Original Article

The role of physical education in the achievement of international recommendations: A study based on pedagogical models

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ABSTRACT

Physical activity (PA) has been associated with numerous benefits. The World Health Organization recommends practicing 60 minutes of Moderate to Vigorous PA (MVPA). However, young people are not achieving these recommendations. Physical education, due to their purely motor character has been highlighted as a change agent. Traditional sport teaching has not attracted young people to the achievement of these objectives. Thus, new models, such as Sport Education, have been proposed to increase the students' interest. The objectives of this study were to evaluate the PA in two pedagogical models in PE lessons, as well as the differences in the teaching process phases. In addition, there were checked if there existed PA differences in terms of gender and to determine the contribution of each model to the MVPA in primary education students. The results showed that Sport Education helped to the achievement of a greater MVPA percentage than the Direct Instruction in both genders, with a varying contribution of the different phases.

Keywords: Physical activity; Accelerometery; Gender; School.

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INTRODUCTION

Practicing physical activity (PA) regularly is a key health-component in a healthy lifestyle and is associated with numerous long and short-term benefits (Poitras et al., 2016). For that reason, and due to the evident benefits of practicing PA, the increment of Moderate-to-Vigorous PA (MVPA) has been highlighted as a health public priority (USDHHS, 2010).

Thus, international recommendations note that youth people and adolescents should participate in, at least, 60 MVPA minutes each day including vigorous and strength activity three times a week (WHO, 2012). Unfortunately, only 42% of children between 6 and 11 years and the 8% of adolescents between 12 and 19 years achieve these recommendations (USDHHS, 2008; Troiano et al., 2008). Specifically, in girls, these percentages are lower (Torres-Luque, Calahorro, López-Fernández and Carnero, 2014; Brascum and Bhochhibhoya, 2016). These data are not positive to create healthful lifestyles.

Traditionally, the scholar context has been considered the master key to promote PA in youth people (Ridgers, Stratton, Fairclough, and Twisk, 2007). Besides, it has been recommended that scholar curriculum should contribute to the achievement of, at least, half of daily recommendations, that is to say, 30 MVPA minutes (Pate and O'Neill, 2008). Generally, PA in school implies between 30 and 40% of total daily MVPA in youth people (Fairclough, Butcher, and Stratton, 2007; Gidlow, Cochrane, Davey, and Smith, 2008), becoming school a factor that could contribute to palliate the lack of achievement of international recommendations and decrease the inactivity among students (Mooses et al., 2017).

Recesses have been highlighted by their contribution in daily PA, providing the 16% of the total PA in school (Ridgers, Saint-Maurice, Welk, Siahpush, and Huberty, 2011). Besides, the USDHHS (2010) emphasized physical education (PE) as a key factor for students to participate and create healthy habits due to their contribution to daily PA (Meyer et al., 2013). That is because PE is the only subject in which the main objectives include MVPA participation, the development of motor skills and the focus on the development of active lifestyles (Smith, Monnat, and Lounsbery, 2015). PE is especially important for those students that are not active, because it is the only place in which these students can experience high intensity PA (Sallis et al., 2012).

Recent research has revealed that youth people remain less than 45% of total PE time in MVPA, not meeting international recommendations of 50% of the lesson time in MVPA (Fairclough and Stratton, 2006; Hollis et al., 2016; Pate et al., 2006). To maximize MVPA in PE lessons, teachers play a central role (Smith et al., 2015) because some sport-based programs are not attracting students in the achievement of appropriate PA levels (McKenzie et al., 2006).

One of the factors associated to this lack in the consecution of international objectives is the constant application of multi-activity units, which has triggered to the prevailing use of Direct Instruction (DI) in the practice of many PA teachers (Ennis, 2014; Kirk, 2013). Recently, Roberts and Fairclough (2011) highlighted that high levels of inactivity in DI are due, in part, to the teacher instruction time, the predominance in the practice of games with full versions of the sport, which makes students that are not playing to wait for their turn to play.

Therefore, an improvement in the PE quality is necessary because it is the only opportunity to be active for many students (Mooses et al., 2017). For this reason, a modification of the teaching strategies could

increment PA levels (Slingerland and Borghouts, 2011). In this sense, new pedagogical models have been developed in an attempt to generate an attractive and motivational sport practice to youth people.

