning physical activity levels and MVPA in dance. The research that has been conducted uses accelerometers or heart rate monitors, limiting the sample size of each study (Fromel, Stratton, Vasendova, & Pangrazi, 2002; Guidette, Gallotta, Emrenizani, & Baldari, 2007; Nelson, Evans, Guess, Morris, Olson, & Buckwalter, 2011; O'Neill, Pate, & Hooker, 2011; O'Neill, Pate, & Liese, 2011; O'Neill, Pate, & Beets, 2012). With the need for more quantitative studies with large sample sizes, affordable, efficient, and accurate assessment instruments are needed. An observation instrument would be beneficial in terms of cost and measuring more than one variable.

One of the most accurate, comprehensive field measures of physical activity is direct observation (McKenzie, 2002). Information can be collected about the type, intensity, duration, and frequency of any observable physical activity using direct observation (McKenzie, 2002). In addition, when conducted in an educational setting (e.g., physical education) it provides meaningful feedback to instructors, including lesson context and teacher behavior. One such measurement, the System for Observing Fitness Instruction Time (SOFIT), has been shown to be a valid and reliable instrument to evaluate physical activity levels during physical education classes in young children (McKenzie, Sallis, & Nader, 1991; Rowe, Schuldheisz, & van der Mars, 1997). The SOFIT is a multifactor observation system designed to record several variables during physical education every 10 seconds: student physical activity intensity, lesson context, and teacher behavior. It is a modification of the Behaviors of Eating and Physical

Activity for Children's Health Evaluation System (BEACHES), which uses a momentary time sampling interval of one minute (McKenzie et al., 1991). The SOFIT instrument is used to record physical activity intensity using a 5-code rating scale. Codes 1–3 are used to describe the body position of the student as lying down, sitting, or standing (very low energy expenditure). Code 4 assesses moderate intensity activity such as ordinary walking, and the 5th code represents vigorous activity that requires more energy than ordinary walking. MVPA is a combination of categories 4 and 5.

McKenzie et al. (1991) validated the BEACHES with heart rate monitors and concluded that heart rate increased as the BEACHES activity codes increased in a free play setting. However, no statistical analysis was calculated to determine whether the BEACHES instrument was statistically related to changes in heart rate. The same activity codes were used to create SOFIT (McKenzie, Sallis, & Nader, 1991). In another study conducted by McKenzie, Sallis, and Armstrong (1994), a strong correlation of $r = .74$ was reported between the SOFIT and a uniaxial accelerometer (CALTRAC). Finally, Rowe, Schuldheisz, and Van der Mars (1997) reported moderate to strong correlations between the SOFIT and heart rate monitors during specific activities such as lying, sitting, standing, walking, jogging, curl-ups, and push-ups ($r = .66$ to .91). Despite the positive findings of these validation studies, one limitation was that data were collected in a simulated, controlled setting which does not typically reflect the field conditions where SOFIT is typically used.

Since its creation in 1991, SOFIT has been validated numerous times for physical activity levels (Heath, Coleman, Lensegray, & Fallon 2006; Honas et al., 2008; McClain, Abraham, Brusseau, & Tudor-Locke, 2008; McNamee & van der Mars, 2005). The

SOFIT instrument has also been modified for various populations and subjects. Cardon, Verstraete, De Clercq, and De Bourdeaudhui (2004) validated the SOFIT instrument for use in swimming classes. Rowe, Schuldheisz, and van der Mars (1997) validated SOFIT for use with first through eighth graders. Later, Rowe, van der Mars, Schuldheisz, and Fox (2004) validated SOFIT for use with high school students. The SOFIT instrument has also been expanded to include additional activity levels (Pope, Coleman, Gonzalez, Barron, & Heath, 2002). Additionally a computer based SOFIT has been validated (Keating, Kulinna, & Silverman, 1999).

The SOFIT instrument has also served as a basis for systematic observation systems in settings other than physical education. McKenzie, Marshall, Sallis, and Conway (2000) used a system based on SOFIT to record contextual characteristics of youth during play. This instrument, titled System for Observing Play and Leisure in Youth (SOPLAY), provides information on participant activities, supervision, and equipment. The System for Observing Play and Active Recreation in Communities (SOPARC), also derived from SOFIT, records the number of participants and activities in park and recreation settings (McKenzie, Cohen, Sehgal, Williamson, & Golinelli, 2006). Ridgers, Stratton, and McKenzie (2010) created the System for Observing Children's Activity and Relationships during Play (SOCARP). This observation system uses a similar protocol to SOFIT, but focuses on children's relationships as well as physical activity during recess. It is clear that the SOFIT instrument is a highly adaptable tool that can be applied to a variety of settings and populations.

Details of SOFIT Protocol

As stated earlier, the SOFIT instrument is used to measure physical activity levels by time sampling the activity levels of a randomly selected student (McKenzie, 1991). A worksheet has established areas with spaces for recording data. The researcher randomly selects four students at the beginning of class (when 51% of the students have entered the space). The researcher listens to a SOFIT pacing audio prompt that indicates every 10 seconds when to record data as well as when to move to the next student. At the audio prompt, the researcher records the current physical activity level of the chosen student using the established five codes (McKenzie, 1991). After 12 data collections of that student, the prompt will instruct the researcher to locate the next student and begin recording data for that student. This cycle continues through all four students and then returns to the first student and so on for the remainder of the class (McKenzie, 2009).

In addition to measuring physical activity levels, the SOFIT instrument also measures lesson content and teacher interactions. At each 10-second interval, the current lesson content is recorded. The lesson content areas are: Management, Knowledge, Fitness, Skill, Game, and Other (McKenzie, 2009). The teacher interactions category measures what type of, if any, feedback on physical activity the teacher is providing to students. The options are: Promotes in-class MVPA, Promotes out-of-class MVPA, and No promotion (McKenzie, 2009). These two areas are important components of the SOFIT instrument, but are not the focus of the current validation study.

Prior to this study, there was no observation instrument to assess students' physical activity levels, lesson content, or teacher interactions specific to a dance technique class. Therefore, the purpose of this study was to test the validity of the SOFIT instrument for use in a dance technique class. More specifically, the study sought to identify the physical activity intensities of various dance skills that are typically performed; thus SOFIT codes could be assigned to these tasks for use in direct observation during dance class.

Methods

Setting

Data were collected at a public creative and performing arts school (grades 4-12) in the southeastern United States. The school utilizes an audition program with students majoring in various creative and performing arts. All students have a declared major such as drama, visual art, ballet, contemporary dance, or creative writing in which they take daily classes. Middle school students spent 55 minutes a day in their major class. High school students participated in a 100-minute major class each day.

