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SPORT EDUCATION

Analysis of the Sport Education Tactical Model in Badminton University Physical Activity Courses

Tony Pritchard, Andrew Hansen, Hannah Grossman, Matthew Williams, Sherrie Loomis

Abstract

The purpose of this study was to investigate the impact of the Sport Education Tactical Model (SETM) on game performance, content knowledge, and physical activity levels of university students enrolled in badminton. Thirty-eight university students completed 19 lessons. Pre- and posttests consisted of a 15-min, video recorded singles badminton match, plus a 50-question content knowledge test. Game performance was measured via the Game Performance Assessment Instrument. Physical activity levels during each SETM lesson were measured via Actigraph GT3X triaxial accelerometers. Paired-samples t tests revealed significant increases between pre- and posttest scores for game performance and content knowledge. Participants achieved 60.10% (9.03) in moderate to vigorous activity during badminton lessons. In conclusion, the SETM was effective in improving game performance and content knowledge while helping participants meet the recommended 50% moderate to vigorous physical activity level.

Tony Pritchard is a professor, Waters College of Health Professions, Georgia Southern University. Andrew Hansen is an associate professor, Jiann-Ping Hsu College of Public Health, Georgia Southern University. Hannah Grossman is a physical education teacher, Monroe County Middle School. Matthew Williams is a physical education teacher, Screven County Elementary School. Sherrie Loomis is an assistant professor, Department of Fine Arts, Humanities, and Wellness, Savannah State University. Please send author correspondence to tpritchard@georgiasouthern.edu

According to the American College Health Association (2012), 34.3% of students on college campuses are overweight or obese and 50.6% of college students meet the weekly recommended amounts of moderate to vigorous physical activity (MVPA). With obesity trends continuously increasing and physical activity decreasing as people age, college students need availability of and accessibility to education and opportunities to be physically active. One such opportunity is an effective higher education physical activity (PA) instructional program. The National Association for Sport and Physical Education (NASPE, 2009) provides guidelines for higher education PA programs. NASPE (2009) stated, "Appropriate instructional practices in physical activity programs are those that recognize each student's development of movement abilities, as well as his or her individual differences" (p. 2).

Effective teaching in a PA program is key to encouraging students to continue to be physically active and live a healthy lifestyle once completing any course offered in the program. To have effective teaching, PA teachers should be required to choose an appropriate instructional model to deliver the course content. An instructional model is a "blueprint" for the teacher to follow and teach the content to the students (Metzler, 2011). Eight instructional models can be utilized in physical education, whether it is a K–12 or college/university setting (Metzler, 2011). One of the more popular instructional models is the Sport Education model (SEM). The SEM was designed for students to become competent, literate, and enthusiastic in the activity being taught (Siedentop, Hastie, & van der Mars, 2011). To reach this goal, the SEM has six characteristics to be followed: (1) season, (2) affiliation, (3) record keeping, (4) formal competition, (5) culminating event, and (6) festivity. Research in SEM has discovered many positive learning outcomes of the instructional model, such as more opportunities to learn for students with lower skill levels (Hastie, 1998a, 1998b), minimal off-task behaviors by students (Hastie, 1996), and opportunities for MVPA with SEM in floor hockey (Hastie & Trost, 2002) and basketball (Perlman, 2012). Researchers have found an increase in game-playing abilities through use of the SEM in different activities (Hastie, 1998b; Hastie, Sinelikov, & Guarino, 2009; Ormond, Christie, Barbieri, & Schell, 2002; Pritchard, Hawkins, Wiegand, & Metzler, 2008; Pritchard,

McCollum, Sundal, & Colquitt, 2014) and students were more motivated to participate in physical education (Wallhead, Garn, & Vardini, 2014). With so many positive learning outcomes of the SEM at the middle and high school levels, it is worthwhile to investigate the impact of the SEM in PA programs at the college/university level.

Research of college/university PA programs that utilized the SEM revealed that university students perceived they learned more in the SEM class than any other PA class, and 90% of those students would take another course taught via the SEM (Bennett & Hastie, 1997). Mohr, Sibley, and Townsend (2012) found that students' ratings of progress were high and ratings of teaching effectiveness were high compared to published norms in university PA courses that utilized the SEM.

