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EFFECTS OF A TEACHING GAMES FOR UNDERSTANDING PROGRAM ON PRIMARY SCHOOL STUDENTS' PHYSICAL ACTIVITY PATTERNS

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Abstract:
The promotion of regular exercise and the adoption of lifelong activity habits is undoubtedly one of the primary goals of school Physical Education (PE). To this direction, game-based PE teaching approaches are utilized by practitioners as a means for both launching students' in-class Physical Activity (PA) levels and promoting wider-base curriculum learning outcomes. As an approach of this kind, the Teaching Games for Understanding (TGfU) model is widely used as a game-based approach aiming at developing students' tactical skills and knowledge. Up to nowadays, only a limited amount of research has tested the impact of TGfU on students' PA levels during PE instruction time. Therefore, the aim of the present research was to evaluate the effects of a TGfU intervention program on primary school students' patterns of PA. Sixteen third and fourth grade students (mean age=9.2 years, SD 0.7) from two public schools in Athens, Greece, participated in a TGfU intervention program, that took place during their regularly planned PE classes. Students' PA levels were assessed at baseline and six-weeks follow-up, within a 10-minute four vs four handball game. PA measures were obtained both quantitatively by using pedometers (steps per minute) and qualitatively through direct observation with the System for Observing Fitness Instruction Time (SOFIT). The comparison of students' pre-and-post measures showed that although students' movement intensity was higher at the end of the intervention, their PA behaviors did not differ significantly between the two time points. These findings were attributed both to the development of students' game skills and competence and the short duration of the evaluation period. Results suggest that

judgments about the health-related usefulness of the TGfU model should be based on multiple-source and long-duration assessment procedures.

Keywords: Teaching Games for Understanding (TGfU), System for Observing Fitness Instruction Time (SOFIT), Physical Activity, Physical Education

1. Introduction

The promotion of regular exercise and the adoption of lifelong activity habits is undoubtedly one of the primary goals of school Physical Education (PE). Since students spend a significant amount of time at school, it is important for PE teachers and other stakeholders (i.e. school directors, district authorities, curriculum developers) to recognize that children should be given various opportunities to feel competent during PE lessons and stay physically active for more than the half percentage of lesson time. By referring to current physical activity (PA) guidelines, many PE researchers and sport pedagogues have concluded that school PE has failed to meet public health related goals, since either lesson time and/or frequency is continuously decreasing, or PA interventions have narrowed their focus on fitness and high intensity protocols, without considering wider PE pedagogical objectives (Fairclough & Stratton, 2005a; Trost, 2004). The latter are of major importance since all students cannot be treated as a uniform group which shares common behaviors, or bears similar experiences. Student physical and personal characteristics (i.e. somatometric indices, age, sex) and other background variables (i.e. previous experience, personality traits, socio-economic status), affect the way each student approaches the content of the lesson and gets involved in its activities.

Relevant research has shown that elementary school students seem to spend more time in moderate-to-vigorous physical activity (MVPA) during PE lessons compared to secondary school ones (Fairclough & Stratton, 2005a), while students with higher levels of motor skill competency seem to remain more active throughout the lesson in relation to their less skilled classmates (Specato, Gabbard & Valentini, 2013). Furthermore, girls seem to adopt a spectator-player stance during PE games, in relation to boys' more active game-behaviors (Gutierez & Garcia – Lopez, 2012), and students with higher perceived competence (Slingerland et al., 2007) or students that experience autonomy supportive lesson approaches (How, Whipp, Dimmack & Jackson, 2013) are benefited more in terms of their in-class PA patterns. Overall and especially at younger ages, students tend to participate more actively in PE lesson activities that are based on

enjoyment, personal interest and pure satisfaction (Hager, Hardy, Aldana, & George, 2002).

The above reported findings highlight the importance of lesson planning and adjustment to students' interests, all with a focus on allocating quality lesson time both to health and behavioral goals. Interventions carried during the last decade have proved that students are more active during game activities than within activities that are organized around skill practice (van Acker, Carreiro Da CostaI, De Bourdeaudhuij, Cardon & Haerens, 2010). Indeed, game-based approaches to PE teaching allow physical educators to differentiate the learning content to meet students' individual needs and thus provide more opportunities for intensified lesson engagement. Especially, when games are modified to meet context specific pedagogical principles, the learner is put at the center of the process, tends to perform more actively, and reacts with heightened enjoyment and personal interest (Bunker & Thorpe, 1982; Hagger, Chatzisarantis, Biddle & Orbell, 2001).