Participants

A convenience sample of all female dance majors grades 6-12 at the performing arts school were included in recruitment (*N* = 70). Due to reported differences in heart rates among female and male youth, only females were included in participant recruitment (Bar-Or, 1983). Two classes, one ballet and one contemporary, were composed of middle school students in grades 6-8. Two other classes, one ballet and one contemporary, were composed of high school students in grades 9-12. All participants in recruitment were ages 11-17 years old and current dance majors, either ballet or contemporary. The procedures were explained to all potential participants and recruitment letters were sent home to the parents. Informed consent was obtained from 42 participants. On the first day of data collection assent was obtained from each participant.

Age, height, weight, BMI, BMI percentile, stride length, percent fat, fat mass, and fat free mass are presented in Table 1. Fat mass, percent fat, fat free mass, and BMI were measured using bioelectrical impedance analysis. BMI percentiles were found using the CDC classifications. The participants included 42 females aged 11-17 years. The mean age was 13.4 (± 2.6) years. The mean BMI was 19.2 (± 2.6) with a mean BMI percentile of 46.1 (± 23.8). The majority of the participants, 92.8%, were in the healthy weight percentile with 2.3% in the underweight category and 4.8% in the overweight category. Accounting for the stride length of each participant, the mean speed for the walking activity was 64.8 m/min (2.4mph) and the mean speed for running was 76.6 m/min (2.9mph).

Table 1

Demographic information for SODANCE validation participants

	Mean	± Standard Deviation (*N*=42)	Range
Age (yr)	13.4	± 2.6	11 – 17
Height (cm)	135	± 9.8	135.0 – 172.5
Weight (kg)	47.8	± 9.8	23.4 – 67.6
BMI (kg/m^2)	19.2	± 2.6	12.8 – 24.4
BMI Percentile (%)	46.1	± 23.8	1.0 – 87.0
Stride Length (ft)	1.9	± 0.3	1.3 – 2.6
Percent Fat (%)	22.2	± 5.6	10.0 – 34.9
Fat Mass (kg)	11.0	± 4.5	2.8 – 22.1
Fat Free Mass (kg)	36.8	± 6.2	20.4 – 47.8

Data Collection

Height for each participant was measured in centimeters to the nearest tenth using a freestanding stadiometer. Weight for each participant was measured in kilograms to the nearest tenth using a digital scale. Participants were measured in light clothing with no shoes.

The same trained researcher proctored the validation protocol for all participants. The 48-minute activity protocol (see Table 2) was introduced, taught, and practiced with all participants before the date of actual data collection. The first five activities of the protocol coincide with the established SOFIT activity levels (McKenzie et al., 1991). The other activities were identified by the principal investigator through four informal SOFIT assessments as common activities used in dance technique classes that do not directly fall into one of the established SOFIT activity codes (e.g., balance, pirouettes, and leg swings). The time intervals for the protocol were established based on previous validation studies (Cardon et al., 2004; McKenzie et al., 1991; McKenzie, Sallis, & Armstrong, 1994; Rowe et al., 1997; Rowe et al., 2004). The pace for each movement activity was set by a metronome to maintain a consistent pace for all participants (see Table 3).

Prior to executing the protocol, the participants were asked about caffeine consumption and prior physical activity for that day. The participants were each fitted with a heart rate monitor (Polar T31, Polar USA, Lake Success, NY) on their chest as well as a triaxial accelerometer (GT3X, ActiGraph, Pensacola, FL) on their right hip. Heart rate and accelerometer activity counts were recorded using 5 second epochs. To account for the variation in dance movement, the vector magnitude in addition to the vertical axis was used to measure all three axes of the accelerometer. The activity protocol was administered in groups of 2-6 to allow enough space for each participant to fully and freely move without interference among heart rate monitors. Data from the heart rate monitors and accelerometers were uploaded to a personal computer using the manufacturer's software (ActiLife, Version 5, Pensacola, FL) immediately following completion of the protocol.

Table 2

Time intervals and activities for SODANCE validation protocol

Time	Activity
4 minutes	Laying (SOFIT Code 1)
4 minutes	Sitting (SOFIT Code 2)
4 minutes	Standing (SOFIT Code 3)
4 minutes	Walking (SOFIT Code 4)
4 minutes	Running (SOFIT Code 5)
4 minutes	Rest
2 minutes	Balance (One leg in arabesque on relevé with barre assistance changing legs after one minute)
4 minutes	Rest
2 minutes	Leg Swings (Seven leg swings in attitude with arms in 2^{nd} position stepping to other side)
4 minutes	Rest
2 minutes	Pirouettes (Tendu to 4^{th} position, pirouette alternating sides)
4 minutes	Rest
2 minutes	Leaps (Run, run, leap alternating sides)
4 minutes	Rest

Table 3

Metronome setting for movement activities for SODANCE validation activity protocol

Walking	110 beats per minute (bpm)
Running	130 bpm
Leg Swings	80 bpm
Pirouettes	120 bpm
Leaps	120 bpm

Data Reduction

The data were analyzed using Microsoft Excel 2008 for Mac and IBM SPSS Statistics Version 21. To ensure that steady state activity was reached, only the data from the final two minutes of each four-minute activity and final one minute of each two-minute activity were used. In the lying, sitting, and standing activities any data signifying movement at the beginning and end of the activity intervals when participants changed positions early or late were removed from the mean to better represent the activity counts of the participants. Any data set with less than 80% of recorded values was not used. Missing 5s epochs were calculated by finding the mean of the previous 5s epoch and the following 5s epoch data. Each 5s epoch for both heart rate and accelerometry was extrapolated to represent 1 minute and then the mean for the final 1 or 2 minutes of the activity was calculated. Using the age predicted maximal heart rate formula and the participants' mean lying heart rate, percentage of maximum heart rate and percentage of heart rate reserve for each activity was calculated. Data from the lying activity was used as the resting heart rate due to its consistency with resting heart rate data from previous resting heart rate data (Ostchega, Porter, Hughes, Dillon, and Nwankwo, 2011).

Each participant's mean vector magnitude for each activity was classified into light (<950), moderate (951-3410), and vigorous (>3410) categories according to the vector magnitude cut points established by Vanhelst et al. (2010). Each participant's mean vertical axis accelerometer counts for each activity was classified into light (<2999), moderate (3000-5200), and vigorous (>5200) categories according to the activity cut points established by Treuth et al. (2004). These classifications were chosen due to their applicability to this specific population of female youth. Each participant's percentage of maximal heart rate and percentage of heart rate reserve was classified into light (<63%; <40%), moderate (64-76%; 40-60%), and vigorous (>77%; >60%), categories, respectively, according to the American College of Sports Medicine classifications (Thompson, Gordon, Pescatello, 2009).

