

Original article

Effect of an inside-outside school alternated teaching unit of knowledge of the environment for practicing physical activity: A cluster randomized control trial

Running head: Inside-outside teaching unit and physical activity

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Abstract

Purpose: To examine the effect of two physical education-based alternated teaching units on students' environmental knowledge for practicing out-of-school physical activity (PA), perceived autonomy support, self-determined and controlled motivation towards PA, intention to be physically-active, self-reported and objective PA levels, and sedentary behavior.

Method: A sample of 179 students (94 females), aged 13-15 years old, were cluster-randomly assigned to the Innovative group (two alternated teaching units for practicing PA, with one lesson inside and one outside the school grounds) or the Traditional group (a teaching unit for practicing PA, solely inside the school center). **Results:** The alternated teaching units improved students' knowledge of their environment for practicing PA, perceived autonomy, autonomous motivation, intention to be physically active, and self-reported PA during the whole week ($p < 0.05$). **Discussion/Conclusion:** The innovative program improved students' knowledge about their environment for practicing PA and self-reported PA, but did not improve objectively-measured PA levels.

Keywords: Secondary school, Physical Education, autonomy support, self-determined motivation, Trans-Contextual Model, accelerometry.

Introduction

Currently, there is strong evidence that regular physical activity (PA) is associated with many health benefits in school-aged children (Poitras et al., 2016). Unfortunately, worldwide only one-fifth of high-school students achieve the 60 minutes of moderate-to-vigorous PA (MVPA) recommended (Guthold, Stevens, Riley, & Bull, 2020). Therefore, the promotion of adequate PA levels among high-school students is an important public health challenge **which can take place** in various settings of daily life (World Health Organization, WHO, 2018). Among others, school context and specifically the Physical Education (PE) subject play an essential role in students' PA promotion (WHO, 2018).

Although many educational objectives have to be developed throughout the annual PE plan, promoting students' lifelong PA is one of the fundamental aims in most countries (e.g., Spanish Ministry of Education, Culture and Sport, 2015). In order to achieve this purpose, PE teachers need to provide students with tools for practicing PA autonomously, making them competent and transferring learning from the classroom to students' daily life (Author, 2018). A strategy for promoting this transferability of learning may be the education outside the classroom, a teaching method in which teachers relocate teaching activities from the classroom to the environment that surrounds the educational center to provide students authentic and situational PA practices (Becker, Lauterbach, Spengler, Dettweiler, & Mess, 2017; Author, 2018). Previous studies regarding education outside the classroom embedded within the school curricula, have shown to be effective in stimulating students' skills learning, as well as improving key psychological variables, such as students' autonomous motivation (Becker et al., 2017; Bølling, Otte, Elsborg, Nielsen, & Bentsen, 2018). Although education outside the classroom has been used recently to promote students' PA (e.g., Schneller et al., 2017), the systematic review by Becker et al. (2017) highlighted that more research is needed to further investigate these findings.

Furthermore, this transference of learning could be facilitated through the application of the alternated teaching units proposed by Author (2016), which are based on delivering PE lessons belonging to two different teaching units alternatively while putting them into practice. The implementation of two teaching units regarding complementary contents makes students aware that both contents are based on the same learning principles and avoids unconnected learning perceived by students in traditional and isolated units (Author, 2016). Consequently, the use of these alternated teaching units in combination with the education outside the classroom strategy could be an excellent structure of planning to increase students' out-of-school PA. Specifically, it could allow PE teachers to connect in-school PA (inside the school) with the immediate environment practice (outside the school), promoting the transference of significant learning in the PE context to students' daily life.

Additionally, understanding the determinants and factors influencing PA behavior is crucial to implement effective PA interventions for students in the PE setting (Sheeran, Klein, & Rothman, 2017). The Social Cognitive Theory (Bandura, 2004) includes health-related knowledge as a core determinant on the design of PA promotion interventions, which can be conveyed readily to students and supposes a first step toward generating a behavior change. Previous studies have shown that the students' knowledge about PA practice leads to a change in PA behavior and voluntary participation in PA (Wang & Chen, 2019). Moreover, the Self-Determination Theory (SDT, Deci & Ryan, 2020) is a theoretical framework widely used to explain the antecedents and consequences of students' motivation to engage in PA. The SDT considers motivation as a multidimensional term with different levels along a continuum according to the degree of autonomy, ranging from more self-determined (i.e., autonomous) to less self-determined (i.e., controlled) forms of behavioral regulations (Deci & Ryan, 2020). Furthermore, the SDT highlights the concept of three basic psychological needs and their satisfaction as a fundamental factor for understanding students' motivation: autonomy

(referring to the need for initiative and ownership in one's own behavior), competence (referring to the need to feel capable of carrying out a certain behavior effectively), and relatedness (referring to the need of feeling connected and supported by significant others).

According to the SDT, autonomy support is an important social context for encouraging higher levels of students' more self-determined regulations from the SDT perspective (Deci & Ryan, 2008). Specifically, teachers who support students' autonomy are favoring the satisfaction of the three psychological needs (i.e., autonomy, relatedness, and competence), and, therefore, promoting the students' most self-determined forms of motivation, while in contexts where autonomy support is not provided, these needs are thwarted (Deci & Ryan, 2020). This autonomy support in educational contexts is characterized by an environment that supports students' choice, initiation, and understanding, where students feel that they can participate in their own learning (Deci & Ryan, 2008). According to this framework, the use of an autonomy-supportive teaching style and the improvement of students' autonomous motivation are considered key determining factors related to the acquisition and maintenance of students' PA (Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Consequently, school-based interventions with the aim of promoting students' lifelong PA should be based on psychological theories that have motivation and autonomy as a core point of its tenets.

For this purpose, the Trans-Contextual Model (TCM, Hagger & Chatzisarantis, 2016) could be an ideal framework on which to base PE interventions focused on promoting motivation toward PA and PA participation out-of-school. Hagger & Chatzisarantis (2016) proposed three empirically-testable propositions to explain how teachers can encourage students' PA participation during out-of-school contexts. The first proposition hypothesizes that students' perceived autonomy support from teachers can develop students' self-determined motivation toward in-class activities, and it will predict self-determined

motivation toward similar activities within the educational context. The second hypothesizes that self-determined motivation within the educational context will predict self-determined motivation toward similar activities in out-of-school contexts. Finally, the third proposition hypothesizes that self-determined motivation toward activities in an out-of-school context will predict future intention to engage in similar activities as well as actual behavioral engagement. **The systematic review conducted by Hagger & Chatzisarantis (2016) showed their** empirical support across multiple studies conducted in the PE setting highlighting significant relationships between perceived autonomy support and self-determined motivation in PE (i.e., first proposition), between self-determined motivation in PE and in PA (i.e., second proposition), and between self-determined motivation and intention toward PA and actual PA engagement (i.e., third proposition). Therefore, according to this model, a key target is for teachers' autonomy-supportive behaviors and active styles of teaching in PE to be transferred to an increase of self-determined motivation, future intention, and actual participation in PA during out-of-school contexts (Wang & Chen, 2019).