Given the beneficial effects of moderate-to-high PA on students' psychomotor and academic achievement (Dania & Karteroliotis, 2016), researchers from the field of PE and sport call for game-based teaching approaches that could both launch students' in-class PA levels and promote wider-base curriculum learning outcomes. As an approach of this kind, the Teaching Games for Understanding (TGfU) model is used by practitioners as a nonlinear pedagogical approach that utilizes the context of game play as a means for developing students' tactical skills and knowledge, while engaging them in short bouts of physical activity (Butler, 2006; Mitchell, Oslin, & Griffin, 2013). Unlike the technique-oriented approach, TGfU contributes to improving students' tactical awareness and performance (Kirk & MacPhail, 2002), together with their feelings of autonomy, competence, and self-efficacy within small-sided games (Mitchell et al., 2013). The basic distinctive feature of TGfU is that students understand "what" to do before learning "how" to do it and appreciate the value of those skills needed to sustain their flow of performance.

However, even though this knowledge and understanding has proven beneficial in terms of enhancing students' motor and socio-cognitive abilities (Blomqvist, Vänttinen, & Luhtanen, 2005; Holt, Stream, & Garcia Bengoechea, 2002; Mandigo, Holt, Anderson & Sheppard, 2008), there is still dearth of evidence regarding the relationship between the adoption of the TGfU approach and possible changes in students' PA levels (Harvey & Jarrett, 2014). Based on the above, the aim of the present study was to evaluate the effects of a TGfU intervention program on primary school students' patterns of PA, the latter being recorded both quantitatively with the use of pedometers and qualitatively by the System for Observing Fitness Instruction Time (SOFIT)

(McKenzie, Sallis & Nader, 1991). Specifically, we inquired how PA indices of primary school students who participated in an eight week TGfU intervention program would show changes in time spent on moderate-to-vigorous physical activities, as a result of the program.

2. Materials and Methods

2.1 Participants and Context

The study participants were 91 third and fourth grade students (mean age=9.2 years, SD 0.7) from two public schools in Athens, Greece, already divided in four separate PE classes, with approximately 20 students per class. Both schools were experimental pedagogy schools, in the sense that they welcomed and supported innovations and educational research. The study was a part of a wider professional development partnership between the two schools' PE teachers and the Sport Pedagogy Laboratory of the University of Athens, Greece. However, due to a lack of funding, the sample size was reduced to sixteen participants (four participants per class), who were selected as target-students. According to the research protocol, these students would be measured and observed in terms of their PA both before the beginning and at the end of an eight-week TGfU intervention program. Informed consent was received from all participants, together with a formal approval from both schools' principals.

Both schools' PE teachers were trained in the use of TGfU and they had already applied it as a teaching approach in their everyday practice. However, since the primary goal of the school-university partnership was the development of students' game competence and lesson attitudes, the content of the TGfU intervention units was not designed with a focus on PA promotion. Similar with Harvey's research (2009, p.7), we wanted students "to get the game right so that they could think more and within the game", while experiencing challenge and enjoyment.

All TGfU units were taught in outdoor spaces, four times per week and within regular PE classes, with each lesson lasting 35-45 minutes, conditions that are typical of primary schools in Greece.

2.1 The Intervention Program

The intervention program consisted of a series of fourteen invasion game-units, which were implemented by utilizing the TGfU approach. Based on Metzler's (2000) guidelines, the general format of all units was designed according to the following scheme: a) students' introduction to a tactical problem within an initial game form, b) use of questioning and guided discovery techniques by the teacher, c) skill development

practices (when judged appropriate), and d) final game form. Changes to game rules, conditions and equipment were made according to each class's demands and all game-activities were modified to students' developmental level and abilities. Tactical problems were introduced in a sequential order in terms of their complexity, so that an in-depth coverage of concepts and game strategies could be achieved. Outdoor yards were divided into multiple play areas, allowing students to play in small, equal teams simultaneously.

In both schools, video observations and recordings of teachers' instruction with TGfU were made by expertly trained observers, to ensure teaching integrity with the new approach. The use of Turner and Martinek's (1999) validation protocol proved that our PE teachers utilized the TGfU approach for more than 80% of their lesson time. All PE classes were co-educational and did not share any activity space with others. However, since all lessons were made outdoors, many factors interfered with lesson flow and hindered the 100% fidelity of the approach. Time-consuming explanations of lesson rules that were not heard, re-organization of displaced equipment due to other students' passing from the courtyard in their way to school buildings, unstable weather conditions, were some of the often-recorded causes of PE teachers' distraction of attention.

