Gender and school-level differences in students' moderate and vigorous physical activity levels when taught basketball through the Tactical Games Model

Abstract

The Tactical Games Model (TGM) prefaces the cognitive components of physical education (PE), which has implications for physical activity (PA) accumulation. PA recommendations suggest students reach 50% moderate-vigorous physical activity (MVPA). However, this criterion does not indicate the contribution from vigorous physical activity (VPA). Consequently, this study investigated: a) the effects of TGM delivery on MVPA/VPA and, b) gender/school level differences. Participants were 78 seventh and 96 fourth/fifth grade co-educational PE students from two different schools. Two teachers taught 24 (middle) and 30 (elementary) level one TGM basketball lessons. Students wore ActigraphGT3X® triaxial accelerometers. Data were analyzed using four one-way ANOVAs. Middle school boys had significantly higher MVPA/VPA (33.34/21.80%) than girls (24.90/15.32%). Elementary school boys had significantly higher MVPA/VPA (29.73/18.33%) than girls (23.03/14.33%). While TGM lessons provide a context where students can accumulate VPA consistent with national PA recommendations, teachers need to modify lesson activities to enable equitable PA participation.

Keywords: models-based practice; physical activity; accelerometers

Introduction

Models-Based Practice (MBP) has been suggested as a means of overcoming limitations of traditional physical education (PE) curricula (Kirk, 2013), which has been chastised for being ‘a mile wide and an inch deep’. MBP offers teachers and other stakeholders the opportunity to “limiting the range of learning outcomes, subject matter and teaching strategies appropriate to each pedagogical model and thus the arguments that can be used for educational value” (p. 972). Kirk’s main justification for a move towards MBP is that educational value can be developed in MBP because it centers on affirming the notion that PE has the potential to contribute to a wide range of beneficial outcomes across an array of domains. This is in contrast to a traditional ‘one-size fits all’, physical-education-as-sports-techniques (Kirk, 2010), multi-activity curricula (Kirk, 2013). In this model students often practice in isolated, decontextualized conditions that are unlikely to generalize to game conditions, spend much of their lesson time inactive, and have little opportunity for empowerment and creativity (Kirk & MacDonald, 1998).

Kirk’s argument, and those before him (Jewett, Bain, & Ennis, 1995; Metzler, 2011), for centering the development of PE curricula using MBP, is justified by an emerging literature base on second generation models (cooperative learning, sport education, and the Tactical Games Model) underpinned by constructivist learning theory (Kirk & MacDonald, 1998). For example, in Game-Centered Approaches (GCAs) such as the Tactical Games Model (TGM), the teacher utilizes a game-skill-game format to promote the links between tactics and technique with the aim of promoting skillful and intelligent performance. For example, an initial game form is introduced first (i.e., a 3 vs. 3 game to one basket in basketball), with skill practice introduced second (i.e., creating

passing lanes off the ball), before returning to the 3 vs. 3 game form. As Mitchell, Griffin and Oslin (2006) note, the *what* therefore comes before the *how* in the TGM, refuting the notion that quality game play cannot emerge until the core techniques are mastered a priori (Oslin and Mitchell, 2006, p. 627).

Research on GCAs such as the TGM provide evidence for the development of cognitive outcomes (i.e., tactical; Vande Broek, Boen, Claessens, Feys, & Ceux, 2011), affective outcomes (i.e., student motivation; Gray, Sproule, & Morgan, 2009) and psychomotor outcomes, particularly off-the-ball movement (Lee & Ward, 2009). More recently, however, a limited number of studies (Harvey, Smith, Fairclough, Savory, & Kerr, 2015; Harvey, Song, Baek & van der Mars, 2015; Miller et al., 2015, 2016; Smith et al., 2015; Van Acker et al., 2010; Yelling et al., 2000) have begun to provide evidence that teachers' use of a GCA can afford students opportunities to engage in moderate-vigorous physical activity (MVPA) for at least 50% of the lesson time, consistent with national recommendations (Association for Physical Education, AfPE, 2008; Institute of Medicine, IOM, 2013). This is particularly significant as it has been well documented that regular physical activity (PA) of at least a moderate intensity is related to an overall improvement in health and wellbeing along with a reduced risk of chronic diseases in children and young people (e.g. Andersen et al., 2006).