Statistical Analysis

To determine what SOFIT code corresponded to a given intensity classification, a chi squared test was used. Specifically, the chi squared was used to determine if there were significant differences in the proportion of subjects whose heart rate reserve data classified the activity as light vs. moderate vs. vigorous. If a statistical significance was found, binomial post hoc tests were used to determine which intensity classifications differed. The level of significance was set at $p < .05$ for all statistical analyses.

Results

Vertical Axis and Vector Magnitude

The mean vertical axis and mean vector magnitude for each activity are reported in Table 4. Participants were immobile during the first three activities. As predicted in other SOFIT validation studies, the accelerometer counts increased from walking and running (Rowe et al., 1997; Rowe et al., 2004). Additionally the accelerometer counts in both the vertical axis and vector magnitude increased through all four of the dance activities.

Table 4

Vertical axis and vector magnitude data for various activities in 11-17 year old female dance students

Activity	Mean Vertical Axis (*N*=42)	± Standard Deviation	Mean Vector Magnitude (*N*=42)	± Standard Deviation
Lying	0	± 0	0	± 0
Sitting	0	± 0	0	± 0
Standing	0	± 0	0	± 0
Walking	1942	± 816	3026	± 908
Running	9993	± 2386	10715	± 2386
Balance	314	± 282	813	± 708
Leg Swings	1388	± 866	4936	± 1716
Pirouette	2433	± 871	7763	± 2587
Leaps	10154	± 2571	11764	± 2238

Heart Rate

The mean heart rate, mean percentage of heart rate maximum, and mean percentage of heart rate reserve are reported in Table 5. As in other SOFIT validation studies, all heart rate indicators increased through the five SOFIT categories (Cardon et al., 2004; McKenzie et al., 1991; Rowe et al., 1997; Rowe et al., 2004). Heart rate data also increased through all four of each of the dance activities.

Table 5

Absolute and relative heart rate data for various activities in 11-17 year old female dance students

Activity	Mean Heart Rate	± Standard Deviation	Mean Percentage Heart Rate Maximum	± Standard Deviation	Mean Percentage Heart Rate Reserve	± Standard Deviation
Lying	74.26 (*N*=33)	± 8.64	35.97 (*N*=33)	± 4.20	0 (*N*=33)	± 0
Sitting	84.83 (*N*=35)	± 8.95	41.09 (*N*=35)	± 4.21	8.64 (*N*=31)	± 5.49
Standing	90.72 (*N*=36)	± 10.10	43.94 (*N*=36)	± 4.81	12.57 (*N*=32)	± 6.62
Walking	99.63 (*N*=33)	± 9.87	48.22 (*N*=33)	± 4.65	19.07 (*N*=30)	± 6.12
Running	158.04 (*N*=31)	± 18.72	76.47 (*N*=31)	± 8.89	62.93 (*N*=30)	± 14.92
Balance	123.68 (*N*=34)	± 13.61	59.82 (*N*=34)	± 6.62	38.40 (*N*=31)	± 10.61
Leg Swings	145.77 (*N*=29)	± 16.32	70.54 (*N*=29)	± 7.85	54.86 (*N*=28)	± 11.98
Pirouette	156.37 (*N*=29)	± 16.43	75.69 (*N*=29)	± 7.82	62.68 (*N*=28)	± 11.88
Leaps	185.66 (*N*=33)	± 11.23	89.84 (*N*=33)	± 5.17	84.41 (*N*=31)	± 8.41

The physical activity classifications for each activity are reported by percentage of participants in each classification for each measurement instrument in Table 6. For activities with more than one classification reported, the chi square results between classifications are reported in Table 6. For activities with classifications in three areas, the post-hoc binomial test results for the two highest classifications are also reported in Table 6.

Table 6

Percentage of participants in each classification of each activity by measurement

Activity		Light	Moderate	Vigorous	As. Sign.
Lying	Vertical Axis	100.0%	0%	0%	
	Vector Magnitude	100.0%	0%	0%	
	% Heart Rate Max	100.0%	0%	0%	
	% Heart Rate Reserve	100.0%	0%	0%	
Sitting	Vertical Axis	100.0%	0%	0%	
	Vector Magnitude	100.0%	0%	0%	
	% Heart Rate Max	97.1%	2.9%	0%	
	% Heart Rate Reserve	96.7%	3.3%	0%	<0.001[a]
Standing	Vertical Axis	100%	0%	0%	
	Vector Magnitude	100.0%	0%	0%	
	% Heart Rate Max	100.0%	0%	0%	
	% Heart Rate Reserve	100.0%	0%	0%	
Walking	Vertical Axis	88.1%	11.9%	0%	
	Vector Magnitude	0%	71.4%	28.6%	
	% Heart Rate Max	97.0%	3.0%	0%	
	% Heart Rate Reserve	100.0%	0%	0%	
Running	Vertical Axis	0%	0%	100.0%	
	Vector Magnitude	0%	0%	100.0%	
	% Heart Rate Max	6.5%	41.9%	51.6%	
	% Heart Rate Reserve	10.0%	23.3%	66.7%	<0.001[a] 0.019[b]
Balance	Vertical Axis	100.0%	0%	0%	
	Vector Magnitude	76.2%	21.4%	2.4%	
	% Heart Rate Max	76.5%	23.5%	0%	
	% Heart Rate Reserve	64.5%	29.0%	6.5%	<0.001[a] 0.061[b]
Leg Swings	Vertical Axis	0%	92.9%	7.1%	
	Vector Magnitude	0%	19.0%	81.0%	
	% Heart Rate Max	10.3%	69.0%	20.7%	
	% Heart Rate Reserve	3.6%	60.7%	35.7%	<0.001[a] 0.248[b]
Pirouettes	Vertical Axis	71.4%	28.6%	0%	
	Vector Magnitude	0%	0%	100%	
	% Heart Rate Max	6.9%	44.8%	48.3%	
	% Heart Rate Reserve	0%	42.9%	57.1%	0.450 [a]

					0.572[b]
Leaps	Vertical Axis	0%	0%	100%	
	Vector Magnitude	0%	0%	100%	
	% Heart Rate Max	0%	0%	100%	
	% Heart Rate Reserve	0%	0%	100%	

[a]Indicates a significant difference between the percentages within a given variable.

[b]Indicates a significant difference between the two highest percentages within a given variable.

Discussion

This study aimed to validate the SOFIT instrument for use in dance technique classes in the public school setting. These participants have 0% classified as obese and 4.8% classified as overweight, much lower than the general population of females age 12-19 with 16.8% classified as obese and 16.0% classified as overweight (Ogden and Carroll, 2010; Ogden, Carroll, Curtin, McDowell, Tabak, and Flegal, 2006). This data suggests this sample of students is more fit than the general population of students, which may affect their heart rate responses to these activities.