2.2 Data Collection

According to the study protocol, data regarding students' patterns of PA would be collected before the beginning (pre-test) and at the end of the intervention program (post-test) within a 4 vs 4 TGfU handball game, which would be video-recorded and assessed for each PE class separately. Since all units were taught outdoors, only a ten-minute duration was scheduled for PA assessment to minimize the chances of possible lesson interferences. Within the handball game, the four target students of each PE class played against four other classmates, who were not included in the study sample. Due to lack of financial support, Garmin Vivofit pedometers were used to measure the PA only of the target students. As soon as students were given instructions regarding the rules of the game, pedometers were put on and the game started. During the last five seconds of the game, the PE teacher began a final countdown and students stopped in place. The number of steps each student achieved during the game was divided by the 10 minute duration of the game to provide a step-per-minute (SPM) index of his/her PA (Graser, Pangrazi & Vincent, 2009).

However, since pedometers measure only the movement dimension of PA (Fairclough & Stratton, 2005b), our students' PA behavior was also assessed with the System for Observing Fitness Instruction Time (SOFIT) (McKenzie, Sallis & Nader,

1991). SOFIT is an interval recording system that can capture both student PA levels and other contextual variables that possibly impact them, such as lesson content and teacher behavior (McKenzie & van der Mars, 2015). Since the assessment context of the present study was a TGfU game and not the whole PE lesson, only the first SOFIT coding phase was used. This phase involved the observation of students' PA levels, which were coded as 1=lying down, 2=sitting, 3=standing, 4=walking and 5=very active (McKenzie & van der Mars, 2015).

Students' patterns of PA were recorded during pre-and-post measurements by two expertly trained observers and with the use of standardized procedures outlined in the SOFIT training manual. Particularly, a lead observer coded all videotaped TGfU games and a second observer coded randomly selected video excerpts to ensure observer accuracy. Accepted percentages of 80% interobserver agreement were obtained (van der Mars, 1989), a fact that provided feedback regarding reliability in PA coding.

Momentary time sampling was used, which meant that 10 seconds of observation were alternated with 10 seconds of recording. This meant that for every student three observations were obtained each minute, adding to a total of 30 observations per student during the ten-minute duration of the game. Both during the pre-and-post assessment periods, every student's moderate to vigorous (SOFIT level 4) and vigorous PA behaviors (SOFIT level 5) were recorded by summing the proportion of time spent during the handball game in walking and very active activities (i.e. running, jogging, skipping, hopping). Only the scores of the lead observer were used for the analysis of the SOFIT data.

2.3 Data analysis

Data concerning changes in students' patterns of PA between the pre-and-post measurements were analyzed by using paired samples t-tests. Students' Steps per Minute (SPM) and percentages of lesson time spent in Moderate to Vigorous PA (MVPA) were set as dependent variables. The alpha level was set at .05.

3. Results

Means and standard deviations for the pre-and-post measurement scores of SPM and MVPA are depicted in Table 1.

Table 1: Descriptive Statistics and t-test Results for SPM and MVPA

	Pretest		Posttest			95% CI for Mean Difference		
Outcome	M	SD	M	SD	n		t	Df
SPM	133.15	78.61	207.53	70.34	16	-85.18, -63.57	-14.66*	15
MVPA	87.68	8.86	90.4	6.95	16	-9.49, 4.07	-8.52	15

* $p < .05$

As displayed in Table 1, results showed that statistically significant differences were recorded at the .05 significance level between the pre-and-post measurement scores of students' SPM. Particularly, at the end of the intervention program students seemed to be more active within the handball game in terms of their recorded steps.

With reference to time spend in MVPA; results showed that students' patterns of PA behavior remained unchanged between the pre-and-post measurements, as these were recorded by the SOFIT instrument within the 10-minute duration of the TGfU assessment game.

4. Discussion

The aim of the present study was to examine the effects of a TGfU intervention program on primary school students' patterns of PA, the latter being recorded both with the use of pedometers and the SOFIT observation instrument. Pre-and-post measurements were administered to all students, to determine changes in their movement intensity (SPM) and activity behavior (MVPA), as a result of the program.