Recently, Brusseau and Burns (2015) published a compendium of PA in a range of middle school physical education activities measured using pedometers, which included the activity chosen for this current study, basketball. These authors noted that across invasion games, skill-focused lessons yielded between 37-40 (basketball, floor hockey) and 61 steps per minute (soccer), which resulted in MVPA of 17.5% and 35%,

respectively. Skill focused lessons were described as those involving “a warm-up, skill development through individual and small group static practice and small-sided skill games” (p. 647). Game-focused invasion game lessons yielded between 47 (tchoukball, floor hockey) and 85 steps per minute (flag football), which resulted in 22.5% and 52.5% MVPA, respectively. The authors defined these lessons as those that “consisted primarily of a warm-up activity and multiple game playing opportunities” (p. 647). Flag football was the only activity where students attained higher than 50% MVPA, and this was during lessons focused on game play. In basketball, the game chosen for this current study, skill-focused basketball lessons yielded 37 steps per minute (17.5% MVPA) and 55 steps per minute (28% MVPA) for game-focused lessons. These data are useful in the context of the current study, given its focus on PA levels, and teachers utilization of a different instructional model to those described in the Brusseau and Burns’ study.

In addition, more recent studies (e.g. Harvey et al., 2015a; Smith et al., 2015) have shown that teachers use of a GCA can provide opportunities to engage in PA of a vigorous intensity. For example, Harvey et al. (2015a) have reported VPA data demonstrating that a GCA-focused TGM unit of field hockey afforded students opportunities to accumulate vigorous physical activity (VPA) above and beyond that previously reported in the literature. The limitation of this study was its focus on only two middle school-aged classes, and therefore its low sample size. Nevertheless, this is significant given that national recommendations, both in the US and United Kingdom (UK), are emphasizing the importance of VPA on at least three days per week (Centers for Disease Control, CDC, 2008 Department of Health, DoH, 2011). Providing children with more opportunity to engage in VPA is of particular significance given its positive

association with cardiorespiratory fitness (e.g. Denton et al., 2013), vascular function (e.g. Hopkins et al., 2009) and body fat (e.g. Ruiz et al., 2006).

This body of emerging research into PA in GCAs is therefore promising. However, a limited number of GCA studies to date have examined differences in PA between boys and girls whilst participating in the same GCA activity, particularly for more than one individual lesson (Van Acker et al., 2010). Gutierrez and Garcia-Lopez (2012) found significant differences in boys and girls game behavior in a modified invasion game, with boys handling the ball more and girls spending more time as a spectator-player, suggesting that PA levels could also be impacted. Knowing the impact of GCA's such as TGM on PA levels could aid teachers in selecting balanced teams and designing appropriate game forms that promote equitable participation to meet skill/psychomotor and PA goals in PE. Second, none of the GCA-focused PA studies to date have included reports of PA data from both elementary and middle school contexts in the same study. While trends suggest higher PA participation in PE as students become older (Fairclough & Stratton, 2005, 2006), this affect could be mediated by the type of instructional model chosen by the teacher, and the content taught within this model. Third, given the growing focus in PA recommendations on the need to participate in VPA on three days of the week (CDC, 2008; DoH, 2011), greater attention can be afforded to research studies in reporting VPA data, particularly where the content chosen may result in significant accumulation of VPA.

This current study is therefore a timely addition to the growing literature base on PA within GCAs given its inclusion of data from boys and girls from both elementary and middle school levels as they participated in multiple lessons where teachers

employed the TGM. Moreover, it additionally reports the contribution of MVPA/VPA. Consequently, the purposes of this study were to investigate: a) the effects of TGM delivery on MVPA/VPA and, b) gender/school level differences.