In addition to these above-mentioned individual theories related to students' PA promotion, the integration of some constructs from each of those theories could help to better understand the underlying mechanisms of behavior change using each theory's strengths (Biddle, Hagger, Chatzisarantis, & Lippke, 2007). Specifically, the increase of students' health-related knowledge proposed by the Social Cognitive Theory to promote PA practice, could also improve students' perception of competence (i.e., one of the basic psychological needs proposed by the SDT), which leads to greater levels of students' more self-determined motivation forms (Deci & Ryan, 2020). Furthermore, according to the TCM postulates, those high levels of students' autonomous motivation will work to increase students' intention and PA practice (Hagger & Chatzisarantis, 2016). Therefore, the increase of students' knowledge of the possibilities of PA practice offered by their environment along with an autonomy

support context in PE, could be an effective way to promote students' motivation towards PA and ultimately, actual PA practice out-of-school.

Unfortunately, to our knowledge, no previous studies have examined the effect of two alternated teaching units on the environmental knowledge for practicing out-of-school PA, motivation, and PA participation transferred from the PE class to real-life. Additionally, although several correlational studies have shown the TCM to be a useful framework for understanding how autonomy-supportive behaviors during PE lessons can promote PA practice during out-of-school contexts, the current research evidence of school-based interventions studies according to the postulates of the TCM is still scarce (e.g., Mavropoulou, Barkoukis, Douka, Alexandris, & Hatzimanouil, 2018). Furthermore, there is a lack of intervention studies based on the TCM examining PA participation using objectively measured PA. The present study was designed to address these needs from a holistic perspective by investigating the effectiveness of two alternated teaching units (i.e., inside and outside the school center) involving fitness tasks and games/sports, and promoting an autonomy-supportive teaching style compared with a traditional teaching unit delivered only inside the school center involving fitness tasks and games/sports and based on direct instruction methodologies. Thus, the main aim of the present study was to compare the effects of two alternated teaching units (i.e., inside and outside the school center) and a traditional teaching unit on students' knowledge of their environment for practicing PA. The secondary aim was to compare the effects of the above-mentioned teaching units on students' perceptions of autonomy support, autonomous and controlled motivation towards PA, intention to be physically active, and self-reported and objective PA levels. The main hypotheses were that students **in** the innovative program will obtain: (a) higher knowledge of their environment for practicing PA; (b) higher perceptions of autonomy support and, in consequence, higher autonomous and lower controlled motivation towards PA; and (c) higher

intention to be physically active, and self-reported and objective PA levels as compared with students attending the traditional teaching unit.

Methods

Study design

The present study is reported according to the CONSORT for cluster randomized trials guidelines (Campbell, Piaggio, Elbourne, & Altman, 2012). The protocol conforms to the Declaration of Helsinki statements (64th WMA, Brazil, October 2013) and it was approved by the Ethical Committee for Human Studies at the University of [Omitted]. For practical reasons and due to the nature of the present study (i.e., pre-established classes in a school setting), a cluster randomized controlled trial design was used.

Participants

The principal and the PE teachers of a public high-school center (chosen by convenience) from an urban area situated in [Omitted] were contacted and informed about the project, obtaining the approval to carry out the study. All 179 students (52.5% females) from the eighth to ninth grades (i.e., aged 13–15 years old) were invited to participate in the present study. Students and their legal guardians were fully informed about the project features. Participants' signed written informed assent and their legal guardians' signed written informed consent before taking part in the study.

The following inclusion criteria were considered: a) being enrolled in the eighth to ninth grade at the secondary education level; b) being free of any health disorder that would make them unable to engage in PA normally; and c) presenting the corresponding signed written consent/assent by their legal guardians/students. The exclusion criterion was not having performed the dependent variables correctly at the beginning and/or at the end of the intervention program following the administration rules (being removed only for incomplete variables and not for the overall study).

Sample size

A priori sample size calculation was estimated with the Optimal Design Plus Empirical Evidence Software Version 3.01 for Windows. Parameters were set as follows: significance level $\alpha = 0.05$, number of participants per cluster $n = 25$, effect size $\delta = 0.50$, intra-class correlation coefficient $\rho = 0.01$, and statistical power $(1 - \beta) = 0.80$. A total number of six clusters (150 participants) was estimated.

Randomization

Before the pre-intervention evaluation was administered, the six pre-established available classes were, balanced by grade, randomly assigned by an independent and blinded research into the Traditional Group (TG) or the Innovative Group (IG). Randomization was conducted at the class-level, using a computerized random number generator. However, according to the education rules, the school center assigned the students randomly and balanced by gender to each class, before starting the scholar year.

Intervention

Before the intervention, the guidelines for correctly delivering the lessons of each teaching unit were designed by the researchers and given to the PE teachers. Figure 1 shows the general scheme of the intervention. Both groups carried out a four-week intervention program (eight PE lessons, two lessons a week). Each PE lesson lasted approximately 55 minutes and consisted of: a 10-minute warm-up, a 40-minute main part and a five-minute cool-down.

[Insert Figure 1]

Innovative group. The IG students carried out two alternated teaching units (Author, 2016) for the practice of inside and outside school PA. It consisted of delivering one inside lesson (i.e., in school teaching unit, using conventional school facilities like a gym or sports courts) followed by another outside lesson in the immediate environment (i.e., out-of-school teaching unit, using outside installations and features, green zones, or a municipal sport

center) during the whole program (four of each modality). The main part of each lesson was divided into two portions of approximately the same length (i.e., 20 min each). The first one was focused on physical fitness and health tasks (e.g., CrossFit-teens). The second part was focused on traditional and alternative games and sports (e.g., basketball). During both in-school and out-of-school lessons of the same week, students performed the same contents and the main difference was the material and the space used in each of them. This structure was developed to establish learning transference from the PE class to the out-of-school context in order to promote PA practice in the immediate environment.

The lessons teaching approach was based on three main characteristics: (a) to teach general concepts about PA; (b) to significantly develop students' knowledge of the environment for practicing PA; and (c) the use of a teaching methodology focused on motivational strategies and students' autonomy. These features were included based on previous evidence (Cheon, Reeve, Lee, & Lee, 2018; Hagger & Chatzisarantis, 2016; Wang & Chen, 2019) in order to encourage PA participation through the increase of autonomous motivation. These strategies are completely detailed in Table 1.

Traditional group. The TG students developed a similar lesson structure, contents, and tasks as the IG. Similar to the IG, the first portion of each lesson was focused on improving physical fitness and the second was focused on traditional and alternative games and sports. However, unlike the IG, students only received in-school lessons using conventional school facilities and materials. Furthermore, the TG group did not receive any of the specific strategies developed in the IG (i.e., PA concepts, knowledge of the environment nor specific motivational strategies). Therefore, no transference of learning from the PE context to the out-of-school context in the immediate environment was promoted. The main strategies applied are detailed in Supplementary Table 1.