In this area, a model that has aroused the interest of researchers and teachers is the Sport Education (SE) model, which was proposed in an attempt to all students living an authentic sport experience in PE. SE works with the use of roles, the affiliation to a team, and the record keeping during a season that culminates with a final event (Siedentop, Hastie, and van der Mars, 2011). That is, SE uses the characteristics of elite sport, but adapts them to the school context. This model has been widely investigated (Evangelio, Sierra-Díaz, González-Víllora, and Fernández-Río, 2018) and has generated a growing interest in terms of PA in recent years, proving to be an adequate pedagogical model to achieve MVPA levels greater than 50% in PE lessons (Hastie and Trost, 2002; Pritchard, Hansen, Scarboro, and Melnic, 2015; Ward et al., 2017). On the other hand, although with lower PA levels, Perlman (2012) and Rocamora et al. (2019) also pointed out that SE was more adequate in terms of PA than traditional model mainly based on the DI teaching style.

Despite the recent evidence of the effectiveness of SE in terms of PA, to date, none of the studies carried out in this line has provided the contribution of PA of the PE lessons based on different pedagogical models to the daily official international recommendations. Therefore, the objectives of this study were: (1) evaluate PA objectively measured with two pedagogical models; (2) determine if there are differences attending to the phase in the teaching-learning process; (3) determine possible differences in terms of PA associated with gender; and (4) determine the contribution of each of the pedagogical models to the daily MVPA.

METHOD

Participants

A total of 84 students (43 boys and 41 girls) of fifth and sixth grade (11.2 years, SE = 0.66) in a coeducational public school in Cuenca (Spain) participated in the study. The students attended 15 PE lessons three times per week with a duration of 45 minutes each one. Real time in practice was reduced due to hygiene and transition issues between the main class and the gymnasium. Two basketball interventions were carried out by the first author. One of them, using SE as the pedagogical model (with two classes: one fifth grade and one sixth grade), and the other one using DI (with two classes: one fifth grade and one sixth grade). Students had previous experience with DI, however, they did not have with SE. The teacher-researcher was a PE graduate and possessed adequate basketball knowledge (coaching and playing) as well as experience using both pedagogical models. During the models' implementation, the teacher was supervised by the rest of the research team.

Measures

Anthropometry

Before starting the intervention, students were measured and weighed twice with an interval of five minutes between each measurement. The weight was measured using a digital scale with integrated printer (Tanita DC- 430 MA S) with the students slightly dressed and without shoes. The height was measured with a stadiometer (SECA Model 213), with the children leaning against the wall without shoes, to align the spine with the stadiometer. The head was positioned with the chin parallel to the ground. Body Mass Index (BMI) was calculated as BMI = kg/m^2.

Physical activity (PA)

PA data were collected by using accelerometery. The model ActiGraph GT3X was used (ActiGraph LLC, Pensacola, Florida). This device provides the measure of the intensity and duration of PA in counts. It was

placed in the hip on the right side, held by an elastic band. The data was downloaded with the ActiLife 6.0 software.

Accelerometers were programmed in 100 Hz to collect the PA of each lesson and the data were downloaded in 1-second epoch. The cut points of Evenson, Catellier, Gill, Ondrak, and McMurray (2008) were used to determine Sedentary PA (≤ 100 counts / minute), Light PA (101 - 2295 counts / minute), Moderate PA (2296 - 4011 counts / minute), Vigorous PA (≥ 4012 counts / minute) and MVPA (MVPA was calculated as the sum of Moderate PA and Vigorous PA).

Before starting the interventions, the teacher explained to the participants how to position and adjust the accelerometers. Every day, the students put on the accelerometers when they arrived at the gymnasium and they deposited them at the established point when the class finished.

Sport Education and Direct Instruction unit design

Both SE and DI followed a learning process in three phases: (1) technical development of basic skills in basketball (lessons 1-9), (2) competition phase (in SE)/ application of skills to game situations (DI) (lessons 10-14), and (3) final phase and festivity (in SE)/ final tournament (DI) (lesson 15). The learning objectives were similar within each of the models (i.e., passing or throwing to the basket). However, the main difference was that the students involved in the SE followed a teaching process based on the six key characteristics proposed by Siedentop et al. (2011): affiliation, season, formal competition, final phase, festivity, and record keeping).