Method

Participants & Settings

Students. Participants were 174 students (79 girls), 78 middle school (40 girls) and 96 (39 girls) elementary school students from four seventh and five fourth/fifth grade co-educational classes at two schools in the Eastern United States, respectively. These schools were chosen because their teachers and students had no previous exposure to GCAs such as TGM, either in their present schools, or in previous grade levels. Informed consent was received from participants using standardized procedures after approval from the Institutional Review Board for the protection of human subjects at a large Mid-Western United States University. Permission was also gained from the County School Board, school principals and the resident PE teachers who signed an informed consent.

Teachers. There were two teachers in this study, one middle school teacher and one elementary school teacher, both male. Both teachers had over 20 years of teaching experience. Both had or were currently coaching interscholastic basketball teams within the same school district where they taught PE, but not within the same school they taught at. As the teachers had no previous experience teaching using TGM, the use of basketball therefore gave the opportunity to ease the transition of the teachers to the TGM (Griffin, 1996). TGM lessons were taught in an indoor gymnasium of 40 x 30 yards and had six baskets available at both schools. Lessons covered were a replication of the level one

TGM basketball lessons from the *Teaching sports concepts and skills: A tactical games approach* text (Mitchell, Oslin, & Griffin, 2006).

Settings. The middle school students had daily PE and lesson periods were between 43-47 minutes' bell to bell, which included dressing out time. However, for observed sessions, actual lesson instructional time averaged M_{length} = 35mins 53 secs and M_{length} = 27mins 37 secs for the middle school and elementary schools, respectively. Lesson length at the elementary school was slightly shorter to the middle school because of slightly shorter class periods, but also because some lessons were shortened due to assembly (2 lessons) and 2-hour delays on days where there was inclement (wintery) weather where lessons were reduced by 10-minutes (3 lessons).

In total, the middle school teacher taught a total of 24 lessons (four per day) during the month of November. The elementary school students only had one PE lesson per week and lesson periods were 40 minutes' bell to bell, which included the teacher needing to collect classes from their classroom and bring them to the gym. The elementary teacher taught the TGM lesson once a week from January to March.

The middle school had an enrollment of approximately 500 students, with 29.5% of students receiving free or reduced lunch. According to school demographic information, 74.2% of the school population are white, 12% Asian/Pacific Islander, 9.1% Black/African American, 1.9% Hispanic, 0.8% Alaskan/American Indian, with the remaining 1.2% of mixed races. The elementary school had an enrollment of approximately 500 students, with 40% of students receiving free or reduced lunch. According to school demographic information, 90% of the school population are white,

8% Black/African American, with the remaining 2% other races (i.e., Latino/Hispanic, Alaskan/American Indian, Asian/Pacific Islander).

Research Design

This project used a non-experimental observational design. One main advantage cited for this type of study is that it gets "close to social practices and everyday situations" to see "what occurs when people act in a context" (Ohman & Qunnerstedt, 2012, p. 190). Hastie (2015) recently made a call for less comparative studies of different 'models' of teaching and additional examination of the micro-pedagogies of practice within each of the 'models'. Moreover, Kirk (2005) outlined how the 'practice-referenced approach' can serve as an alternative to traditional instructional method studies which compare alternative approaches such as a GCA, typically to direct instruction (Miller et al., 2015; Smith et al., 2015). Kirk (2005) noted the practice-referenced approach "is concerned with making judgments about the usefulness of TGfU [TGM] for achieving learning appropriate to the model itself and to the circumstances in which it has been applied" (p. 218). In this current study, the practice-referenced approach enabled the specific investigation of PA levels (AfPE, 2008; CDC, 2008; DoH, 2011; IOM, 2013) and how this was influenced by gender and school level when teachers taught TGM-focused lessons to multiple classes within two school contexts (Harvey et al., 2015b).