Intervention programs fidelity. The main researcher observed carefully the fidelity of each teaching unit. Specifically, and according to the checklists reported in Table 1 for the IG and in Supplementary Table 1 for the TG, the observer registered if the behavior described by each item was present (i.e., it was used at least once during the lesson) or not during the lesson. Afterward, the percentage of fidelity was calculated. Firstly, if the evaluated behavior (i.e., the item) was present in at least the 75% of the lessons, it was considered that this specific strategy had been faithfully applied according to its design. Secondly, the percentage of overall fidelity for each category was calculated by dividing the number of items that met that criterion by the total number of items in the category and multiplied by one hundred. Therefore, regarding IG teaching unit fidelity, 100% of fidelity was obtained in the categories of general concepts about PA and knowledge of the environment for practicing PA. However, in the teaching methodology category, 90% fidelity was obtained (i.e., nine out of the 10 items observed were applied correctly) as the item “Teacher provides explanatory and meaningful rationales” was not correctly completed in three out of the eight lessons. Regarding TG teaching unit fidelity, the main researcher registered 100% fidelity in the three categories observed.

Measures

Knowledge test about the environment to practice physical activity. Students’ knowledge was measured through the *Knowledge about the Environment to Practice PA in schoolchildren test* (CEPAF, Author, 2020). It consisted of 30 questions with four possible answers where only one was correct, divided into three knowledge dimensions: (a) Declarative (i.e., to know the *what* of something); (b) Procedural (i.e., to know *how* to do something); and (c) Causal (i.e., to know *why* something happens). Furthermore, it was also divided into two main contents (i.e., physical fitness and games/sports). The CEPAF test has shown adequate reliability and validity among high-school students (ICC = 0.72; adequate difficulty and discrimination indices; discriminant validity $p < 0.001$, $d = 1.54$; Author, 2020).

Perceived autonomy support. The PE teacher autonomy-support was assessed through the Spanish version of the Perceived Autonomy Support Scale for Exercise Settings (PASSES, Moreno, Parra, & González-Cutre, 2008). It consists of 12 items that evaluate a single factor of autonomy support in a 10-point Likert-type scale. The Spanish version of PASSES has shown adequate psychometric properties among high-school students (CFI = 0.92; IFI = 0.92; TLI = 0.90; SRMR = 0.04; RMSEA = 0.08; α = 0.91; Moreno et al., 2008).

Self-determined motivation towards physical activity. Students' motivation towards PA was measured using the Spanish version of the Behavioral Regulation in Exercise Questionnaire (BREQ-3, González-Cutre, Sicilia, & Fernández, 2010). It consists of 23 items distributed into six dimensions (intrinsic motivation, demotivation, integrated, identified, introjected and external regulation). A 10-point Likert-type scale was also used.

Subsequently, the autonomous (i.e., intrinsic, integrated and identified regulation) and controlled (i.e., introjected and external) motivation was calculated using the average of the corresponding dimensions (Chemolli & Gagné, 2014). The Spanish version of the BREQ-3 has shown adequate psychometric properties among high-school students (CFI = 0.91; IFI = 0.91; RMSEA = 0.06; SRMR = 0.06; α = 0.66-0.87; González-Cutre et al., 2010).

Intention to be physically active. The Spanish version of the Intention to partake in leisure-time PA questionnaire was applied to measure the students' intention to be physically active in their free time (Granero-Gallegos, Baena-Extremera, Pérez-Quero, Ortiz-Camacho, & Bracho-Amador, 2014). It is composed of three items measured in a 10-point Likert-type scale. The Spanish version of this questionnaire has shown adequate psychometric properties among high-school students (GFI = 1.00; CFI = 1.00; RMSEA = 0.03; α = 0.93; Granero-Gallegos et al., 2014).

Self-reported habitual physical activity and sedentary behavior. Self-reported PA and sedentary behavior (SB) profiles were assessed with the Spanish version of the Youth PA

Profile (YAP, Saint-Maurice & Welk, 2015). It includes 15 items referring to PA and SB in different contexts. A 5-point Likert-type scale from 0 to 4 was used. Subsequently, six categories were calculated using the average of the scores (0 to 4) obtained for the corresponding dimensions: (a) PA during weekdays (items 1 to 8); (b) PA in after-school time (items 6 to 8); (c) PA during weekends (items 9 to 10); (d) SB (items 11 to 15); (e) Total leisure-time PA (items 6 to 10); (f) Whole week PA (items 1 to 10). The YAP has shown adequate validity to estimate PA and SB among high-school students in comparison with objective instruments (e.g., MVPA, $r = 0.58$; SB, $r = 0.75$; Saint-Maurice & Welk, 2015).

Objectively measured habitual physical activity and sedentary behavior.

Students' PA and SB were objectively measured by a GT3X+ accelerometer (ActiGraph, LLC, Pensacola, FL, USA). Students were asked to wear accelerometers on their right hip for eight consecutive days from waking to bedtime, except when they engaged in aquatic activities (Chinapaw et al., 2014). All data were downloaded and analyzed using the ActiLife Lifestyle Monitoring System Software version 6.13.3.

In order to avoid participants' reactivity biases, the first day was considered as a familiarization day and it was not used for statistical analysis (Mattocks et al., 2008). Accelerometers were initialized with a sample rate of 30 Hz (Migueles et al., 2017). Since short bursts of rapidly changing activity characterize schoolchildren's behavior, a one-second *epoch* was used (Migueles et al., 2017). A minimum wear time of 480 min per day and 240 min per after-school time was set (Chinapaw et al., 2014). Non-wear periods were set with a minimum length of 60 min of consecutive zero-count *epochs* with up to two minutes of spike tolerance (Chinapaw et al., 2014). Regarding the data scoring, Evenson's cut-off points were used to obtain the percentage of time engaged in SB and MVPA (i.e., ≤ 100 counts/min and $\geq 2,296$ counts/min, respectively; Trost, Loprinzi, Moore, & Pfeiffer, 2011). To calculate students' PA during the whole week, a minimum criterion of two weekdays and one weekend

day with valid time was established (Mattocks et al., 2008). Then, to calculate the students' PA during weekdays/after-school time and weekend days, a minimum criterion of two days and one day with valid time, respectively, was established. ActiGraph accelerometer-measured PA and SB has shown a high reliability and validity among school-aged children (e.g., SB, ROC-AUC = 0.90, Se = 1.00, Sp = 0.79; MVPA, ROC-AUC = 0.90, Se = 0.88, Sp = 0.92; Trost et al., 2011).

Statistical analysis

Mean (\pm standard deviation; continuous variables) or percentage (categorical variables) for the general characteristics of the participants and dependent variables were calculated. The one-way analyses of variance (ANOVA; continuous variables) and the chi-squared test (categorical variables) were conducted to examine potential differences in terms of general characteristics and attendance rate between the two groups. The internal consistency of the dependent variables measured by the questionnaires was examined with the Cronbach's alpha.