Sport Education Model

Mixed teams (skill and gender) in which each member performed a role other than player were created. The students gradually directed the lessons during pre-season, selecting games from a dossier that they received during the first lessons. Besides, during pre-season, they performed friendly matches that served to help referees for the competition phase. All the teams played matches during the competition phase, which finished with a final phase and an awards ceremony.

Direct Instruction

The activities were mainly focused in the technical development. Teams were selected for the teacher and changed daily. The teacher also controlled task selection. Once the students controlled the technical skills, they practiced them in game situations, finishing the unit with a tournament between teams.

Ethics

Before beginning the study, the University of Castilla-La Mancha, the management team and the legal tutors of the students gave their consent to participate in the study.

Data analysis

The SPSS statistical software (v. 24.0) for Windows (SPSS, Inc., Chicago, IL) was used to data analysis. The Kolmogorov-Smirnov test showed normality in the dependent variables, which allowed to the use of parametric statistics. BMI was used as a covariate to control the influence of this variable on PA levels in the participants. Multivariate analysis controlled by BMI and lesson duration in minutes (MANCOVA) were used to evaluate the PA levels. MVPA were transformed to the percentage of achievement of the official recommendations based on the 60 minutes proposed by the World Health Organization (WHO). The lessons were divided by phase (three phases) to evaluate the MVPA in each one throughout the unit. Finally, the effect size was calculated. Cohen (1988) established the following effect sizes: small (0.20), medium (0.50)

and large (0.80). The level of statistical significance was established at $p \leq .05$, with a confidence interval of 95%.

RESULTS

MVPA in each pedagogical model and phase: contribution of daily recommendations

The mean by minutes of PA by pedagogical model is shown in Table 1. The students in DI had significantly higher time in Sedentary PA in comparison with the students in SE, with a medium effect size (d = 0.60). Conversely, the students in SE showed significantly higher levels in Light PA, Moderate PA, Vigorous PA and MVPA in comparison with the students in DI group with small and medium effect size.

Table 1. Comparison of Physical activity levels in Sport Education and Direct Instruction in minutes/lesson.

	SE	DI		
	M (SD)	**M (SD)**	**p**	**d**
Sedentary PA	19.15 (4.16)	21.87 (4.75)	**< .001**	0.60
Light PA	12.35 (2.55)	11.24 (2.54)	**< .001**	0.43
Moderate PA	4.86 (1.41)	4.08 (1.30)	**< .001**	0.57
Vigorous PA	8.62 (2.98)	7.79 (2.82)	**< .001**	0.28
MVPA	13.48 (3.63)	11.87 (3.57)	**< .001**	0.44

Note: PA = Physical activity, M = Mean; SD = Standard Deviation; SE = Sport Education; DI = Direct Instruction; p = Significance; d = effect size.

Table 2 shows the results of MVPA in minutes and percentage of contribution to the daily recommendations during the entire lesson plan and each of the phases. The students in the SE accumulated 13.48 minutes/lesson in MVPA, whereas the students in DI accumulated 11.87 minutes/lesson, showing significant differences with a small effect size (d = 0.44). Therefore, the lessons based on SE provided 22.47% of MVPA recommended by the WHO, whereas DI contributed to the 19.80% of the daily MVPA.

Table 2. Comparison of Moderate to Vigorous Physical activity by phases in Sport Education and Direct Instruction.

		SE	DI		
		M (SD)	**M (SD)**	**p**	**d**
Total	**Minutes/lesson**	13.48 (3.63)	11.87 (3.57)	**< .001**	0.44
	% Contribution	22.47 (6.06)	19.80 (5.95)	**< .001**	0.44
1st phase	**Minutes/lesson**	12.76 (3.20)	10.73 (2.85)	**< .001**	0.66
	% Contribution	21.27 (5.34)	17.89 (4.76)	**< .001**	0.66
2nd phase	**Minutes/lesson**	14.27 (3.97)	13.00 (3.51)	**.002**	0.33
	% Contribution	23.78 (6.63)	21.67 (5.85)	**.002**	0.33
3rd phase	**Minutes/lesson**	14.16 (4.24)	15.54 (4.27)	.176	0.32
	% Contribution	23.61 (7.06)	25.91 (7.12)	.176	0.32

Note: PA = Physical activity, M = Mean; SD = Standard deviation; SE = Sport Education; DI = Direct Instruction; p = Significance; d = effect size.