The Unit

Pre-study training of teachers. Teachers were supported in learning about and using the TGM via the lead researcher. Initially, the lead researcher met with the two teachers individually and overviewed the tenets of the TGM, concluding this meeting by asking if they would be able to participate in the study. After this initial meeting, the lead

researcher provided the two teachers with copies of the first three chapters of Mitchell et al. (2006) and chapter 14 from *Instructional Models in Physical Education* (Metzler, 2011). They were additionally provided with a copy of chapter 5 from Mitchell et al., which outlined the lesson content for basketball. Once the teachers had read this material, the lead researcher conducted a second individual meeting with each of the teachers to discuss the content covered in chapter 5 (Mitchell et al., 2006) and review model benchmarks from chapter 14 (Metzler, 2011), and address any questions and/or concerns.

TGM lesson delivery. Students were arranged into mixed ability teams of three by each of the two teachers using their previous knowledge of the students. Before each lesson the first author met both teachers individually and reviewed lesson content, which included the three lesson sections (game-skill-game) and transitions between the three, as well as the teachers' deductive questions from the Mitchell et al. (2006) lesson plans (e.g. 'When you receive the ball, what are your three options?'). The first author also provided the teachers with suggestions on how games or skills drills could be simplified to make games more developmentally appropriate (e.g., both hands behind back defense) but still meet model benchmarks (Metzler, 2011)[1].

Post-lesson teacher feedback. Researcher/teacher post-lesson discussions occurred between taught sessions so that the teacher could ensure that they continued to meet model benchmarks controlling for possible teacher drift over the course of the study. For example, the first author overviewed the game-skill-game lesson format, the

[1] In lesson 5 (tactical problem of attacking the basket) the teacher started with a 3 vs. 3 game with the condition of no dribbling unless to drive to the basket. The teacher would stop this initial game, gather the class around one basket and asked deductive questions in line with those outlined by Mitchell et al. (2006) to aid learning. The teacher then demonstrated with students how to set up the skill drill practice. This practice involved three players. One player would defend with arms behind their back (an additional modification to ease the initial task complexity), a second player, on receipt of a pass from a third player, would ball fake, juke or jab step, and drive to basket, making a jump stop to shoot the ball. The final part of the lesson involved the same 3 vs. 3 conditioned game, this time, with the additional condition that each team must dribble and drive to basket as often as possible.

utilization of deductive questions, game modifications and skill drills, as well as adherence to model benchmarks (Metzler, 2011).

Please note that while the teachers were aware that the researchers were examining PA levels in the context of the study, at no point were teachers given feedback relative to the amount of PA gained by the students in any of the classes. Moreover, no specific strategies to encourage higher levels of PA were given to the two teachers (i.e., asking students to conduct walk and talks to consider an answer to a teacher question).

Instruments and Data Generation

The lead researcher and at least two other members of the research team were present at each PE lesson to distribute/collect accelerometers, conduct lesson context analyses and assess the two teacher's fidelity to model benchmarks.

Actigraph GT3X® triaxial accelerometry. PA levels during each lesson were measured using ActigraphGT3X® triaxial accelerometers (Pensecola, FL). The GT3X® measures acceleration of movement across three axes (x, y and z) and these data are subsequently converted to activity counts. The GT3X® activity counts for moderate and vigorous have been validated through indirect calorimetry (Evenson, Catellier, Gill, Ondrak, & McMurray, 2008; Trost, Loprinzi, Moore, & Pfeiffer, 2010). The thresholds (counts/min) of Evenson et al., (2008) were used in this study: moderate 2296-4010 (3 METs) and vigorous >4011 (6 METs).

Each participant was assigned a specific identification (ID) number by the first author. Accelerometers with these corresponding numbers were pre-programmed by a member of the study team for the individual specifications of each participant (i.e., height, weight, date of birth). Stature and body mass were measured using standardized