All the participants were included in the statistical analyses regardless of adherence to the protocol (i.e., intention-to-treat approach). However, since the implementation of the missing data requires strong assumptions that are hard to justify, "complete case" analyses including only those whose outcomes were known were used (Campbell et al., 2012). Missing data was low (4.5-5.6%), except for the objectively measured habitual PA/SB (32.4-51.4%). Because the unit of intervention was the class, the effect of the teaching units on the dependent variables was examined using a Multilevel Linear Model with participants nested within classes and measures nested within participants as random effects, and with the between-subjects factor *group* (TG, IG) and the within-subject factor *time* (pre-intervention, post-intervention) as fixed effects (i.e., two-way mixed nested ANOVA/ANCOVA; Li, Xiang, Chen, Xie, & Li, 2017). All the potential confounding variables (i.e., gender, age, grade, body mass, body height, body mass index, and intervention attendance) were explored

and used as covariables when necessary (see Tables 1-3 footnotes). The maximum likelihood estimation method was used. The *post-hoc* within-subject pairwise comparisons with the Bonferroni adjustment was carried out. Effect sizes were estimated using the Cohen's *d*. All statistical analyses were performed using the SPSS version 25.0 for Windows (IBM® SPSS® Statistics). The statistical significance level was set at $p \leq 0.05$.

Results

Final sample and general characteristics

Although all the invited 179 students (52.5% female) agreed to participate and met the inclusion criteria, the number of students that satisfactorily passed the exclusion criterion to become the final sample group was different depending on each dependent variable ($N = 87-171$) (Figure 2). The results of the one-way ANOVA and the chi-square test did not show statistically significant differences in terms of general characteristics between the two groups ($p > 0.05$; TG, age = 14.1 ± 1.1 years, gender = 52.3%/47.7% females/males, grade = 64.8/35.2% eighth/ninth, body mass = 61.2 ± 14.8 kg, body height = 164.5 ± 8.4 cm, body mass index = 22.5 ± 4.6 kg/m², weight status = 65.5/34.5% overweight/obese; IG, age = 14.0 ± 0.8 years, gender = 52.7%/47.3% females/males, grade = 64.8/35.2% eighth/ninth, body mass = 58.4 ± 11.7 kg, body height = 164.1 ± 8.0 cm, body mass index = 21.6 ± 3.6 kg/m², weight status = 69.2/30.8% overweight/obese). In the sample of the present study, the internal consistency of all the dependent variables measured by dimensional questionnaires was above 0.80. Regarding the attendance rate, the IG and TG participants obtained an average of 91.5% and 89.3%, respectively (overall = 90.4%). The results of the one-way ANOVA and the chi-square test did not show statistically significant differences in attendance rate between the two groups ($F = 0.908$, $p = 0.342$; $\chi^2 = 0.769$, $p = 0.380$).

[Insert Figure 2]

Knowledge about the environment for practicing physical activity

The MLM results showed statistically significant interaction effects between *group* and *time* in all the knowledge dimensions ($p < 0.001$) (Table 2). Subsequently, the pairwise comparisons showed that the IG participants statistically significantly improved all their knowledge dimensions from pre- to post-intervention ($p < 0.001$; $d = 0.90-1.97$). However, while the TG participants statistically significantly improved their procedural knowledge ($p < 0.05$), they reduced their declarative and causal knowledge ($p < 0.05$), and statistically significant differences were not found for the overall knowledge ($p > 0.05$) from pre- to post-intervention.

[Insert Table 2]

Perceived autonomy support and self-determined motivation toward physical activity

The MLM results showed statistically significant interaction effects between *group* and *time* on perceived autonomy support and controlled motivation toward PA ($p < 0.01$) (Table 3).

Moreover, regarding the autonomous motivation toward PA a tendency towards statistical significance was found ($p < 0.10$). Subsequently, the pairwise comparisons showed that the IG participants statistically significantly improved their perceived autonomy ($p < 0.001$; $d = 1.03$) and autonomous motivation ($p < 0.05$; $d = 0.22$) from pre- to post-intervention.

Additionally, the IG participants statistically significantly decreased their controlled motivation ($p < 0.05$; $|d| = 0.42$). However, the TG participants statistically significantly reduced their perceived autonomy ($p < 0.001$), while for the rest of comparisons statistically significant differences were not found ($p > 0.05$).

[Insert Table 3]

Intention to be physically active, physical activity, and sedentary behavior

The MLM results showed statistically significant interaction effects between *group* and *time* on the intention to be physically active, self-reported PA during weekdays, the after-school time, total leisure time and the whole week ($p \leq 0.05$) (Table 4). Subsequently, the pairwise

comparisons showed that the IG participants statistically significantly improved all the above-mentioned variables from pre- to post-intervention ($p < 0.001$; $d = 0.27-0.36$). On the other hand, regarding the PA levels during weekend days and overall SB statistically significant interaction effects were not found ($p > 0.05$). However, for the pairwise comparisons with the TG participants, statistically significant differences were not found from pre- to post-intervention ($p > 0.05$). Regarding the objectively measured PA and SB, the MLM results did not show statistically significant interaction effects between *group* and *time* on habitual MVPA and SB during weekdays, weekend, after-school time, nor whole week ($p > 0.05$) (Supplementary Table 2).

[Insert Table 4]

Discussion

The first hypothesis of the present study was focused on examining if two alternated teaching units (i.e., inside and outside) promoting an autonomy-supportive teaching style are more effective than a traditional teaching unit for increasing students' knowledge of their environment for practicing PA. The results of the study showed that the innovative program improved the students' knowledge from pre to post-intervention. These findings are meaningful because if students do not have enough knowledge about their environment, it is unlikely they will be competent enough to practice PA autonomously out-of-school as it is an enabling factor for PA practice (Bandura, 2004). Therefore, according to the Social Cognitive Theory (Bandura, 2004), the IG students' acquisition of the knowledge about *what* kind of PA tasks to do in their environment, *how* to do them, and *why* to practice them, could positively influence their perception of capability for practicing PA masterfully on their own (i.e., satisfying their need for competence) and being the first step toward generating a behavior change. Consequently, a positive effect of this knowledge variable on the students' behavior change towards PA is expected (Wang & Chen, 2019).

Moreover, meeting with the goal of the transferability of learning from the PE class to students' daily life (Spanish Ministry of Education, Culture and Sport, 2015; Author, 2018), these inside-outside alternated teaching units improved students' knowledge, making them capable of using the resources offered by the environment and structure their own PA program during out-of-school time. In this line, some previous studies proved the importance of enhancing health-related knowledge during school-based interventions for voluntary PA participation in leisure time promotion (e.g., Chen, Chen, Sun, & Zhu, 2013). However, those studies were focused on fitness knowledge (i.e., training principles), and as far as we know, no previous research has inquired on the students' knowledge about their environment for practicing PA. On the other hand, conflictive findings have been found in the TG students, with them improving their procedural knowledge but decreasing their declarative and causal knowledge. These results seem to indicate that the development of the same contents as the innovative teaching unit (i.e., physical fitness tasks and games/sports) improves students' knowledge about *how* to do specific tasks in the environment. However, the realization of only inside PE lessons working on physical fitness and games/sports seems not enough to increase students' overall knowledge about their environment for practicing PA.