To determine the measurement instrument that best represented the physical activity level of each activity, data from the vertical axis, vector magnitude, percentage heart rate maximum, and percentage heart rate reserve were evaluated. While the vertical axis is the most commonly used axis in accelerometry measurement for physical education, for the dance activities it was evident that vector magnitude better represented the movement in the dance activities. The vertical axis did not capture the movement accurately during the leg swing and pirouette activities. In the leg swings activity, the horizontal axis had high counts and the vertical and rotational axes had low counts. In the pirouette activity, the rotational axis reported high accelerometer counts, but the vertical and horizontal axes had low counts. The vector magnitude was a better representation of the activities because it accounted for all types of movement.

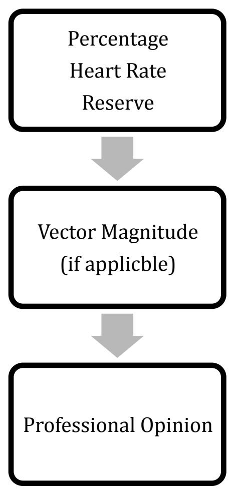
However, the vector magnitude reported great variability among participants on the dance activities. For example, during the balance activity students were instructed to maintain an arabesque balance for 2 minutes changing side at the 1-minute mark. Some participants were able to maintain an arabesque balance without assistance for the entire interval. Others had difficulty maintaining the position and had to lower their leg resulting in high accelerometer counts where others had low. In the pirouette activity, some participants were able to complete three rotations in a pirouette while others could only complete one. This type of data resulted in skewed distribution of scores. The variability in dancers' ability and skill level resulted in misleading accelerometer counts determining that this instrument was not the best measurement of dance activities.

Heart rate measurements were better indicators of physical activity levels due to the cardiovascular response for each activity. The accelerometer data did not accurately reflect the body's response to the activities as it only reported motion. Percentage of heart rate maximum was calculated to account for each participant's age and maximum heart rate. Heart rate reserve was calculated to account for each participant's resting heart rate. Ultimately heart rate reserve was chosen as the best indicator of physical activity levels for all activities.

Chi square tests were calculated on all activities with two or more intensity classifications using the heart rate reserve data. If a statistical significance was not found, the vector magnitude data classification, if applicable, for that category was used to determine the appropriate category. As mentioned previously, the vector magnitude was not the best indicator for all activities. If the vector magnitude data was not an appropriate indicator, then professional opinion was used to determine the correct coding. Professional opinion considers the nature of the activity, absolute heart rate data, and dance experience. The decision chart for activity classification is presented in Figure 1.

Figure 1

Decision chart for determining SODANCE classifications



The data from the present study agreed with the original SOFIT data for the first three activities (lying, sitting, standing). However, this study found the walking activity to be classified as light rather than moderate as SOFIT instructs. The data from this study agrees that running should be classified as vigorous. The pace for the running activity was set particularly low (2.9mph). The participants were instructed to run while stepping on each beat of the metronome. However, the students actually engaged in a common dance activity referred to as “prancing.” This dance activity is generally used as a warm up activity or a strengthening activity intended to prepare for jumps, strengthen the lower body, and/or practice musicality. Setting a more appropriate running pace based off of the students' stride length would strengthen this study. A faster running pace would most likely lead to more conclusive data that running should be classified as a 5.

The heart rate data from this study and the original SOFIT data are presented in Table 7 (McKenzie, 1991). For the first four activities these participants had lower heart rates than the participants in the SOFIT study. These discrepancies could be a result of differences in age, gender, and fitness abilities. The participants in McKenzie's (1991) study included 19 male and female children aged 4-9 years with mean weight of 24.4 kg and mean height of 47.1 cm. Heart rate has been shown to have an inverse relationship with age in youth and higher rates in females, which could explain the differences in data sets (Ostchega et al., 2011). Additionally the participants in this study have lower than average rates of unhealthy weights and are more physically active than the general population. These data are not reported in the McKenzie (1991) study, but may explain the lower heart rate data.

Table 7

Absolute heart rate per activity of SODANCE validation participants compared to absolute heart rate of original SOFIT validation data

Activity	Mean Heart Rate	± Standard Deviation	Mean Heart Rate from SOFIT Validation (*N*=19) (McKenzie, 1991)	± Standard Deviation	Sig. (2-tailed)
Lying	74.26 (*N*=33)	± 8.64	99	± 9.9	0.000
Sitting	84.83 (*N*=35)	± 8.95	107	± 9.8	0.000
Standing	90.72 (*N*=36)	± 10.10	110	± 8.8	0.000
Walking	99.63 (*N*=33)	± 9.87	130	± 6.5	0.000
Running	158.04 (*N*=31)	± 18.72	153	± 12.6	0.144
Balance	123.68 (*N*=34)	± 13.61	No Data	No Data	0.011

Leg Swings	145.77 (*N*=29)	± 16.43	No Data	No Data	0.000
Pirouettes	156.37 (*N*=29)	± 11.23	No Data	No Data	0.279
Leaps	185.66 (*N*=33)	± 11.23	No Data	No Data	0.000

With the exception of leaps, the dance activities did not show statistically significant differences between categories. The balance activity data were classified in all three categories, but the two highest reported classifications were light and moderate. After the chi squared test and post-hoc binomial tests were calculated, there was no statistically significant difference between light and moderate. Vector magnitude was not an accurate predictor of activity for balance for the aforementioned reasons. Following the decision chart, the next determinant was professional opinion. When examining the absolute heart rate data, the data for the balance activity for this population was higher than the heart rate data for the walking activity. This suggests that these participants were working at a higher intensity while executing the balance than the walking activity. In accordance with the SOFIT procedures, walking is coded as a 4. To accurately represent the intensity of the balance activity in dance techniques classes, balances should be coded as a 4.

The leg swings activity was classified in all three activities, with the two highest classified categories in moderate and vigorous. After the chi squared test and post-hoc binomial test, there was no statistical significance between the two categories. Vector magnitude was not found to be an accurate predictor of this activity. Absolute heart rate data for leg swings was higher than walking and balance activities, but not as high as the running activity. For this reason, it was determined leg swings should be coded as a 4.

The pirouette activity was coded in moderate and vigorous, but a statistical significance between the two was not found. However, the vector magnitude for the pirouette activity was entirely coded as vigorous. Vector magnitude was found to be a reliable indicator for pirouettes. For this reason, pirouettes should be coded as a 5. The leaps activity was unanimously classified as vigorous resulting in being coded as a 5 in the SODANCE classifications. Based on the data from this validation study, the coding classifications for SODANCE are presented in Table 8.

Table 8

SODANCE code classifications

Activity	SODANCE Code
Lying	1
Sitting	2
Standing	3
Walking	4
Running	5
Balance	4
Leg Swings	4
Pirouette	5
Leaps	5

Limitations

As with all studies, this one has some limitations. This study only included female participants. At this school, females accounted for 91.9% of the middle and high school dance majors. This may not be representative of all middle and high school dance programs. Studies examining the difference between male and female dance students would be beneficial.