There are different versions of the SEM such as the original SEM (Siedentop et al., 2011), the Pedagogical Approach to Sport Education (Bulger, Mohr, Rairigh, & Townsend, 2007), and the Sport Education Tactical Model (Pritchard & McCollum, 2009b). Pritchard and McCollum (2009b) described the integration of the original SEM with the properties of the Tactical Games Model (TGM) to form the Sport Education Tactical Model (SETM). The goal of the SETM is the same as the original SEM, but the instruction provided to students is different. The SETM combines the properties of the SEM and the TGM to teach students the skills necessary to solve the tactical problem being taught during the lessons. Mitchell, Oslin, and Griffin (2013) recommend using the SEM components within the TGM "to organize teams, equipment, and games to help students develop game play and sport behaviors" (p. 41). Hastie and Curtner-Smith (2006) were the first to investigate a hybrid model of SEM and TGM with sixth-grade students. Students responded well to problem solving, game play appreciation, and executing skills/tactics of the batting/fielding games. Research demonstrated an increase in game performance among fifth-grade students for soccer (Farias, Mesquita, & Hastie, 2015) and middle school students in basketball coeducational classes and single-gender classes (Pritchard et al., 2014). Little research has been conducted on the SETM at other levels including the college/university level. The purpose of this study was to investigate the impact of the SETM on game performance,

content knowledge, and PA levels of university students enrolled in PA badminton courses.

Method

Participants and Setting

The investigation was administered in two university PA badminton courses at a public university in the southeastern United States. The badminton courses met during the university summer session for 80 min each day, 4 days a week over 5 weeks, for 19 lessons. On the first day of class, the teacher went over the course syllabus and discussed the study. This day was not included in the 19-lesson season. Participants were 38 university students (23 male, 15 female) with an age range of 19 to 33 years ($M = 21.71$, $SD = 2.29$). Participation was voluntary, and no extra credit was provided. The Institutional Review Board for the Protection of Human Subjects approved the investigation prior to data collection.

Instrumentation

Game Performance Assessment Instrument. The Game Performance Assessment Instrument (GPAI; Oslin, Mitchell, & Griffin, 1998) was developed to measure "game performance behaviors that demonstrate tactical understanding, as well as the player's ability to solve problems by selecting and applying appropriate skill" (p. 231). To characterize game performance in net wall games, the researchers identified observable components including (1) decisions made, (2) skill execution, and (3) base. The decisions made category consisted of participants making appropriate choices about skills to use including the clear shot to push the opponent back, the drop shot to bring the opponent forward, and a smash to win the point. For example, if the opponent was playing up near the net, then the participant would want to hit a clear shot to push the opponent to the baseline to set up the next shot. If the opponent was at the baseline, then the participant would want to hit a drop shot since the open area of the badminton court is near the net. The participant could also hit a smash to win the point if the shuttle is high and near the net, which would make it difficult for the opponent to hit a return shot. If the participant made a correct decision on the type of shot to attempt, a tally mark was written in the appropriate decision

made column. If the participant made an incorrect decision on the type of shot to attempt (e.g., attempt a drop shot when opponent was at the net), a tally mark was written in the inappropriate decision made column.

In the skill execution category, the participant had to execute the skill proficiently for the researchers to code the skill as appropriate. In the case of the clear shot, it had to be high and deep for it to be coded as appropriate. If the clear shot was not high enough or deep enough on the court, the researchers coded the skill as inappropriate. For the drop shot, the shot was coded appropriate when the drop shot was short and low, so the opponent had trouble getting to the shuttle. If the drop shot was not low or short, then the researchers coded the skill execution as inappropriate. For the smash shot, the researchers coded it as appropriate if the smash was hit hard and down toward the court. If the smash was not hit hard and down, then the shot was coded as inappropriate.

The last behavior of game performance assessment was the base category. The researchers used this category to assess if the participant returned to home position between skill attempts. For the researchers to code the base category as appropriate, the participant had to return to the appropriate position on the court to be ready for the next shot. If the participant did not return to this base position, the researchers coded the behavior as inappropriate.

The researchers computed overall game performance scores by dividing the number of appropriate codes by the total number of codes within each category, then multiplying this by 100, resulting in percentage scores for (1) decisions made, (2) skill execution, and (3) base, as recommended by Mitchell, Oslin, and Griffin (2013). The average of these three scores served as an overall game performance score for each participant.