In the first phase (phase of acquisition of basic skills in basketball) the students in the SE accumulated a significantly higher average in MVPA with a mean of 12.76 minutes in MVPA, while students in DI accumulated 10.73 minutes (d = 0.66). During the first lessons, the percentage of contribution to the international recommendations were 21.27% of the total time recommended in SE and 17.89% in DI. In the second phase (phase of competition in SE and phase of application of skills in DI), the students in SE accumulated significantly higher values in MVPA that the students in DI with 14.27 minutes of MVPA in SE and 13.00 in DI (d = 0.33). Therefore, this second phase provided the 23.78% of the daily MVPA for the students in SE and the 21.67% for the students in DI. Finally, in the third phase (final phase and festivity in the SE and tournament phase in DI), there were not found significant differences in MVPA between models, with an average of 14.16 minutes of MVPA in the SE and 15.54 in DI. Thus, this final phase contributed to the 23.61% of the recommended daily MVPA for the students in the SE and to the 25.91% for the students in DI.

MVPA in each pedagogical model and phase: contribution of daily recommendations for girls and boys

Table 3 shows the results for PA in girls and boys in both models during the unit. In relation with girls, the participants in DI presented significantly more minutes in Sedentary PA than their partners in SE. However, the girls that participated in the SE accumulated significantly more minutes in Light PA, Moderate PA, Vigorous PA and MVPA than the students in DI. The boys presented similar results, being the students in SE more active than the students in DI. The effect sizes ranged from low (d = 0.18) to medium (d = 0.60).

Table 3. Comparison of Physical activity levels in Sport Education and Direct Instruction in minutes/lesson.

Types of Physical Activity	Girls				Boys			
	SE	DI			SE	DI		
	M (SD)	M (SD)	p	d	M (SD)	M (SD)	p	d
Sedentary PA	20.35 (4.00)	22.84 (4.34)	**< .001**	0.59	18.07 (4.06)	20.67 (4.88)	**< .001**	0.57
Light PA	12.22 (2.27)	11.03 (2.33)	**< .001**	0.51	12.55 (2.79)	11.42 (2.73)	**< .001**	0.40
Moderate PA	4.52 (1.37)	3.84 (1.08)	**< .001**	0.55	5.20 (1.39)	4.34 (1.45)	**< .001**	0.60
Vigorous PA	7.90 (2.24)	7.28 (2.37)	**.003**	0.26	9.16 (3.38)	8.56 (3.19)	**.048**	0.18
MVPA	12.42 (2.92)	11.12 (3.05)	**< .001**	0.43	14.37 (3.94)	12.90 (3.92)	**< .001**	0.37

Note: PA = Physical activity, M = Mean; SD = Standard deviation; SE = Sport Education; DI = Direct Instruction; p = Significance; d = effect size.

The average time in MVPA minutes and the percentage of achievement of the daily recommendations for girls in each model, as well as the phase of the unit are presented in Table 4. During the unit, the SE contributed to a significantly higher percentage time to the daily-recommended MVPA (20.70% in SE and 18.53% in DI). In the first phase, SE contributed to a greater percentage of fulfilment of the official recommendations with a 20.20% of MVPA, while the girls in DI had a 16.83%. In the second phase, not differences were found in the contribution of daily MVPA with a 21.59% for the girls in the SE and a 20.13%

for the girls in DI. Finally, the third phase contributed to a significantly higher percentage of MVPA for the girls in the DI (23.68% MVPA) than in the SE (18.95% MVPA).

Table 4. Comparison of Moderate to Vigorous Physical activity by phases in Sport Education and Direct Instruction in girls.