Heart rate and accelerometry data do not measure isometric activities, such as balances, accurately. Additionally heart rate monitors and accelerometers are commonly used instruments for measurement in free-living environments, but VO_2 uptake measurement would provide more accurate cardio respiratory data. Research examining the most appropriate measurement instruments for dance activities would aid in measuring all types of dance activities.

Four dance activities were chosen as common dance movements in dance technique classes. These activities were determined from informal SOFIT assessments conducted in dance classes. Other researchers may have identified different activities to assess. The great variety of dance movements, dance techniques, and dance teaching styles lead to an infinite number of movement possibilities. This study only begins to determine classifications for common dance movements. In particular, more research could be conducted on different balance activities during dance techniques classes.

Future Research

Dance as a form of physical activity has limited research, so any research measuring physical activity levels is warranted. Studies measuring energy expenditure may provide additional information about physical activity in dance. The balance activity presented erratic data. The data suggest that different types of balances present different types of physical activity levels. Presumably a balance on two feet is different from a balance on one foot in terms of intensity. Furthermore, a single leg balance may vary depending upon the position of the working leg. Additional circumstances such as the use of relevè, the use of the barre, and/or the length of the balance may affect the physical activity level of participants.

This study focuses on dance as an artistic technical subject in the K-12 school system. Unfortunately this is not always the most common form of dance in public schools. It would be beneficial for research to be conducted on dance as a creative form or social dance form. The original SOFIT format is capable of measuring dance instruction in the physical education classroom. However, classes that are specific to dance as its own course may have additional activities that need validation for use. Additionally this instrument was validated for use in the public school system with secondary students and therefore may not be applicable for elementary students or use in the private sector.

The coding classifications for SOFIT may not be accurate. Other validation studies have reached the same conclusions (Rowe et al., 2004; Rowe et al., 1997; Pope et al., 2002). The validation study upon which SOFIT is based only used the continuous increase in heart rate as a basis for coding rather than comparing the data to an accepted standard for intensity thresholds (McKenzie et al., 1991).

Conclusion

The validation of the System for Observing Dance Activities in the Classroom Environment is a promising step in providing evidence of the physical activity levels, lesson context, and teacher interactions for artistic dance technique. SODANCE provides a more accurate measure of student physical activity outcomes in a dance technique class and has the potential to promote dance classes in the K-12 school system.

Part II Descriptive Analysis of the System for Observing Dance Activities in the Classroom Environment (SODANCE)

Physical activity is an important part of a healthy lifestyle (Strong et al., 2005). Studies suggest that children should participate in some form of moderate-intensity physical activity for at least 60 minutes daily (US Department of Health and Human Services, 2008). Researchers have established that the health benefits of physical activity decrease the odds of developing a broad range of diseases as well as improve an individual's well being. Physical activity can decrease mortality and the likelihood of cardiovascular disease, type 2 diabetes mellitus, osteoporosis, depression, obesity, breast cancer, and colon cancer (Strong et al., 2005). Individuals who are physically active daily enjoy better mental health, an improved immune system, and greater function of the metabolic and endocrine systems (Spain & Franks, 2001). Other benefits of physical activity include healthier muscles, bones, and joints as well as increased health-related quality of life (Strong et al., 2005).

Unfortunately, despite the overwhelming evidence of the benefits of physical activity, there is an increasing trend of inactivity among adolescents (Ogden & Carroll, 2010). As children get older, their levels of physical activity decline, with a drastic drop during adolescence (Spain & Franks, 2001). Kimm et al. (2002) found that physical activity levels drop by 50 percent in adolescence beginning as early as 10 years of age. Research has shown that the activity patterns adopted in adolescence greatly influence physical activity habits into adulthood (Spain & Franks, 2001). Logic insinuates that if children can be taught at an early age to participate in physical activity and learn the health benefits, they will be more likely to maintain that lifestyle into adulthood. This evidence should encourage educators, parents, and community leaders to establish more physical activities for children, adolescents, and young adults (Ward, Saunders, & Pate, 2007).

In addition to the decline in activity among adolescents, there is an even greater decline of activity among females. In physical education classes, girls participate less often and generally participate at a lower intensity than boys (Fairclough & Stratton, 2005). Contributing to this decrease in activity may be the physical, psychological, and social changes occurring during the high school years (Fairclough & Stratton, 2005). The National Heart, Lung, and Blood Institute's Growth and Health Study stated that females' average activity scores were drastically reduced between the ages of 9 and 18 years. In fact 64% of Caucasian girls' physical activity decreased and 100% of African American girls' physical activity decreased (Pate et al., 2005). Several factors could be contributing to the decline in activity among adolescent girls. Some of these factors include perceived low exercise efficacy, lack of time, lack of social support, self consciousness during exercise around males, curriculum centered on team sports, and rise in sedentary activities such as watching television or talking on telephone (Neisen, Braun, & Shepherd, 2007).

Dance and Physical Activity Outcomes

Dance is considered an activity that females tend to enjoy. In fact, 41% of adolescent girls participate in cheerleading/dance, second only to basketball (44%) (Barr-Anderson et al., 2007). Females may thrive in an activity that is geared more toward their particular interests. One successful physical activity intervention focused on high school girls and used lessons that targeted activities that girls and young women typically enjoy such as aerobics, dance, walking, self-defense, martial arts, and weight training. This intervention increased habitual participation in vigorous physical activity among high school girls (Pate et al., 2005). Another physical education intervention targeted towards high school girls focused on a gymnastics-based curriculum and was successful in increasing the girls' moderate to vigorous physical activity levels as well as their perceived competence and intrinsic motivation (Fairclough & Stratton, 2005). These outcomes lead one to believe that if girls are involved in activities in which they enjoy, such as dance, they are more likely to be engaged for a longer amount of time leading to healthier lifestyles.

There is limited research about technical dance as a form of physical activity in the school setting. Technical dance, defined as movement based in a specific form such as ballet, jazz, and/or modern dance, is most often taught for the purposes of developing physical abilities for performance. Physical activity is not generally viewed as the primary goal of artistic technical dance; rather the focus is on skill development and artistic expression. Kassing (2010) outlines the dance content knowledge necessary for dance teachers and lists under the category of dance science "dance-specific exercise principles, nutrition and weight control," a rather vague description. The National Dance Standards for grades K-12, developed by the National Dance Association, fail to make any reference to physical activity or physical fitness as a goal or purpose of dance education (National Dance Association, 2012). With subjects competing for funding, time, and resources in the current educational climate, the health benefits of dance should be presented to help make the case that dance is an important component of K-12 education. Dance education as a field needs more empirical research of all types, particularly evidence-based research on the health benefits of dance education to students.