A secondary hypothesis was focused on examining if the innovative program is more effective than a traditional teaching unit for increasing students' perceptions of autonomy support and self-determined motivation towards PA. The results of the present study showed that the innovative program increased students' perceived autonomy in PE classes from pre- to post-intervention, and that may be due to: (a) the PA counseling included which provided explanations as to why the behavior is truly worth the students' effort (Dobbins, Husson, DeCorby, & LaRocca, 2013); (b) the teaching methodology based on nurturing students' inner motivation and autonomy (see Table 1 for detailed strategies; Wang & Chen, 2019; Cheon et al., 2018); and (c) the use of out-of-school contexts to deliver PE classes, which

provide students with authentic performances they can apply to their daily life's competencies (Author, 2018). As a result of these applied autonomy support strategies, the present study has also shown a positive effect on students' autonomous motivation towards PA and a decrease in students' controlled motivation towards PA, from pre- to post-intervention.

It is in line with the SDT (Ryan & Deci, 2020) and past evidence, which imply that perceived autonomy support in the educational context would have an indirect effect on promoting students' autonomous motivation toward PA in out-of-school contexts (Cheon et al., 2018). According to Wang & Chen (2019), this increase in autonomous motivation towards PA may also be related to an increment in students' competence and autonomy, as a result of the improvement of the knowledge about their environment for practicing PA. Furthermore, these findings are also in line with previous Education Outside programs which have shown to be effective in nurturing students' autonomous motivation through relocating their PE lessons from the conventional classroom to places outside the school center (e.g., Bølling et al., 2018). Therefore, although further research is needed to confirm the influence of each strategy used in the present study on students' positive behavior towards PA, it is possible to conclude that combining the above-mentioned strategies with the alternated teaching units is an effective PE-based intervention to engage students with the real context where the PA would be implemented in their leisure time. Conversely, students' perceived autonomy decreased in the TG students while their self-determined motivation did not change. This may be due to the teaching methodology applied in the TG, where students could not elect any aspect of their class, the tasks were not individualized according to their skill levels, and there was a predominance of instructional feedback used by the PE teacher.

Finally, the third hypothesis was based on examining if the innovative program is more effective than a traditional teaching unit for increasing students' intention to be physically active, and self-reported and objective PA levels. The present results support an increase in

the intention to be physically active after experiencing an autonomy-supportive program from pre- to post-intervention. These findings provide further evidence to the **SDT** which supports students' autonomous motivation as being an influential factor related to the acquisition of PA habits in students (Teixeira et al., 2012). Moreover, these results are also in line with previous intervention programs based on the TCM. For instance, Mavropoulou et al. (2018) found higher students' intention to be physically active in leisure time in the group where PE teachers adopted an autonomy-supportive methodology (e.g., explaining the benefits of PA or giving positive feedback) after similar length intervention programs (i.e., six weeks).

Regarding the actual PA participation, students in the IG increased self-reported PA during weekdays, the after-school time, total leisure time, and the whole week from pre- to post-intervention. These findings are so valuable because the main goal of this innovative program seems to be achieved (i.e., an increase in students' PA levels in most of the self-reported variables). Furthermore, it is in line with the third proposition of the TCM which hypothesizes that autonomous motivation toward PA will predict future intention to engage in similar activities as well as actual behavioral engagement (Hagger & Chatzisarantis, 2016). Nevertheless, it should be noted that no effect was found for students' objectively-measured habitual MVPA and SB levels. Therefore, although the TCM suggests that autonomy-supportive contexts will lead to students' PA participation (Hagger & Chatzisarantis, 2016), in previous literature, inconsistent results have been registered in the last steps trying to link the improvement of psychological variables (e.g., perceived autonomy support or intention to be active) with an increment in out-of-school PA after an intervention program, and most of the time their results depend on the measurement. Self-reported PA measurements had confirmed the TCM hypotheses (e.g., Hagger & Chatzisarantis, 2016; Yli-Piipari, Lavne, Hinson & Irwin, 2018), whereas objectively measurements had not (Author, 2019).

Therefore, the feasibility of the TCM in predicting PA out-of-school seems not to be fully supported for objective PA, and more interventions are needed to test its effectiveness. Moreover, the absence of improvements in habitual objectively-measured PA levels could be obtained due to the short length of the intervention (four weeks), since previous literature suggests longer school-based PA interventions (around 12 weeks and up) in order to achieve changes in PA behavior (Dobbins et al., 2013). Moreover, complementing the intervention with a proposal of an extracurricular PA plan for weekends might have also helped to achieve significant results because, although they learned about how to use their environment for practicing PA, an appropriately designed and structured PA plan to increase students' PA levels (in periods of time where doing PA is voluntary) seems necessary (Dobbins et al., 2013).

Strengths and limitations

To our knowledge, this is the first study that examines the effect of two alternated teaching units on the students' environmental knowledge for practicing out-of-school PA and their objectively measured PA. Furthermore, the accelerometer-measured PA improves the validity and quality of the results, taking a step ahead regarding previous studies carried out with self-reported measures. The use of a cluster-randomized and controlled research design also adds quality to this study. Finally, the evaluation of the effect of the program with a Mixed Multilevel Linear Model with participants nested within classes and measures nested within participants represents an advance with respect to the commonly applied analyses in previous literature (Li et al., 2017).

However, some limitations should also be considered. First of all, due to human, time, and material resource restrictions, a larger sample could not be examined, limiting the generalizability of the obtained outcomes to the particular studied setting. Moreover, due to some resource constraints such as time available for evaluation sessions, and participant's

attention and patience during these sessions, the students' self-determined motivation in the educational context (i.e., a variable presented in the first and second proposition of the TCM) could not be measured in the present study. However, students' motivation towards PA in general, which is more directly linked to the ultimate goal of promoting actual daily PA in out-of-school contexts, was measured instead. Regarding the contents, the present innovative program was developed with physical fitness and traditional and alternative games and sports contents, which dominate the students' PA experiences globally in PE (Hardman et al., 2014) and could be the most applicable to students' free-time (individually or in small groups with friends), but these effects should also be studied with other PE contents. Moreover, the program length may have been a limitation to achieving greater effects on the objective PA. However, given the large volume of objectives that have to be developed throughout the school year with a very limited time for the PE subject (Hardman et al., 2014), the present study was adjusted to the mean length of PE teaching units. Finally, current results should be taken with caution due to the non-compliance rate in objectively measured PA variables, especially during weekend days. However, as analyses showed no differences in students' general characteristics in the valid subsample for each particular dependent variable, the non-compliance rate may not bias the findings of the present study.

Conclusion

In conclusion, the results of the present study showed that it is possible to improve students' knowledge about the environment for practicing PA, perceived autonomy, autonomous motivation towards PA, and the intention to be physically active. However, outcomes do not support the effectiveness of the program on actual objective PA, questioning its usefulness in promoting healthy PA habits if applied as it was. Further studies are necessary to deeply analyze this complex relationship between psychological variables and actual PA.