Content knowledge. The researchers used a 50-question multiple-choice test to measure badminton content knowledge. They chose questions from the test bank by McGee and Farrow (1987). The knowledge test had no data quality coefficients, but other researchers have effectively used the test bank (French, Werner, Rink, Taylor, & Hussey, 1996; French, Werner, Taylor, Hussey, & Jones, 1996; Pritchard et al., 2008). Safrit and Wood (1995) considered the test bank "the best source of test items for sport" (p. 421). The number

of questions answered correctly on the content knowledge test was multiplied by 2 for a score out of 100%. The test was administered to physical education teacher education (PETE) majors the semester before data collection for the current study and was evaluated by an outside researcher, which further established content validity.

Physical activity. PA was measured during the badminton lessons via Actigraph GT3X triaxial accelerometers (ActiGraph, Pensacola, FL). Accelerometers were attached to a belt with monitors positioned on the right hip, and data were acquired in 1-min intervals. Participants wore the accelerometers during each lesson except Lesson 1, which was the day the badminton class syllabus was introduced, the purpose of the study including consent forms was presented, and pretest data were collected. The researchers downloaded accelerometer data using Actilife software (ActiGraph, Pensacola, FL) to determine the amount of time participants spent in MVPA (≥ 3 METS) and vigorous activity (≥ 6 METS), using triaxial vector magnitude cut points established by Sasaki, John, and Freedson (2011).

Teacher and Data Collector Training

The teacher was a university professor who was part of the research team and had over 10 years of experience implementing different versions of the SEM including the SETM. The teacher had taught badminton in previous years at the university level, utilizing the SETM to provide experience and expertise in the activity and sport. To ensure the SETM was appropriately implemented, the researchers followed the teacher and student benchmarks of the SEM and TGM described by Metzler (2011), because the SETM combined the characteristics of both models (Pritchard & McCollum, 2009b). Another researcher was present during the badminton lessons observing the implementation of the SETM during the badminton lessons.

Two researchers who did not teach the badminton lessons analyzed the game performance scores and were trained to use the GPAI prior to starting the research study. Training required the researchers to score performance using the GPAI badminton instrument while observing badminton games played in a PETE methods course. These games were video recorded via the same protocol as the current study. Game performance was scored using the GPAI

by the primary researcher and the other two researchers for each participant of the PETE course. Interobserver agreement of at least 80% was achieved for GPAI scores during the training period. For the current study, the two trained researchers coded the participants' game performance during game play episodes of each testing occasion, and interobserver agreement scores were calculated, with an average of 87%.

Procedures for Data Collection

Participants were given the content knowledge test on Day 1 of the badminton season. Immediately after, they were given a short tutorial on the rules of playing badminton. After the tutorial, participants played a 15-min game of singles badminton. Posttesting occurred on the last day of the badminton season via the same protocol as pretesting except without the short tutorial. All participant games were video recorded pre- and postseason to later be analyzed via the GPAI by the researchers.

Badminton Season

The badminton season was broken down into three phases consisting of the preseason, midseason, and postseason (see Table 1). During the preseason, participants were placed on teams based on playing ability ranked by the teacher. Participants conducted daily roles (i.e., coach, fitness trainer, equipment manager, statistician, substitute, and reporter) for each phase of the season. In the preseason lessons, the teacher taught the tactics and skills by employing a play, teach, play format. At the beginning of the lesson, the participants assigned as fitness trainers warmed up the teams while coaches met with the teacher to review the coaching plan. The coaching plan comprised the rules of the first modified game, which was designed to encourage participants to think about the tactic being taught in the lesson. Once the modified game was completed, the teacher asked participants about the tactical problem and how one would solve the problem by utilizing specific skills. The teacher taught the badminton skill to solve the tactical problem and then provided movement tasks. Participants practiced the skill during the movement tasks. When the tasks were completed, participants played a second modified game to reinforce the tactic and skill that was practiced. A lesson

closure reviewing the tactic learned in the preseason lesson and the cues of the skill to solve the tactic was provided.

Before the midseason and postseason lessons began, coaches ranked their teammates playing ability using a ranking system of 1 to 6, with 1 representing the most skilled. When one team played another team in the midseason or postseason, the number 1 seeds played each other, the 2 seeds played each other, and so on, which ensured participants played someone with similar ability. During the midseason and postseason, teams competed against one another to earn points for the overall championship. Points were awarded for wins and losses during the midseason and postseason, and teams could also earn points by wearing team colors, performing the team cheer, and performing daily roles. The team with the most points at the end of the season was the champion of the badminton season. The champions received certificate awards at the end of the badminton season, along with individual awards (e.g., most improved, team before self) being given to players on any team.