Beyond the K-12 school setting, research has been conducted on moderate to vigorous physical activity (MVPA) levels and time spent in MVPA during dance technique classes in private dance studios. O'Neill, Pate, and Hooker (2011) found that dance technique classes contributed substantially to participants' daily MVPA. Female adolescents, age 11-18 years, who participated in dance technique classes in local dance studios wore accelerometers for one week as well as completed an activity log for the week. From these data, dance participation was found to contribute to 29% of participants' total daily physical activity (O'Neill et al., 2011a). Additionally it was found that dance participants accumulated more MVPA on days they engaged in dance classes compared to those without, and engaged in less sedentary behaviors on days with dance classes (O'Neill et al., 2011a). In another study, O'Neill, Pate, and Liese (2011) presented the prevalence of dance participation in U.S. adolescents (n = 3,598) collected via a self-report national physical activity survey. These data found that 34.8% of girls and 8.4% of boys participate in dance regularly as a form of physical activity. From this self-report survey, MVPA was calculated using the reported frequency, duration, and type of activity determining that dance contributed 39.3% of total MVPA for girls and 23.0% of total MVPA for boys (O'Neill et al., 2011b).

In a separate study, O'Neill, Pate, and Beets (2012) found through accelerometry data that participants in dance technique classes in private dance studios engaged in 9.8 minutes of MVPA (6.0 minutes of moderate, 3.8 minutes of vigorous), 39.3 minutes of light physical activity, and 10.9 minutes of sedentary behavior per hour of dance class participation. Jazz/tap classes provided more MVPA than ballet classes, and intermediate level classes provided more MVPA than advanced level classes. Girls with more dance training obtained more MVPA than girls with less dance training (O'Neill et al., 2012). These findings indicate that dance contributes to total MVPA for participants; however, these figures are well below the national recommendations for physical education of at least 50% of a lesson in MVPA (US Department of Health and Human Services, 2010). These data provide a starting point for research demonstrating the physical activity outcomes from dance. Further research with larger sample sizes conducted in the school setting needs to be conducted to provide data that will support dance as a meaningful source of daily MVPA as well as artistic expression. If evidence is positive, the argument could be made that dance should be included in school curriculum as its own class.

Physical Activity Measurement Instrument for Dance

Without a doubt dance has the potential to develop creative ability, foster artistic expression, and improve health (Bonbright, 2007; O'Neill et al., 2011). As budgets and resources continue to decrease in public education, dance education needs evidence-based research to demonstrate the multitude of benefits it can provide for students. Further research about the physical health benefits of technical dance is warranted. Of particular relevance, due to the current rise in childhood obesity, would be research that measures MVPA in dance classes in school settings (Ogden & Carroll, 2010). It is known that dance is an activity that students, particularly females, enjoy (Barr-Anderson et al., 2007; Fairclough & Stratton, 2005; Pate, Ward, Saunders, Felton, Dishman, & Dowda, 2005). However, the available dance-related physical activity research focuses mostly on data collection methods that can be expensive, invasive, and somewhat impractical for dance technique classes (O'Neill et al., 2011a; O'Neill et al., 2012).

One such instrument to gather information on large data sets in a timely, inexpensive manner, the System for Observing Dance Activities in Classroom Environment (SODANCE) has been validated (Sims et al., in progress). Prior to this study, there was no direct observation method available to measure physical activity in a dance technique class in any setting. This type of assessment instrument is a valuable asset to the field for dance education advocacy.

The SODANCE instrument was modified from the System for Observing Fitness Instructional Time (SOFIT) (McKenzie, 1991). The SOFIT instrument is used to measure physical activity levels by time sampling the activity levels of a randomly selected student (McKenzie, 1991). A worksheet has established areas with spaces for recording data. The researcher randomly selects four students at the beginning of class (when 51% of the students have entered the space). The researcher listens to a SOFIT pacing audio prompt that indicates every 10 seconds when to record data as well as when to move to the next student. At the audio prompt, the researcher records the current physical activity level of the chosen student using the established five codes of physical activity: Lying (Code 1), Sitting (Code 2), Standing (Code 3), Walking (Code 4), and Vigorous (Code 5) (McKenzie, 1991). After 12 data collections of that student, the prompt will instruct the researcher to locate the next student and begin recording data for that student. This cycle continues through all four students and then returns to the first student and so on for the remainder of the class (McKenzie, 2009).

In addition to measuring physical activity levels, the SOFIT instrument also measures lesson context and teacher interactions. At each 10-second interval, the current lesson context is recorded. The lesson context areas for the SOFIT are: Management, Knowledge, Fitness, Skill, Game, and Other (McKenzie, 2009). The teacher interactions category measures what type of, if any, feedback on physical activity the teacher is providing to students. The options are: Promotes in-class MVPA, Promotes out-of-class MVPA, and No promotion (McKenzie, 2009).

The SODANCE instrument was validated using the SOFIT procedure. Secondary female dance majors at a performing arts school wore heart rate monitors and accelerometers during a validation protocol to validate the activity levels of the SOFIT coding system as well as determine the correct classifications of dance specific activities (i.e. balance, pirouettes, etc.). Heart rate reserve data from each participant was classified according to the American College of Sports Medicine (ACSM) activity thresholds (Thompson, Gordon, Pescatello, 2009). These standards were then compared to the SOFIT classifications to determine the appropriate category. Single leg balances and leg swings were determined to be coded as a 4. Pirouettes and leaps were determined to be coded as a 5.

Based on this validation study (Sims et al., in progress), the SOFIT instrument vocabulary for lesson context was slightly altered to better reflect the activities of a dance technique class. The term "skill" was labeled "technique." Any activities focused on improving students' dance technique such as ballet exercises at the barre, floor work in modern technique, and progressions across the floor should be labeled as this. The term "game" was labeled "choreography." Any time spent working specifically on choreography intended for a performance should be labeled as this. The category “other” should include activities such as improvisation, small group collaboration, and free dance. The physical activity codes were labeled 1-5 rather than including activity labels (i.e., walking) to better represent the inclusion of dance activities.. Teacher promotion of physical activity remained the same.

The purpose of this descriptive study was to observe dance technique classes using the SODANCE instrument, validated specifically for dance classes, to determine physical activity time, time spent in MVPA, time spent in lesson context areas, and frequency of teacher promotion of student activity.

Methods

Participants and Setting

Data were collected at a public arts school (Grades 4-12) in the southeastern United States. The school utilizes an audition program with students majoring in various creative and performing arts. All students have a declared major such as drama, visual art, ballet, contemporary dance, or creative writing, in which they take daily classes. Middle school students spend 55 minutes per day in their major class. High school students participate in a 100-minute major class.