References

- Bandura, A. (2004). Health promotion by social cognitive means. *Health education & behavior, 31*(2): 143-164.
- Becker, C., Lauterbach, G., Spengler, S., Dettweiler, U., & Mess, F. (2017). Effects of regular classes in outdoor education settings: A systematic review on students' learning, social and health dimensions. *International Journal of Environmental Research and Public Health, 14*(5), 485.
- Biddle, S. J. H., Hagger, M. S., Chatzisarantis, N. L. D., & Lippke, S. (2007). Theoretical frameworks in exercise psychology. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of sport psychology* (3rd ed., pp. 537–559). New York, NY: Wiley
- Bølling, M., Otte, C. R., Elsborg, P., Nielsen, G., & Bentsen, P. (2018). The association between education outside the classroom and students' school motivation: Results from a one-school-year quasi-experiment. *International Journal of Educational Research, 89*, 22-35.
- Campbell, M. K., Piaggio, G., Elbourne, D. R., & Altman, D. G. (2012). Consort 2010 statement: Extension to cluster randomised trials. *BMJ, 345*: e5661.
- Author, 2020
- Chemolli, E., & Gagné, M. (2014). Evidence against the continuum structure underlying motivation measures derived from Self-Determination Theory. *Psychological Assessment, 26*(2): 575–585.
- Chen, S., Chen, A., Sun, H., & Zhu, X. (2013). Physical activity and fitness knowledge learning in physical education: Seeking a common ground. *European Physical Education Review, 19*(2): 256-270.
- Cheon, S. H., Reeve, J., Lee, Y., & Lee, J. W. (2018). Why autonomy-supportive interventions work: Explaining the professional development of teachers' motivating style. *Teaching and Teacher Education, 69*: 43-51.

- Chinapaw, M. J., de Niet, M., Verloigne, M., De Bourdeaudhuij, I., Brug, J., & Altenburg, T. M. (2014). From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. *PLoS One*, *9*(11): e111205.
- Deci, E. L., & Ryan, R. M. (2008). Facilitating optimal motivation and psychological wellbeing across life's domains. *Canadian Psychology*, *49*, 14–23.
- Dobbins, M., Husson, H., DeCorby, K., & LaRocca, R. L. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*, *2*: CD007651.
- González-Cutre, D., Sicilia, A., & Fernández, A. (2010). Hacia una mayor comprensión de la motivación en el ejercicio físico: medición de la regulación integrada en el contexto español. *Psicothema*, *22*(4): 841-847.
- Granero-Gallegos, A., Baena-Extremera, A., Pérez-Quero, F. J., Ortiz-Camacho, M. M., & Bracho-Amador, C. (2014). Validación española del «intention to partake in leisure-time physical activity». *Retos*, *26*: 40-45.
- Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *The Lancet Child & Adolescent Health*, *4*(1): 23-35.
- Hagger, M. S., & Chatzisarantis, N. L. (2016). The trans-contextual model of autonomous motivation in education: Conceptual and empirical issues and meta-analysis. *Review of Educational Research*, *86*(2): 360-407.
- Hardman, K., Murphy, C., Routen, A. C., & Tones, S. (2014). *UNESCO-NWCPEA: World-wide survey of school Physical Education*. Paris: United Nations Educational, Scientific and Cultural Organization.

- Li, W., Xiang, P., Chen, Y. J., Xie, X., & Li, Y. (2017). Unit of analysis: Impact of Silverman and Solmon's article on field-based intervention research in Physical Education in the U.S.A. *Journal of Teaching in Physical Education*, 36(2): 131–141.
- Mattocks, C., Ness, A., Leary, S., Tilling, K., Blair, S. N., Shield, J., ... & Wells, J. (2008). Use of accelerometers in a large field-based study of children: Protocols, design issues, and effects on precision. *Journal of Physical Activity & Health*, 5(1): S98-111.
- Mavropoulou, A., Barkoukis, V., Douka, S., Alexandris, K., & Hatzimanouil, D. (2018). The role of autonomy supportive activities on students' motivation and beliefs toward out-of-school activities. *The Journal of Educational Research*, 112(2): 223-233.
- Miguelés, J. H., Cadenas-Sanchez, C., Ekelund, U., Nyström, C. D., Mora-Gonzalez, J., Löf, M., ... & Ortega, F. B. (2017). Accelerometer data collection and processing criteria to assess physical activity and other outcomes: a systematic review and practical considerations. *Sports medicine*, 47(9): 1821-1845.
- Moreno, J. A., Parra, N., & González-Cutre, D. (2008). Influencia del apoyo a la autonomía, las metas sociales y la relación con los demás sobre la desmotivación en educación física. *Psicothema*, 20(4): 636-641.
- Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J. P., Janssen, I., ... & Sampson, M. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*, 41(6): S197-239.
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61: 101860.
- Saint-Maurice, P.F., & Welk, G. J. (2015). Validity and calibration of the youth activity profile. *PloS one*, 10(12): e0143949.

- Schneller, M. B., Duncan, S., Schipperijn, J., Nielsen, G., Mygind, E., & Bentsen, P. (2017). Are children participating in a quasi-experimental education outside the classroom intervention more physically active? *BMC Public Health*, *17*(1), 523.
- Sheeran, P., Klein, W. M., & Rothman, A. J. (2017). Health behavior change: Moving from observation to intervention. *Annual review of Psychology*, *68*: 573-600.
- Spanish Ministry of Education, Culture, and Sport. (2015). Royal Decree 1105/2014, laying down the curriculum for Secondary Education and Baccalaureate. *Government Gazette*, *3*: 480–486.
- Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1): 78.
- Trost, S. G., Loprinzi, P. D., Moore, R., & Pfeiffer, K. A. (2011). Comparison of accelerometer cut points for predicting activity intensity in youth. *Medicine Science and Sports Exercise*, *43*(7): 1360-1368.
- Author, 2016
- Author, 2018
- Author, 2019
- Wang, Y., & Chen, A. (2019). Two pathways underlying the effects of physical education on out-of-school physical activity. *Research Quarterly for Exercise and Sport*, 1-12.
- World Health Organization. (2018). *Physical Activity Factsheets for the 28 European Union Member States of the Who European Region*. Copenhagen: World Health Organization
- Yli-Piipari, S., Layne, T., Hinson, J., & Irwin, C. (2018). Motivational Pathways to Leisure-Time Physical Activity Participation in Urban Physical Education: A Cluster-Randomized Trial. *Journal of Teaching in Physical Education*, *37*(2), 123–132.