Table 1
Badminton Sport Education Tactical Model Season Plan

Lesson	Topic
1	Preassessment of badminton playing ability and content knowledge
2	Introduction of Sport Education Tactical Model (SETM); team affiliation
3	Creating space using forehand overhand and forehand underhand clears
4	Creating space using backhand overhand and backhand underhand clears
5	Creating space using forehand and backhand drive shots
6	Winning the point using drop shot and smash shot
7	Starting the game using underhand serve and backhand serve
8	Attacking and defending as a pair; doubles play
9	Statistics and chair umpiring; singles play
10–16	Midseason round-robin tournament
17–18	Postseason tournament with consolation rounds
19	Festivity day: Championship with awards ceremony, postassessment of badminton playing ability and content knowledge

Data Analysis

Paired-sample *t* tests were performed in IBM SPSS Statistics for Windows version 23 (IBM Corp., Armonk, NY), and pre- and posttest scores of the following dependent variables were compared: (1) game performance, (2) decision making index, (3) skill execution index, (4) base index, and (5) content knowledge. The Bonferroni corrected alpha was .01.

PA mean levels were calculated and the amount of MVPA participants engaged in when participating in the badminton season was determined.

Results

Table 2 shows the descriptive statistics generated on the dependent variables, including game performance and content knowledge, for the SETM assessment point. Table 3 provides descriptive statistics on activity time.

Table 2
Descriptive Statistics for Content Knowledge Test and Game Performance

Dependent variable	Pretest *M* (*SD*)	Posttest *M* (*SD*)
Game Performance	39.08 (11.11)	62.99 (11.37)
Decision Making Index	41.02 (14.07)	66.52 (8.86)
Skill Execution Index	48.14 (20.04)	67.38 (8.88)
Base Index	28.07 (17.64)	55.08 (27.96)
Content Knowledge	33.74 (10.14)	79.21 (9.50)

Note. Each mean score is out of 100.

Table 3
Physical Activity Levels During the Sport Education Tactical Model Season

Activity level	% *M* (*SD*)
Light	40.25 (8.88)
Moderate	50.15 (10.08)
Vigorous	9.96 (5.95)
Moderate to Vigorous (MVPA)	60.10 (9.03)

Game Performance

A paired-samples *t* test revealed a significant increase in game performance scores from pre- to posttest, $t(37) = -13.152$, $p < .01$. Cohen's effect size ($d = 2.13$) suggested a high practical significance. When game performance was separated into the subcategories, paired-samples *t* tests revealed a significant increase from pre- to posttest scores for the decision making index, $t(37) = -10.086$, $p < .01$, with a Cohen's effect size ($d = 1.64$) suggesting a high practical significance. The skill execution index, $t(37) = -6.177$, $p < .01$, had a significant increase in pre- to posttest scores with Cohen's effect size ($d = 1.00$) suggesting a high practical significance. The base index, $t(37) = -7.969$, $p < .01$, had a significant increase in pre- to posttest scores with Cohen's effect size ($d = 1.29$) suggesting a high practical significance.

Content Knowledge

A paired-samples *t* test revealed a significant increase from pre- to posttest scores for the content knowledge test, $t(37) = -20.573$, $p < .01$, including a high practical significance Cohen's effect size ($d = 2.05$).

Physical Activity Time

Based on mean activity time during the badminton season, participants spent 60.10% ($SD = 9.03$) of their PA time in MVPA. The mean activity time the participants spent in MVPA was higher than the 50% of time to spend in MVPA during physical education lessons recommended by the Centers for Disease Control and Prevention (2010).

Discussion

The findings of this study demonstrate that participants made significant gains in game performance and content knowledge while meeting the required 50% MVPA level during the SETM badminton season.

Game Performance

The significant increase in game performance scores over time demonstrates participants were making better decisions on shot selection, the skill execution of shots was efficient, and participants

returned to base position after each shot. During the preseason of the SETM, the teacher emphasized the tactics of badminton while teaching the skills needed for students to improve in badminton. The play, teach, play format encouraged participants to think about the tactics and the skills necessary to improve game performance. French, Werner, Taylor, et al. (1996) utilized the traditional TGM using a play, teach, play format to demonstrate how effective the model is in improving badminton skills and game performance for ninth-grade students. Hastie et al. (2009) found similar results with significant improvements in skills tests, game play, and tactical knowledge in badminton following a SEM intervention with eighth-grade students. The difference in the Hastie et al. study and the current study was the type of SEM intervention. This study incorporated the TGM within the SEM, while Hastie et al. used a traditional SEM. The SETM (Pritchard & McCollum, 2009b) incorporates the properties of the TGM and SEM to allow students to learn both the tactics and the skills of the activity being taught. This study demonstrated that the SETM is effective in improving badminton game performance. By having participants play in modified games during the preseason, this study allowed participants to execute skills in a game play environment.