Phase	Minutes in PE and percentage of contribution (%)	SE	DI		
		M (SD)	M (SD)	p	d
Total	Minutes	12.42 (2.92)	11.12 (3.05)	**< .001**	0.43
	% Contribution	20.70 (4.87)	18.53 (5.08)	**< .001**	0.43
1st phase	Minutes	12.12 (2.72)	10.10 (2.49)	**< .001**	0.77
	% Contribution	20.20 (4.54)	16.83 (4.15)	**< .001**	0.77
2nd phase	Minutes	12.95 (3.15)	12.08 (2.87)	.059	0.28
	% Contribution	21.59 (5.26)	20.13 (4.79)	.059	0.28
3rd phase	Minutes	11.37 (3.05)	14.20 (3.74)	**.023**	0.82
	% Contribution	18.95 (5.08)	23.68 (6.23)	**.023**	0.82

Note: PA = Physical activity, M = Mean; SD = Standard deviation; SE = Sport Education; DI = Direct Instruction; p = Significance; d = effect size.

Table 5 shows the means in minutes of MVPA and the percentage of achievement of the daily recommendations provided by each model for the boys, as well as the phases of the unit. During the unit, the SE unit provided a significantly higher percentage of MVPA (23.95%) than DI (21.51%). In the first phase, SE provided a percentage significantly greater (22.15% of MVPA) than DI (19.33%). In the second phase, there were not found differences in the contribution of the daily MVPA with a 25.58% for the boys in the SE and 23.77% for the boys in DI. In the third phase, not differences were found in the contribution of the daily MVPA, with a 26.68% for the boys in the SE and 29.65 for the boys in DI.

Table 5. Comparison of Moderate to Vigorous Physical activity by phases in Sport Education and Direct Instruction in boys.

Phase	Minutes in PE and percentage of contribution (%)	SE	DI		
		M (SD)	M (SD)	p	d
Total	Minutes	14.37 (3.94)	12.90 (3.92)	**< .001**	0.37
	% Contribution	23.95 (6.57)	21.51 (6.53)	**< .001**	0.37
1st phase	Minutes	13.29 (3.49)	11.60 (3.08)	**< .001**	0.51
	% Contribution	22.15 (5.82)	19.33 (5.14)	**< .001**	0.51
2nd phase	Minutes	15.35 (4.27)	14.26 (3.87)	.085	0.26
	% Contribution	25.58 (7.11)	23.77 (6.45)	.085	0.26
3rd phase	Minutes	16.01 (3.56)	17.79 (4.52)	.186	0.43
	% Contribution	26.68 (5.94)	29.65 (7.54)	.186	0.43

Note: PA = Physical activity, M = Mean; SD = Standard deviation; SE = Sport Education; DI = Direct Instruction; p = Significance; d = effect size.

DISCUSSION

The purpose of this study was to objectively determine the percentage of MVPA time that PE contributes to the daily PA of girls and boys from 10 to 12 years old, using two pedagogical models: SE and DI. Besides, the possible differences in the phases of teaching within the lesson plans were assessed.

General results: comparison by pedagogical model

The results showed that students which participated in the unit with SE accumulated higher levels of Light PA, Moderate PA, Vigorous PA and MVPA than their partners in DI. Consequently, SE contributed to a higher percentage of MVPA to the official recommendations of 60 minutes of MVPA a day, contributing an average of 13.48 minutes/session (22.47% recommended daily time) in the SE and 11.87 minutes/session (19.80% recommended daily time) in the DI.

Research based on the SE in terms of PA levels has increased in the last decades. Hastie and Trost (2002) were the first in researching the PA that provided the SE with secondary students, allowing the consecution of 38.25% of the recommended time. However, they tried to create and ideal environment in terms of achieving high levels of PA with high school male students who had previously experienced teaching with the SE. Besides, they were allowed to choose the sport to practice, and this has been highlighted as a factor that could increase PA levels (Wadsworth, Robinson, Rudisill, and Gell, 2013). Furthermore, Pritchard et al. (2015) and Ward et al. (2017) showed an even greater contribution during PE lessons based on SE model. Pritchard et al. (2015) showed a contribution of the 45.33% of the minutes required, and Ward et al. (2017) a contribution of 40.86% (to compare the results of these studies, the time in PE lessons has been transformed to 45 minutes to equate the time of the lessons in the present study).