Table 1. Strategies applied in the Innovative Group during the intervention and fidelity checklist.*Explanation of concepts about PA*

Main concepts related to PA (e.g., frequency, levels of intensity, physical inactivity, or sedentary behavior)

International PA guidelines (i.e., daily goal of 60 min of MVPA or 10.000 steps/day)

Kinds of activities (aerobic, muscle strengthening, or bone-strengthening) and examples to reach the daily goal

Health-related benefits of PA and the harmful effect of physical inactivity in school-aged children

Strategies to solve barriers towards PA practice proposed by students

Principles for designing a PA plan with an example week (e.g., selection of frequency, intensity, length, or kind of activity)

Debate about possible students' PA habits modification during the program, where students give their reasons for and/or against this change

Review of the main concepts explained during the previous lessons

Knowledge of the environment for practicing PA

Highlighting the similarities between tasks and how these can be done in the other context (i.e., inside or outside)

Students do situational PA practice in out-of-school installations (i.e., green zones, urban parks or sports center)

Publicizing the structured PA offered by the community (e.g., modalities and timetables offered by sports clubs)

Teacher offers a free trial session at the sports club of students' choice

Teacher hands a weekly physical fitness plan individualized to three levels of difficulty and using outside installations and features

Use of demonstration videos about tasks developed in outside/in-school contexts, in order to have students think about how to carry them in the other context.

Teaching methodology

Students' capability is considered in order to individualize the tasks according to the students' level

Creating opportunities for choice (e.g., choosing activities from a list of what they liked most with the same goal)

Using of interrogative feedback in order to make students reflect on the relationship between the two contexts

Using of an informational and non-controlling language (i.e., avoidance of directives and commands)

Providing explanatory and meaningful rationales (e.g., points out the importance or benefits of a task)

Teacher actively listens to students' PA concerns and has an open attitude towards resolving them

Encouraging students to improve their PA levels to reach the guidelines

Proposing small-group activities with the opportunity to choose activity partners to support their relatedness

Teacher offers hints on how to make progress on tasks

Innovative contents and resources (i.e., an augmented reality mobile app) are included

PA = Physical Activity

Table 2. Effect of the inside-outside alternated teaching units on the knowledge of the environment for practicing physical activity

Variable	Group	Pre-intervention	Post-intervention	Multilevel Lineal Model			ES
		M (SE)	M (SE)	- 2LL	<i>F</i>	<i>p</i>	<i>d</i>
<i>Knowledge of the environment</i>							
Declarative	Innovative	3.6 (0.2)	5.5 (0.2)***	1344.674	59.763	< 0.001	1.63
	Traditional	3.8 (0.2)	3.0 (0.2)**				
Procedural	Innovative	3.2 (0.2)	6.4 (0.2)***	1306.334	57.307	< 0.001	1.57
	Traditional	3.2 (0.2)	3.9 (0.2)**				
Causal ^a	Innovative	4.4 (0.2)	5.6 (0.2)***	1341.860	26.940	< 0.001	0.90
	Traditional	4.3 (0.2)	3.8 (0.2)*				
Overall	Innovative	11.3 (0.4)	17.5 (0.4)***	1819.421	130.584	< 0.001	1.97
	Traditional	11.3 (0.4)	10.7 (0.4)				

ES = Effect size; M = Mean; SE = Standard error; - 2LL = -2 log-likelihood; *d* = Cohen's *d* effect size;

Innovative, *n* = 88, Traditional, *n* = 83. *Post-hoc* pairwise comparisons with the Bonferroni adjustment from pre- to post-intervention (**p* < 0.05; ***p* < 0.01; ****p* < 0.001). Covariables: Gender^a.

Table 3. Effect of the inside-outside alternated teaching units on perceived autonomy support and self-determined motivation toward physical activity.

Variable	Group	Pre-intervention	Post-intervention	Multilevel lineal model			ES
		M (SE)	M (SE)	- 2LL	<i>F</i>	<i>p</i>	<i>d</i>
<i>Perceived autonomy support</i>							
Autonomy	Innovative	6.8 (0.2)	7.8 (0.3)***	1454.621	33.695	< 0.001	1.03
	Traditional	7.0 (0.2)	5.8 (0.3)***				
<i>Self-determined motivation</i>							
Autonomous ^a	Innovative	7.3 (0.2)	7.7 (0.2)*	1347.578	2.813	0.095	0.22
	Traditional	6.9 (0.2)	6.8 (0.2)				
Controlled ^b	Innovative	3.1 (0.2)	2.6 (0.2)**	1199.214	9.580	0.002	-0.42
	Traditional	2.3 (0.2)	2.5 (0.2)				

ES = Effect size; M = Mean; SE = Standard error; - 2LL = -2 log-likelihood; *d* = Cohen's *d* effect size; Innovative, *n* = 88, Traditional, *n* = 81. *Post-hoc* pairwise comparisons with the Bonferroni adjustment from pre- to post-intervention (**p* < 0.05; ***p* < 0.01; ****p* < 0.001). Covariables: Gender^a; Body height^b

Table 4. Effect of the inside-outside alternated teaching units on the intention to be physically active and self-reported physical activity and sedentary behavior.

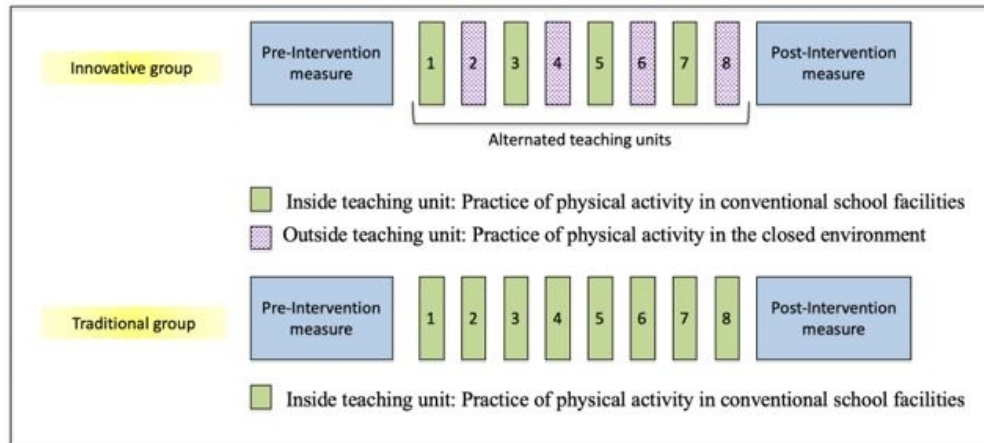
Variable	Group	Pre-intervention	Post-intervention	Multilevel Lineal Model			ES
		M (SE)	M (SE)	- 2LL	<i>F</i>	<i>p</i>	<i>d</i>
<i>Intention to be physically active</i>							
Intention ^a	Innovative	6.9 (0.3)	8.1 (0.3)***	1566.147	4.461	0.036	0.30
	Traditional	6.9 (0.3)	7.2 (0.3)				
<i>Self-reported physical activity</i>							
Weekdays (PA) ^a	Innovative	2.7 (0.1)	2.9 (0.1)***	525.792	4.607	0.033	0.29
	Traditional	2.7 (0.1)	2.7 (0.1)				
After-school time (PA) ^a	Innovative	2.4 (0.1)	2.8 (0.1)***	877.395	6.336	0.013	0.36
	Traditional	2.4 (0.1)	2.5 (0.1)				
Weekend days (PA) ^a	Innovative	2.8 (0.1)	3.0 (0.1)	992.854	0.355	0.552	0.09
	Traditional	2.7 (0.1)	2.8 (0.1)				
Overall sedentary ^a	Innovative	2.6 (0.1)	2.4 (0.1)	605.993	0.342	0.559	-0.07
	Traditional	2.6 (0.1)	2.5 (0.1)				
Total Leisure time ^a	Innovative	2.5 (0.1)	2.9 (0.1)***	799.945	4.097	0.045	0.30
	Traditional	2.5 (0.1)	2.6 (0.1)				
Whole week ^a	Innovative	2.7 (0.1)	3.0 (0.1)***	532.175	3.836	0.052	0.27
	Traditional	2.7 (0.1)	2.7 (0.1)				

ES = Effect size; M = Mean; SE = Standard error; - 2LL = -2 log-likelihood; PA = Physical activity; *d* = Cohen's *d* effect size; Innovative, *n* = 88, Traditional, *n* = 81. *Post-hoc* pairwise comparisons with the Bonferroni adjustment from pre- to post-intervention (****p* < 0.001). Covariable: Gender^a.