Content Knowledge

Content knowledge scores significantly increased over time for badminton following the SETM. These findings are supported by other SEM research measuring an increase in content knowledge for other types of activities (Pritchard, Hansen, Scarboro, & Melnic, 2015; Pritchard et al., 2008). This increase in scores can be attributed to the presentation of content in classes via the SETM. The SETM requires participants to conduct roles during the season. One role is the coach who is responsible for peer teaching content provided on the coaching plan. The coaching plan, provided by the teacher, had information on the previous lesson content and on the current lesson modified game. The content in these coaching plans incorporated rules, cues of skills taught in class, and any other information that one would need to learn to play badminton. By incorporating this material from the coaching plan and from the content being taught by the teacher, the participants significantly improved their content

knowledge scores from the beginning to the end of the badminton season.

Physical Activity Time

PA time during the SETM badminton season exceeded the goal of 50% MVPA during physical education lessons. This PA time can be attributed to several factors. The first factor was the setup of the badminton lessons. Once participants entered the gym and class time officially started, they immediately went to their teams' home court to warm up with the team using a fitness card. This class management protocol ensured participants immediately engaged in PA at the beginning of each lesson. The second factor that influenced PA levels was the inclusion of modified games in the SETM during each lesson. Each preseason lesson included two modified games. The first modified game let participants play with modified badminton rules to enhance a tactical problem. After the first modified game, participants practiced the skill necessary to solve the tactical problem. The second modified game occurred after skill practice, allowing participants to use the learned skill in a game situation. Modified games allow participants to play, instead of practicing skills in isolation to improve MVPA levels (Van Acker, da Costa, De Bourdeaudhuij, Cardon, & Haerens, 2010). Middle school students in Harvey, Song, Baek, and van der Mars's (2016) study met the goal of 50% MVPA in physical education via the TGM with the sport of soccer. Harvey and García-López (2017) broke down the TGM to investigate the MVPA in the three phases of a TGM lesson. The middle and elementary students did not meet the MVPA requirements during the first modified game, skill practice, or second modified game of basketball lessons (Harvey & García-López, 2017). For the SEM, the 50% MVPA guideline was met in floor hockey (Hastie & Trost, 2002) but not in basketball (Perlman, 2012). Pritchard and McCollum (2009b) combined SEM and TGM to form the SETM to improve instruction while students learn to play while practicing the skills needed to play the game. Mitchell et al. (2013) recommend using the SEM components within the TGM for team organization, equipment, and modified games. By having students on teams early in the season and performing daily roles (e.g., fitness trainer), the teacher does not waste lesson time by grouping students to play modified games or prepare equipment at the beginning of class. The routines associated

with SETM are built into lessons, so management time is decreased, thus increasing the opportunities for participants to increase MVPA.

The third factor influencing PA levels was the setup of the practice tasks. Participants practiced skills that would benefit them in learning to play badminton such as clear shots, drop shots, serves, and smashes. The teacher designed tasks so participants had to move when practicing their skills, as described by Pritchard and McCollum (2009a). For example, when participants practiced the underhand clear, the hitter would run and touch the baseline after hitting the shuttle using an underhand clear. The hitter would run back to base position for the next attempt. This hit-and-move technique (Pritchard & McCollum, 2009a) allowed participants to move between attempts, instead of the traditional standing between skill attempts. The last factor influencing PA levels was the setup of the midseason and postseason. During the midseason and postseason, teams played one another in singles and doubles play. Each class had three teams. Each team seeded team members with seed 1 being the most skilled player, seed 2 was next skilled player, and so on to Seed 6. The midseason round-robin tournament had number 1 seeds playing one another, 2 seeds playing one another, and so down the line. This seeding system ensured that participants played others with similar abilities. Playing participants with similar abilities encouraged longer rallies and more movement by players.

Conclusion

The results of this study demonstrate the SETM improves badminton game performance and content knowledge while helping students exceed the 50% MVPA recommended by the Centers for Disease Control and Prevention (2010). If the goal of a university PA class is to improve student learning while incorporating MVPA, the SETM is a model a teacher could utilize.

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