223 procedures (CDC, 2011)[2] and date of birth information was gained from school records
224 with parental and school consent and approval by the Institutional Review Board.
225 On data collection days, accelerometers were placed in a clear bag. Immediately
226 on entering the gymnasium prior to the start of each PE lesson all participants placed
227 their accelerometer onto their waistband with the assistance of members of the study
228 team where needed. This procedure was pilot-tested with all classes in a PE lesson at both
229 the middle and elementary schools prior to the start of the study.
230 Once each lesson was completed, the devices were returned into the correct clear
231 plastic bags, collected and placed into a box and taken back to the first authors office.
232 Here the devices were connected to a personal password protected computer and the
233 information downloaded via the Actigraph software. The utilization of the Actigraph
234 software permitted GT3X® activity counts for each lesson at a 1-second epoch. Data
235 were extracted by applying a filter with the specific times of the lesson, which had
236 previously been noted during data collection at the school. This enabled the mean
237 percentage of time spent in MVPA and VPA to be calculated using the previously cited
238 Evenson et al. (2008) cut off points. These data were then exported from the Actigraph
239 software to Microsoft Excel™ for subsequent data management before being imported
240 into Version 21 of SPSS (SPSS Inc, Chicago, IL) for statistical analyses.
241 **Lesson context.** Lesson context was coded using definitions from the System for
242 Observing Fitness Instruction Time (SOFIT) training manual (McKenzie, 2012). This
243 involves coding the context of the lesson every 20 seconds (McKenzie, 2012). Lesson
244 context codes were recorded as follows; M = general content (transition, break,
245 management), P = knowledge content (physical fitness), K = general knowledge (rules,

[2] Stature and body mass (calibrated Tanita BF-682 scales; Tanita Corp, Tokyo) were measured to the nearest 0.1cm and 0.1kg.

strategy, social behavior, technique), F = motor content fitness, S = skill practice and G = game play. The first, second and third author as well as one additional coder conducted all four parts of the SOFIT training included in the SOFIT manual and reached the acceptable levels of Inter Observer Agreement (IOA) with the gold standard within the lesson context section. When acceptable IOA levels (i.e. 80%) were reached (McKenzie, 2012), observers undertook live coding on at least two occasions alongside the first author. On each occasion acceptable IOA levels were reached (McKenzie, 2012).

Model benchmarks. The TGM lessons were assessed using benchmarks to ensure that lessons were implemented correctly and not detrimental to learning outcomes (Metzler, 2011). While benchmarks offer key criteria to determine if the teacher is 'doing the model' it has been suggested that not all benchmarks need to be met when using curriculum models. For this study, we followed the lead of Gurvitch, Blankenship, Metzler, & Lund (2008) in selecting four key 'non-negotiable' teacher benchmarks, which included: teacher uses tactical problems as the organizing center for the learning tasks, teacher begins each lesson with a game form to assess students' knowledge, teacher uses deductive questions to get students to solve tactical problems, teacher uses high rates of guides and feedback during situated learning tasks. 'Non-negotiable' student benchmarks utilized for model fidelity were: students are given them time to think about deductive questions regarding the technical problem, students understand how to set up situated learning tasks, students are making situated tactical decisions, game modifications developmentally appropriate (for a complete list of model benchmarks, see Metzler, 2011).

Prior to the study the first and fourth authors observed videotaped records of three invasion game TGM lessons not part of the current study using the same 3-point scale as Gurvitch et al., (2008) of ‘not at all’, ‘ok’, and ‘very well’. This same protocol was used during the actual study data collection. Due to the small number of items and choice of three alternatives, inter-observer agreement was set at 70% following guidelines from Osborne (2008, p. 48).

Observer reliability. Inter-observer reliability checks for lesson context data were completed for 18.52% (10) of the 54 lessons (randomly selected based on observer availability and training; McKenzie, 2012). Interval-by-interval agreement between observers was 95-100% for lesson context, which exceeded minimum levels of agreement (McKenzie, 2012). Scores from the lead observer were used for data analysis (McKenzie, 2012). For model benchmarks prior to the study, IOA for the three observed sessions was 100%, 88%, and 100%, thus averaging 96%. Model benchmark IOA during the study was conducted on 24% (13) of the total sessions (randomly selected based on observer availability and training; McKenzie, 2012). IOA levels averaged 78.84%, with scores ranging from 62.50% (one session), 75% (eight sessions), 82.50% (three sessions) to 100% (one session).