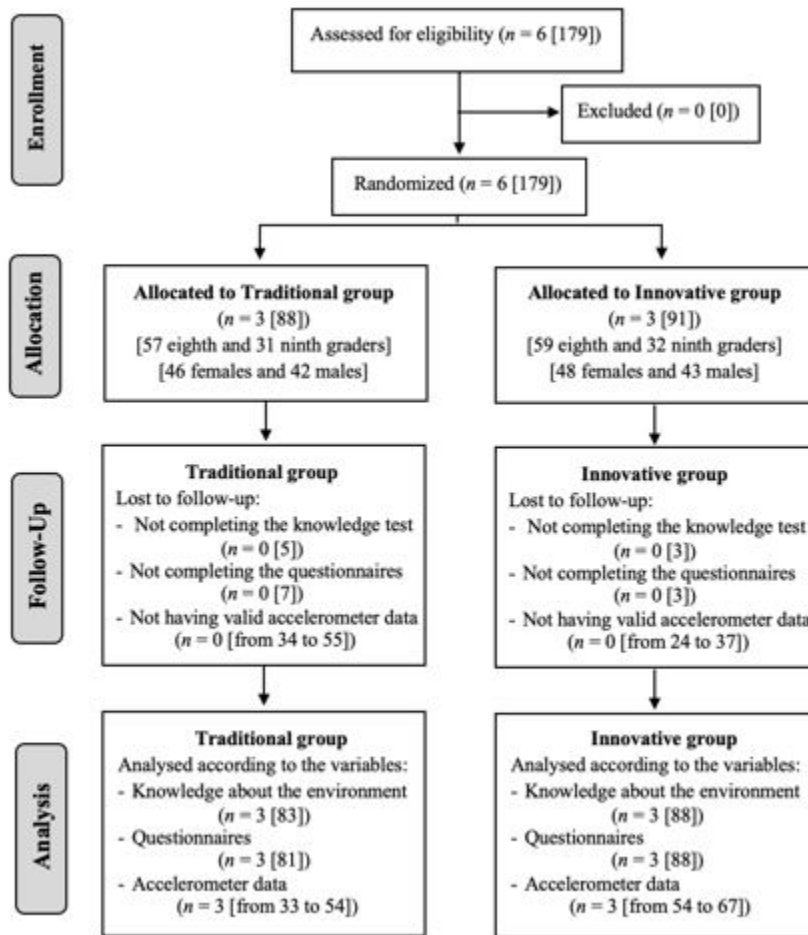
Figure 1. Intervention programs. Alternated inside-outside teaching units versus Traditional teaching unit (adapted from Author, 2016).

Figure 2. Flow chart of the school classes and students of the present study. All numbers are reported as school classes [students].

For Peer Review



168x77mm (96 x 96 DPI)



130x131mm (96 x 96 DPI)

Supplementary Table 1. Traditional group teaching approach during the intervention and fidelity checklist.

Explanation of concepts about PA

No specific explanations about PA concepts, international guidelines, health-related benefits, nor principles for design PA plans
No references regarding PA barriers nor debate about daily physical activity habits are included

Knowledge of the environment for practicing PA

Similarities between tasks develop and how these can be done in the out-of-school context are not highlighted
There is no situational PA practice in the out-of-school context nor information about PA offered by the community included
No information about PA offered by the community is publicized

Teaching methodology

Tasks are not individualized to students' level
No opportunities for choice between different activities are given
Using of instructional feedback and directive language
Meaningful rationales about tasks **are not provided**
Teachers does not encourage students to improve their PA levels nor promote debates about students' PA concerns.
Teachers propose small-group activities, but the opportunity to choose activity partners is not given to students
Innovative contents and resources are not included

PA = Physical Activity.

Supplementary Table 2. Effect of the inside-outside alternated teaching units on objectively measured habitual physical activity and sedentary behavior.

Variable	Group	Pre-intervention	Post-intervention	Multilevel Lineal Model			ES
		M (SE)	M (SE)	- 2LL	<i>F</i>	<i>p</i>	<i>d</i>
<i>Weekdays</i>							
MVPA (%) ^{a,b,c,d}	Innovative	5.6 (0.3)	5.9 (0.3)	992.355	0.404	0.526	-0.10
	Traditional	5.8 (0.3)	6.3 (0.4)				
Sedentary (%) ^{a,d}	Innovative	85.0 (0.4)	84.4 (0.5)	1282.284	0.845	0.360	0.15
	Traditional	84.0 (0.5)	82.9 (0.6)				
<i>Weekend days</i>							
MVPA (%) ^b	Innovative	4.6 (0.4)	4.8 (0.5)	898.828	1.238	0.269	-0.28
	Traditional	5.3 (0.5)	6.4 (0.7)				
Sedentary (%) ^{b,d}	Innovative	86.4 (0.7)	85.5 (0.9)	1097.952	0.906	0.344	0.24
	Traditional	84.3 (0.9)	82.1 (1.2)				
<i>After-school time</i>							
MVPA (%)	Innovative	6.8 (0.4)	7.4 (0.5)	1100.048	0.478	0.491	-0.13
	Traditional	6.5 (0.4)	7.4 (0.5)				
Sedentary (%) ^d	Innovative	83.0 (0.7)	82.1 (0.8)	1355.393	1.119	0.292	0.20
	Traditional	83.1 (0.8)	81.1 (1.0)				
<i>Whole week</i>							
MVPA (%) ^{a,b,d}	Innovative	5.3 (0.3)	5.5 (0.3)	708.543	1.792	0.184	-0.25
	Traditional	5.3 (0.3)	6.0 (0.4)				
Sedentary (%) ^{a,d}	Innovative	85.4 (0.4)	84.7 (0.6)	920.615	2.478	0.119	0.29
	Traditional	84.6 (0.6)	82.8 (0.7)				

ES = Effect size; M = Mean; SE = Standard error; - 2LL = -2 log-likelihood; MVPA = Moderate-to-vigorous physical activity; *d* = Cohen's *d* effect size; Innovative, *n* = 67/54/62/54, Traditional, *n* = 54/33/48/35.

Covariables: Gender^a; Age^b; Body mass^c; Body mass index^d.