A high school ballet class, a middle school ballet class, a high school contemporary dance class, and a middle school contemporary dance class were each observed using SODANCE (details below) four times (Cardon, Verstraete, De Clercq, & De Bourdeaudhui, 2004). The teachers and students were instructed to not alter their teaching practices or behaviors for the observed classes.

Data Collection

Data collection was conducted during the fall semester of 2012. Each class was videotaped and coded by a trained observer (first author) using the SODANCE instrument and SODANCE pacing. To ensure interrater agreement two trained observers coded two classes (12.5% of all classes), one high school and one middle school, each one time. All guidelines established by McKenzie (2009) were followed including data collection start and end time, coding, time intervals, and participant selection.

Once 51% of the students entered the dance studio, the observer began recording data. Following the SODANCE pacing, the observer recorded the physical activity level, lesson context, and teacher interactions at the 10s prompt for the randomly selected student. After 12 intervals, the observer changed to a second randomly selected student and so on through 4 randomly selected students. The observer repeated this pattern for the entirety of the class. When 51% of the students exited the dance studio the observer ended data collection.

Data Analysis

The data were analyzed using Microsoft Excel 2008 for Mac. The mean frequencies for each activity code, lesson context, and teacher activity promotion were calculated. Based on these frequencies, percent of time spent in MVPA, percent of time in lesson context areas, and amount of teacher feedback in dance technique classes were calculated.

Results

Student Physical Activity

Percentage of time spent in each activity category for all of the dance classes were as follows: *lying* 1.02% (n=30), *sitting* 7.49% (n=220), *standing* 51.67% (n=1518), *walking* 9.10% (n=31), and *vigorous* 31.52% (n=897). Total MVPA was 40.62%. Percentages of time spent in SODANCE lesson contexts are as follows: *management* 9.53% (n=280), *knowledge* 22.29% (n=655), *fitness* 6.94% (n=204), *technique* 44.04% (n=1294), *choreography* 17.19% (n=505), and *other* 0.0% (n=0). Percentages of teacher interaction are as follows: *promotes in-class activity* 27.67% (n=813), *promotes out-of-class activity* 0.27% (n=8), and *no promotion* 72.06% (n=2117). The percentages from the SODANCE observations are reported by class in Table 9. Percentages by grade level are reported in Table 10. Percentages by dance style are reported in Table 11.

Class Context

With regard to class context, teachers of dance technique classes spent the most time focused on technique (44.04%), followed by knowledge (22.29%), choreography (17.19%), management (9.53%), and fitness (6.94%). None of the observed classes engaged in any activities that would be classified as "other" such as improvisation, group work, or student choreography. There was little difference in the percentages between ballet and contemporary dance. Students in contemporary dance spent more time focused on fitness (10.48%) than ballet (3.26%). Middle school students spent more time engaged in activities focused on technique (52.47%) and choreography (25.51%) than high school (42.86% and 14.05% respectively).

Teacher Interaction/Behavior

In regards to teacher interaction/behaviors, the observed dance technique classes reported a majority of no physical activity promotion (72.06%). Teachers promoted physical activity in-class 27.67% of the time and out-of-class for 0.27% of time. The ballet classes had slightly higher percentages of in-class promotion (29.93%) than contemporary dance (25.50%). High school classes had slightly higher percentages of in-class promotion (30.95%) than middle school classes (25.41%). For all classes, there was less than 1% of out-of-class physical activity promotion.

Table 9

Percentages of SODANCE categories for middle and high school students in ballet and contemporary dance technique classes

		Mean of All Classes (N=16)	Middle School Contemporary (N=4)	Middle School Ballet (N=4)	High School Contemporary (N=4)	High School Ballet (N=4)
Physical Activity Level	Code 1	1.02	1.08	0.18	2.34	0.11
	Code 2	7.49	10.04	0.36	9.79	7.87
	Code 3	51.67	45.88	54.99	51.28	53.66
	Code 4	9.10	10.57	6.72	14.15	4.95
	Code 5	31.52	32.44	37.75	22.45	33.41
	MVPA	40.62	43.01	44.47	36.6	38.36
Lesson Content	Management	9.53	5.20	9.44	10.74	11.02
	Knowledge	22.29	29.03	15.06	15	30.26
	Fitness	6.94	3.58	0.91	14.57	4.72
	Technique	44.04	54.48	37.39	38.51	47.47
	Choreography	17.19	7.71	37.21	21.17	6.52
	Other	0	0	0	0	0
Teacher Interaction	Promotes In-Class	27.67	22.22	22.32	27.45	34.65
	Promotes Out-of-Class	0.27	1.08	0.18	0	0.11
	No Promotion	72.06	76.70	77.50	72.55	65.24

Table 10

Percentages of SODANCE by middle school and high school dance technique classes

		Middle School	High School
Physical Activity Level	Lying	0.72	1.26
	Sitting	5.97	8.86
	Standing	57.51	52.43
	Walking	9.87	9.68
	Vigorous	40.02	27.77
	MVPA	49.89	37.45
Lesson Content	Management	8.33	10.88
	Knowledge	25.21	22.42
	Fitness	2.57	9.79
	Technique	52.47	42.86
	Choreography	25.51	14.05
	Other	0	0
Teacher Interaction	Promotes In-Class	25.41	30.95
	Promotes Out-of-Class	0.72	0.05
	No Promotion	87.96	69.0

Table 11

Percentages of SODANCE by dance genre, ballet and contemporary, for secondary dance technique classes

		Ballet	Contemporary
Physical Activity Level	Lying	0.14	1.87
	Sitting	5	9.87
	Standing	54.17	49.27
	Walking	5.63	12.82
	Vigorous	35.07	26.17
	MVPA	40.70	38.99
Lesson Content	Management	10.42	8.68
	Knowledge	24.44	20.23
	Fitness	3.26	10.48
	Technique	43.61	44.46
	Choreography	18.26	16.15
	Other	0	0
Teacher Interaction	Promotes In-Class	29.93	25.50
	Promotes Out-of-Class	0.14	0.40
	No Promotion	69.93	74.10

Discussion

The results of this study indicate that students in these 16 dance technique classes spent 40.62% of class time in MVPA. This is below the national recommendation for physical education of 50% of class time spent in MVPA (US Department of Health and Human Services, 2010). However, physical activity is not generally the primary objective of a dance technique class, rather the focus may be on technical skill development, artistic expression, creativity, or choreography. Despite the focus, dance is a movement-based activity that provides physical activity. In terms of advocacy for dance as a subject in schools, this data does suggest that dance contributes to students' daily MVPA participation.