Regarding SPM, it was found that students' recorded amount of PA significantly improved in the post-test measurement, in relation to the pre-test one. This finding was somewhat expected, since small-sided games increase students' opportunities for active participation and motor engagement and help them maintain high levels of PA (Gabbett, Jenkins & Abernethy, 2009). Similar findings are reported in relevant interventions that studied the impact of various game-based approaches on students' PA levels (Cullpepper, Tarr & Killion, 2011; Jago et al., 2009; van Acker, Carreiro Da CostaI, De Bourdeaudhuij, Cardon & Haerens, 2010; Yelling, Penney & Swaine, 2000), by using objective measurement instruments such as heart rate monitors, accelerometers or pedometers.

By commenting on the impact of the present program, it seems that students' participation and involvement with the TGfU approach brought positive changes in their game performance, which in return affected the number of steps they took to move within the game space. Even though the assessment context was a 10-minute

invasion game and not a 35-minute PE lesson students' SPM indices raised to higher levels. This finding was indicative of the TGfU approach since participation in games does not automatically yield enhanced PA. Roberts and Fairclough (2011) state that within direct instructional approaches, many students are left for a long time sitting out on the side-lines, although participating in team games. The modified and small-team structure of games used within TGfU increase students' prolonged engagement with locomotor activities such as running, dodging, speeding, etc., which involve large muscle groups and help sustain high levels of PA (Gabbett, Jenkins & Abernethy, 2009). Even though the focus of the present intervention program was not on PA promotion but rather on supporting students in terms of game-play and learning, it was encouraging to find that students were more active at the end of the intervention, without having compromised other lesson objectives. Movement competence, conceptual understanding and social interaction, although not quantitatively measured, were often traced as qualitative lesson outcomes in the SOFIT notes.

Harvey, Song, Baek and van der Mars (2015) agree that the in-depth coverage of lesson content within TGfU raises the opportunities for skill learning and PA goals to be achieved simultaneously. Relative research has also proved that the student-centered and self-determinated environment of game-based units lays the foundation for the development of PA in students of various ages and skill levels (Hastie & Trost, 2002; Lonsdale, Sabiston, Raedeke, Ha & Sum, 2009; Mandigo et al., 2008; Smith, 2010; van Acker, Carreiro Da CostaI, De Bourdeaudhuij, Cardon & Haerens, 2010). A major conclusion drawn from studies of this kind is that long time periods should be invested in intervention programs for their cumulative effects to be evident in students' progress.

In the present case, the short duration of the study was not enough for all aspects of PA to be significantly affected. As far as our sample's MVPA indices were concerned, our results showed that SOFIT scores were somehow stable between the two measurements, a finding which we attribute mainly to the short duration of the assessment game. According to McKenzie (2012), SOFIT may underestimate PA levels since it is a momentary-time sampling instrument that captures every 20 seconds (10 secs of observation and 10 recording) only the final second of a student's observed behavior. In the present case, the ten-minute duration of the handball game was not sufficient for an in-depth observation of students' PA patterns. Previous study results that have used SOFIT to assess the changes student's MVPA after the implementation of intervention programs (Fairclough & Stratton, 2005a; McKenzie et al., 2004; Verstraete, Cardon, De Clercq & De Bourdeaudhuij, 2006), confirm that statistically

significant changes in MVPA are recorded when multiple PE unit observations are scheduled within longer-program durations.

However, even though we did not come up with statistically significant MVPA changes, we evidenced no decrease in our sample's MVPA behavior patterns. The fact that all students, both in pre-and-post measurement, engaged in MVPA for more than 50% of the game time was a very welcome finding, considering our study's lack of financial support and facilities. The adjustment of the TGfU program to both schools' contextual limitations seemed to sustain students' innate desire for game play, something that we conceive as a finding of major educational importance. However, the small size of our sample limits the validity of such claims and increases the need for further inquiry on the relationship between TGfU and PA learning outcomes.

5. Conclusion

The present study showed that the implementation of TGfU intervention programs within primary education facilitates students' development and performance in terms of their in-class PA levels. However, before such claims are supported with certainty, long-time quantitative and qualitative research is needed since multiple variables can interfere with the process and affect its outcomes.

6. Recommendation

When games are used as the organizing center of PE learning, high amounts of MVPA can be met. Future studies should build on this assertion for the design and implementation of long-time PA interventions.

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