However, these studies only evaluated one pedagogical model (SE), while Perlman (2012) and Rocamora et al. (2019) assessed PA through a research design similar to the one in this study, comparing PA levels in SE and DI. On one hand, the students in the study of Perlman (2012) showed a low contribution to the international recommendations with a 7.46% of the required MVPA in the SE and 5.1% in the DI. This low percentage could be explained by the characteristics of the sample in this study, which were amotivated students and, as a result, PA levels could have been lower than with students with other motivation to PE. On the other hand, the results in the study of Rocamora et al. (2019) showed similar levels of MVPA to the results in this study, with a 20.4% of MVPA for the students that participated in SE and 19.95% of MVPA for the students who participated in DI. In the aforementioned studies, the participants did not have the opportunity to elect the sport as they did in the research of Hastie and Trost (2002). Nevertheless, in the study of Ward et al. (2017) the sport that the students practiced was CrossFit, which could be an attractive sport for students in the PE subject, being a possible factor that could increase the motivation of students and, as a result, their involvement in PA. It is important to consider the PE classes in youth people because, as recently noted, when students participate in PE the MVPA increases and the time of sedentary PA decreases (Mooses et al., 2017).

Attending to the phases, the phase of acquisition basic skills in basketball (first phase) in the SE was significantly more active than the same phase in the DI and allowed for the achievement of a higher percentage in the daily MVPA, in comparison with DI. These results may be because group work and established routines in SE allow for a more dynamic work (Hastie and Trost 2002). Nevertheless, in DI, players had to wait for the instructions of the teacher, in addition to wait for their turn in some occasions because the organization is in a great group.

In the second phase or competition phase, the results were also higher in SE. Even though the players must play roles that do not involve high intensity activities (i.e. refereeing), they compensate for this inactivity with the practice of constant matches. On the other hand, in DI, since they have not established competition routines, more time is lost during the changes of the game-rest role (Hastie and Trost, 2002). Finally, in the third phase (final phase and festivity in the SE and final tournament in the DI model) differences were not found between models. In the SE, apart from competition final phase, the award ceremony was held, so part of the lesson was devoted to low intensity PA. Conversely, in DI, the last lesson was dedicated to a competition within the group that allowed players to use the entire lesson to participate in matches. Notwithstanding, the time devoted to low intensity PA in the SE is due to the awarding of prizes, this time does not mean a loss if comparing models, since there are no significant differences between one model and another in this third phase.

Gender Physical Activity levels in Sport Education and Direct Instruction

Attending to the gender, the results showed that boys and girls that participated in the SE model were more active than girls and boys that participated in the DI. It could be because the students that participated in a lesson plan with DI, where the teacher have a central role, lost the interest for the practice of PA (Calderón, Martínez de Ojeda, and Hastie, 2013) while in the SE model, the students play a more active role in class (Farias, Mesquita, and Hastie 2015).

In the first phase, boys and girls presented higher levels of MVPA than the students in DI. Moreover, the second phase presented similar results. However, although no significant differences were found in boys in the third phase, in DI, girls were more active than the participants in SE. One possible explanation could be that girls in the SE were very involved in the organization of final event, as in the study of López-García, Sánchez-Gallardo, Burgueño and Medina-Casaubón (2018), and therefore, they accumulated low levels of MVPA. However, this is a hypothesis, future research should evaluate the time in which girls and boys are immersed in PA and in organization aspects.

CONCLUSION

This study support and expand the research based on the assessment of PA levels during the PE lessons through different pedagogical models and the contribution of these PE lessons to the international recommendations. This study shows that when focusing PE classes on different pedagogical models it is possible to find variation in the levels of PA, in this case, favouring students who participated in teaching through the SE. Besides, the results contribute to the international recommendations of the different phases in a lesson plan (between a 17.87% and a 25.91% in the DI and between a 21.27% and a 23.78% in the SE). With these results, we can conclude that student-centred approaches such as SE can contribute to the improvement of students' health during PE lessons. Besides, this kind of models can give the students the necessary tools to play in an autonomous way outside the school, favouring to the development of healthy lifestyles. However, this study has some limitations. Firstly, the sample size was short with only one school. Future studies should include larger samples, as well as the implementation of different pedagogical models (i.e. Teaching Games for Understanding and Cooperative Learning). Besides, future studies within the SE model should apply specific roles with specific functions of development of PA.

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