Compared to other studies measuring MVPA in physical education, these dance technique classes resulted in similar or possible higher rates of MVPA. Scruggs, Mungen, and Oh (2010) found female high school students (grades 9-12) engaged in MVPA 28.88% of a physical education lesson. High school students in the SODANCE study were engaged in MVPA nearly 20% more of the class time (37.45%). McKenzie, Prochaska, Sallis, and LaMaster (2004) measured middle schools students MVPA levels in physical education using the SOFIT instrument and found the students to be engaged in MVPA 35.2% of the lesson. Middle school students in the SODANCE study were engaged in MVPA nearly 15% more at 49.89% of the lesson. These findings suggest that dance technique classes contribute to equal or more MVPA than physical education classes.

In comparison to dance technique classes in private dance studios, the dance classes in this public school setting provided higher percentages of time spent in MVPA.

O'Neill et al. (2012) found students of comparable age and background engaged in MVPA 16.33% of the time in dance technique classes in private dance studios. The students in the public school setting engaged in over two times this amount of MVPA (40.62%). These discrepancies may be due to differences in objectives in these two types of settings. Public schools may have a set of standards to guide the curriculum in class while classes in the private sector may have more freedom in choices in curriculum. Additionally the teaching qualifications at the different settings may influence the instruction practices and pacing of the teachers. For example, there is no set of standards or qualifications for dance teachers in the private sector. These teachers may have little education and experience in dance pedagogy resulting in less activity time. On the other hand, nearly all public schools require specific qualifications for dance teachers including higher education degrees or teaching certifications which should lead to better teaching practices. Regardless of teachers' experiences and education, the objectives of the class may vary from school to school.

Ballet classes elicited slightly more time in MVPA than contemporary dance classes with 40.7% and 38.99% MVPA, respectively. This minute difference suggests that there are little to no physical activity level differences between ballet and contemporary dance. This is an interesting finding in regards to dance style. Ballet traditionally begins with exercises at the barre stopping for instruction between exercises. Contemporary dance often has a "set" warm up that includes center work and floor work. The data in this study suggests that both approaches yield similar incidences of MVPA.

High school dance classes resulted in more time in MVPA than middle school classes with 49.89% and 37.45% MVPA, respectively. This may be due to the difference in length of class. The high school dance classes were 100 minutes as compared to middle school classes of 55 minutes. The additional time may allow the high school classes to spend more time on activities that contribute to MVPA. Students in the high school classes may be able to repeat exercises multiple times increasing physical activity levels. Moreover, the high school students presumably have more experience in dance so they may be able to learn and perform at a faster pace than the middle school students. Likewise, the dance exercises taught in the high school classes may be more difficult than the middle schools classes resulting in higher cardiovascular responses.

Not surprisingly, the majority of class time was spent focused on technique (44.04%). This is generally the primary goal of a dance technique class: to develop technical skill proficiency in dance. It follows that nearly half of the class time would be devoted to this activity. Time spent focused on knowledge contributed to 22.29% of the class. The traditional format of a dance technique class includes providing instruction of dance exercises followed by performance of these exercises. It makes sense that this would be the second highest amount of time spent in class. The knowledge category also includes dance history, kinesiology, and corrective feedback content, so time spent covering these topics would also contribute to this time percentage.

Time spent in choreography contributed to 17.19% of class time. This time may vary depending upon the class and need for choreography development for upcoming performances. In this specific incident, the students were preparing for an upcoming performance, so more of class time was spent focused on choreography than may be representative of a regular dance technique class. Time spent in management contributed to 9.53% of class time. While this percentage is not overwhelmingly high, it could be reduced by better time management in terms of recording attendance, water breaks, and use of technology.

Surprisingly only 6.94% of class time was devoted to fitness. This low incidence of fitness may be an example of the difficulty distinguishing between pure fitness activities and dance activities that incorporate fitness benefits. The SODANCE instrument distinguishes fitness activities as those specifically targeted for fitness benefits such as push-ups or abdominal exercises. However, in dance technique many dance exercises contribute to fitness, but also serve technical skill implications such as relevès and grande pliès. In the classes observed there was no opportunity for students to participate in dance improvisation or small group collaborations, which would be categorized as “other” on the SODANCE instrument. This could be a result of the specific classes observed, the teaching preferences of the instructors, or the curriculum of the school.

The majority of teacher feedback was of no physical activity promotion (72.06%). This may be a result of the teachers not valuing physical activity as a vital part of the class. The teachers provided feedback in terms of correcting technique, encouraging expression, and classroom management. Teachers promoted in-class physical activity 27.67% of the time and out-of-class physical activity 0.27% of the time. Interestingly the students are encouraged to participate in dance technique classes outside of school and are required to submit practice logs documenting their out of class dance activities. However, the teachers did not mention or encourage these activities in the dance classes observed.

Limitations

As with all studies, this investigation has some limitations. Although they were instructed not to, teachers and students may have altered their behaviors due to being observed resulting in reactivity. Additionally the time of the school year may have impacted the time spent in various lesson contexts. For example, the dance majors were preparing for an upcoming performance, which may have resulted in more time spent in choreography than class at other times of the year. Additionally, the data may differ depending upon when in the unit the class is observed. If the teacher is presenting new material there may be more time spent in the knowledge category and less in MVPA. Conversely, if the students have been practicing the dance material for many classes, there may be less time spent learning the exercises and the class may move faster from one activity to another resulting in higher rates of MVPA. Moreover, the teachers' instructional habits may have influenced the data. All ballet classes were taught by the same teacher, but the middle school contemporary classes and the high school contemporary classes were taught by different teachers. However, there were little differences between the three different teachers among all categories. The data presented here represents the students at this school. Further research at varying schools would provide more balanced data about the practices at all schools.

Another limitation of this study is its specificity to dance technique (i.e., ballet and contemporary dance). This instrument may not be appropriate for other forms of dance such as tap, folk, or social forms of dance. However, the SOFIT instrument has been used to measure dance curriculum included in physical education classes, so it may be applicable. Further research is needed to validate the SODANCE instrument for creative movement classes and other forms of dance technique.

The SODANCE instrument was used in the K-12 public school setting with dance majors. Students in a traditional K-12 school setting with dance as an elective subject may present different findings. The students in this study participate in dance technique classes a minimum of five days a week. Students at other schools where dance is an elective course or fills another space in the curriculum may not participate in dance as frequently and may have different activity levels. Additionally studies using the SODANCE instrument in the private sector may report different findings due to different objectives for students.

Conclusion

The SODANCE instrument has the potential to provide quantitative data on the physical activity levels of students in dance technique classes. Information about time spent in MVPA, time spent in certain lesson context areas, and amount of teacher feedback can be gathered from this instrument. This study provides evidence that students in dance technique class are participating in slightly more than 40% of class time in MVPA. Although this does not meet the national standard for physical education of 50% of class time in MVPA, it does provide a starting point to begin to address the issue. Additionally, physical activity is not necessarily the primary goal of a dance technique class, but may provide an additional component in terms of advocacy for dance in schools. Future studies should examine the influence of professional development and trainings on physical activity outcomes of students in dance technique classes.

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