Data Analysis

Accelerometry. Once accelerometry data for each child had been downloaded for each lesson by two members of the study team and exported to SPSS, this enabled computation of mean scores for MVPA and VPA over the six lessons. Accelerometers that did not contain any data either due to absence or neglecting to wear the device were excluded (5.77% and 6.94% – 27 of 468 and 40 of 576 observations – at the middle and

elementary school, respectively). All available data was therefore included in subsequent analyses. Four one-way ANOVAs were utilized to test for significant differences in MVPA and VPA between boys and girls at each school level. Prior to conducting the between-groups ANOVA, Levene's tests revealed that data met the parametric assumptions therefore the alpha level was set at $p < 0.0125$ for the four analyses being conducted (Bonferroni corrected).

Lesson context data. Before data were analyzed, data from paper records were transferred to an electronic SOFIT coding form constructed for the purposes of this current study. This ensured that calculations for each of the lesson context categories were accurate. Descriptive lesson context data (means and standard deviations) were then calculated using percentage of total class intervals as the unit of measurement following standard protocols outlined by McKenzie (2012). For example, the percent of class intervals students spent in each lesson context were calculated for each lesson and a mean percentage score computed over the course of the 24 (middle) or 30 (elementary) observed lessons.

Results

Model Benchmarks

The middle school teacher met all eight (four teacher, four student) benchmarks in each session taught with ratings of 'ok' on 41% of items and 'very well' on 59%. The elementary teacher was rated 'ok' or 'very well' on model benchmarks in all but three lessons. Thus, benchmark percentages for the elementary teacher were rated as 'not at all' for 1.77% of items, 'ok' for 13.02%, and 'very well' for 85.21%.

Accelerometry

At the middle school, boys had significantly higher MVPA ($F(1, 76) = 36.24$, p = .000, $\eta p^2 = .32$) and VPA ($F(1, 76) = 29.37$, p = .000, $\eta p^2 = .28$) than girls (see Table 1). The same results were found from the elementary school data, with boys accumulating significantly higher MVPA ($F(1, 94) = 23.66$, p = .000, $\eta p^2 = .20$) and VPA ($F(1, 94) = 11.90$, p = .001, $\eta p^2 = .11$) than girls (see Table 1).

Lesson Context Data

At the middle school, 44.68% (*SD*=7.30) of lesson time was game play, 25.03% (*SD*=4.72) skill practice, with the remaining time comprised of 15.75% (*SD*=4.80) management and 14.53% (*SD*=4.80) knowledge. At the elementary school, slightly less lesson time, 42.22% (*SD*=4.91), was game play, with 22.25% (*SD*=5.18) skill practice, 16.77% (*SD*=4.29) management time and 18.76% (*SD*=5.15) knowledge (see Table 2).

Discussion

Results of this study indicate that when two teachers implemented basketball lessons using the TGM, students fell short of the national PA recommendations (i.e., 50% of lesson time spent in MVPA). This is commensurate with MVPA data from previous research on basketball lessons in PE measured using pedometers, particularly for game-focused lessons where students' MVPA was 28% (Brusseau & Burns, 2015). In skill-focused lessons, students only gained 17.5% MVPA, suggesting that lessons with greater lesson time attributed to game play, such as the 42-45% observed in this study, can assist students in meeting national recommendations for MVPA. However, previous research by Smith et al., (2015) and Harvey et al, (2015b) also using accelerometry indicated that male and female middle school-aged students taught via TGM in soccer and rugby (Smith et al., 2015) and field hockey (Harvey et al., 2015a) contexts may, indeed, meet

these recommendations. There may be a number of reasons for these disparities. First, the type of accelerometer used in Smith et al., (2015) differed from this current study. Moreover, the cut off points utilized in that study differed from those in the current study, and it has been well reported that caution should be applied to interpretations between cut-points employed and accelerometer brands. For example, Welk et al., (2012) demonstrate the difference between accelerations and activity counts from the Actigraph and RT3 accelerometer devices due to filtering and scaling of acceleration signals used by the different manufacturers. Furthermore, the nature of the game was different. In this study we utilized basketball, and, in particular, a modified version of basketball where the main game form was a half-court game, which did not involve a transition where, we would argue, students could have possibly accrued higher levels of PA. Research with elite junior male players, also using accelerometers, has shown that greater PA from engaging in a 5 vs. 5 full-court game when compared to a 5 vs. 5 game which took place on a half court (Mongomery, Pyne, & Minahan, 2010).

In addition, results of the current study are commensurate with time motion analysis of men's basketball games, which also demonstrate that 60% and 15% of time is spent in low-intensity activity and high intensity activity (McIness, Carlson, Jones, & McKenna, 1995). In contrast, research in PE settings using heart rate monitoring by Slingerland et al. (2014) found that periods of game-based activity without active supervision or teacher intervention yield approximately 70% MVPA for the participants. However, these authors noted the likely ceiling effect of continuous game play on MVPA, suggesting it would be difficult to attain 100% MVPA. Moreover, while simply playing games could potentially increase PA, this would likely not result in student

learning. Striking a balance between productive PA and student learning when utilizing a GCA such as the TGM is therefore needed (Harvey et al., 2015b; Miller et al., 2015, 2016). While the inherent nature of the TGM focuses on learning in small-sided conditioned games and skill drills in small groups, planning lessons with MVPA objectives alongside other PE learning outcomes is necessary for teachers (Fairclough and Stratton, 2005). Within TGM lessons, short 30-second small-group discussions using pre-planned questions (which can also be conducted while transitioning to play other teams), making activities fun, and planning for individual differences such as organizing games by gender and/or ability level (Van Acker, et al., 2010), etc. may assist teachers in attaining PA recommendations while maintaining the focus on the achievement of other student learning outcomes (Miller et al., 2015, 2016), particularly if equitable participation is to be encouraged.

Findings in the current study did, in fact, show an inequitable participation pattern, with boys having significantly more activity time than girls. This was in contrast to the recent GCA study of Van Acker et al., (2010) who showed that girls were more active than boys in korfball, a modified version of basketball. However, these authors used heart rate monitoring, where girls typically show higher levels of PA due to having slower heart rate recovery (Smith et al., 2015). Notwithstanding measurement issues, one strategy for teachers to utilize in order to encourage greater equitable participation may be using additional game modifications. A further suggestion may be to allow the students themselves to self-select into their own teams for game play at the beginning of the unit. This is suggested as an alternative to girl-only games, as Slingerland et al., (2014) previously noted that girls' activity patterns did not differ when girls played in

both co-educational or single-gender games. Whatever the modifications, the teachers need to be purposeful with that modification or strategy and emphasize its importance, thus attempting to decrease the gap between boys' and girls' activity levels.

In addition to difference in activity patterns between genders, we also noted differences in activity by school level. This may not be surprising given that both groups were taught the same lessons from Mitchell et al., (2006), although modifications were made to ensure that content was more developmentally appropriate for the elementary students. Notwithstanding this fact, the maturation levels of the middle school students may have contributed to their ability to assimilate the content presented to them even though it was both groups of students first exposure to the TGM. In addition, the fact that the elementary school teacher had to deal with school delays that shortened some of the lessons may also have been a factor in these findings as the teacher still worked through the normal game-skill-game lesson structure but still had to manage transitions between these and explain and demonstrate the skills drill for that day to students.

One positive finding from this study was that a large proportion of the MVPA gained by students was in the form of VPA (Harvey et al., 2015). Indeed, we noted that up to two-thirds of the MVPA gained by students, both boys and girls and in both elementary and middle school contexts, was in the form of VPA. In consideration of the lesson time, these results indicate that the students spent between 5 and 7 minutes of lesson time in VPA. In the context of this current study, for the middle schoolers, the TGM basketball sessions could provide between 25-35 minutes of that activity over the course of one week. The importance of vigorous activity has been somewhat ignored in the context of PA recommendations in PE, although other guidelines, such as those from

the CDC (2008) and UK DoH (2011) indicate the significance of VPA. It is our contention that these high levels of VPA were a consequence of the context of the games and skill drills within the TGM unit that focused primarily on 'the game', and actions required in the game, such as cutting to open space, dribbling, passing and shooting, all of which require the utilization of large muscle groups (Fairclough & Stratton, 2005; Harvey et al., 2015a).

Notwithstanding this positive finding, we acknowledge that a lot of lesson time was not spent in MVPA although students were active in learning content for the majority of the lesson. The lesson context data revealed that while 42-45% of time was spent in game play and between 22-25% in skill drills, between 30-35% of lesson time was spent managing or providing knowledge to the class. This was despite the utilization of management routines, such as home courts and teams. Although the skills drills were complex to explain, setting up one group as the demonstration group ahead of time and then using a 30-second show and go would have been helpful in reducing this time in large group instruction. Thus, when utilizing a new model such as the TGM, teachers must plan knowledge and management time so that time in games and skill drills can be maximized and students gain enough time to learn content and be physically active.

We can point to several strengths of the current study. First, an objective measure of PA was utilized alongside the inclusion of lesson context variables. Second, we examined VPA as well as MVPA, while also comparing responses from boys and girls and students from different school levels, previously not seen in the GCA literature on PA. A final strength was that no specific PA targets and tactics to increase PA were provided to the teachers.

This study had limitations that should be addressed in future research. First, while the sample size in the current study was an improvement on that seen in the previous GCA research on PA, further increases are required to be able to generalize the current findings. Second, it utilized a non-experimental design, which has been a common trend in research focused on the impact of national PA guidelines (Li et al., 2016). Li and colleagues suggest that even with a small number of classes such as in this study, researchers would be able to utilize experimental designs to detect differences between groups. In the case of the current study, for example, some groups may have followed their normal unit of basketball but with a different teacher to the experimental classes to act as a comparison group to classes where the teacher employed the TGM. Moreover, this study did not examine whether students improved their psychomotor skills and/or game performance while meeting the 50% goal, and the likely trade-offs that may occur due to the emphasis on time spent in skills drills/game play within TGM lessons (Li et al., 2016; Miller et al., 2016). In addition, utilization of subjective measures such as motivation surveys alongside objective measures may also move this research forward (Smith et al., 2015).

Conclusions

TGM lessons provide a context where students can accumulate VPA consistent with national PA recommendations. More delineation between MVPA and VPA should be present in the PE literature. However, teachers must continue to lesson activities such as modified games and skill practices to enable equitable PA participation. Future research may also consider employing an experimental design alongside additional dependent measures to show the development in psychomotor skills, game performances,

and/or motivational profiles to complement the examination of PA. These studies would provide much needed evidence that skill/game learning goals and public health goals are two sides of the same coin and need not be mutually exclusive when a teacher employs a specific model such as the TGM (Harvey et al., 2015b).

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584 *Table 1*: Overall percentage MVPA and VPA (Mean ± SD) according to school level and
585 gender

School	Gender	% MVPA M (±SD)	CI (95%)	% VPA M (±SD)	CI (95%)
Middle	Girls	25.14 (±6.16)	23.19-27.08	15.47 (±5.10)	13.79-17.14
	Boys	34.04 (±6.88)	31.83-36.26	22.37 (±6.14)	20.46-24.27
Elementary	Girls	23.03 (±6.76)	20.93-25.14	14.33 (±5.59)	12.55-16.10
	Boys	29.73 (±6.53)	29.99-31.47	18.33 (±5.58)	16.86-19.80

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588 *Table 2*: Lesson Contexts (Mean ± SD) according to school level

Lesson Context	Middle School M (±SD)	Elementary School M (±SD)
Management	15.75 (±4.80)	16.77 (±4.29)
Knowledge	14.53 (±3.96)	18.76 (±5.15)
Skill practice	25.03 (±4.72)	22.25 (±5.18)
Game play	44.68 (±7.30)	42.22 (±4.91)

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