European Journal of Human Movement

OPEN ACCESS

Original Research

Effect of inside-outside school alternated teaching units on knowledge of the environment for physical conditioning and related psychological outcomes in the Physical Education setting: A cluster-randomized controlled trial

Santiago Guijarro-Romero[1], Jesús Viciana[2], Carolina Casado-Robles[2] and Daniel Mayorga-Vega [3,*]

[1] Department of Physical Education, Sport and Human Movement, Autonomous University of Madrid, Madrid, Spain
[2] Department of Physical Education and Sport, University of Granada, Granada, Spain
[3] Departamento de Didáctica de las Lenguas, las Artes y el Deporte, Facultad de Ciencias de la Educación, Universidad de Málaga, Málaga, Spain

* Correspondence: (DMV) dmayorgavega@uma.es. ORCID ID nº: 0000-0002-4494-4113

Received: 18/03/2024; Accepted: 24/06/2024; Published: 30/06/2024

Abstract: The main aim of the present study was to examine the effect of two inside-outside school alternated teaching units developed following a reflexive and autonomy-supportive teaching style on students' environmental knowledge for physical conditioning outside of school, their perceptions of barriers, autonomy support, motivation towards physical activity, intention to be physically active, their habitual and extracurricular physical activity, and the regular use of their environment for practicing physical activity. One hundred and forty-six high school students (50% females) aged 11-15 years old participated in the study. Six pre-established classes, balanced by grade, were cluster-randomly assigned into the alternated group ($n = 75$) or traditional group ($n = 71$). The alternated group students performed two fitness-based teaching units twice a week for four weeks, alternating lessons inside and outside the school. Meanwhile, the traditional group students performed a fitness teaching unit solely having lessons inside the school center. All variables were measured before and after the intervention by validated questionnaires. The Multilevel Linear Model showed that the alternated teaching units improved students' knowledge of their environment for physical conditioning, autonomy support, and autonomous motivation toward physical activity ($p < 0.05$; $d = 0.16$-1.30), while the rest of variables were not affected ($p > 0.05$). A four-week inside-outside school alternated teaching units developed following a reflexive and autonomy-supportive teaching style improve students' key predisposition variables of habitual physical activity, but not the practice in itself. Some ideas are discussed in order to improve future Physical Education programs.

Keywords: autonomy support; high school students; innovative program; Self-Determination Theory; physical fitness

1. Introduction

Physical fitness is considered a powerful health marker among adolescents (Raghuveer et al., 2020). During adolescence, higher levels of physical fitness are positively associated with better quality of life and mental health (Eddolls et al., 2018). Unfortunately, adolescents' physical fitness has been declining during the last decades (Raghuveer et al., 2020), becoming a global problem which affects, on average, 46% of female and 33% of male adolescents (Raghuveer et al., 2020). Worldwide, more than 80% of adolescents do not meet the daily recommendation of at least 60 minutes of moderate-to-vigorous physical activity (PA) (Guthold, Stevens, Riley, & Bull, 2020). This is why, PA is considered a key element for improving physical fitness (Raghuveer et al., 2020), and consequently, the promotion of better physical fitness levels through an increment in adolescents' PA levels is a priority public health objective (World Health Organization, 2018).

The Physical Education (PE) subject, is considered an ideal context to acquire healthy physical fitness levels through the promotion of health-enhancing PA levels (World Health Organization, 2018). However, due to the low weekly frequency of the subject (e.g., on average, worldwide only about two hours per week) (Hardman, Murphy, Routen, & Tones, 2014) it is not possible to achieve the daily PA recommendations only in the PE setting, therefore, the promotion of students' PA in the out-of-school setting is key. In this sense, national standards consider that transferring the learning from the classroom to students' daily life is a priority objective of PE (European Commission/EACEA/Eurydice, 2013; SHAPE America, 2013). In order to achieve this purpose, PE teachers play an important role providing students with tools to become competent in practicing PA autonomously (Viciana & Mayorga-Vega, 2018). For instance, a strategy for promoting the transference of learning from the classroom to students' daily life could be the education outside the classroom (Becker et al., 2017; Viciana & Mayorga-Vega, 2018). In this teaching method, teachers relocate teaching activities from the classroom to the environment that surrounds the school center and their particular community to provide students authentic and situational PA practices (Becker, Lauterbach, Spengler, Dettweiler, & Mess, 2017; Viciana & Mayorga-Vega, 2018).

Additionally, this transference of learning could be achieved through the application of the alternated teaching units, that supposes a new distribution of the time of learning regarding the traditional teaching unit (Viciana & Mayorga-Vega, 2016). Traditional teaching units are commonly based on the achievement of isolated objectives in a particular context (gymnasium or outdoor school facilities) and not establishing relationships between other teaching units (Viciana & Mayorga-Vega, 2016). Due to this isolated and disconnected work it is difficult to achieve significant and authentic learning (Viciana & Mayorga-Vega, 2016). On the contrary, the alternated

teaching units suppose an innovative distribution of the student's learning time that consists of alternating two teaching units with related elements (complementary contents, PE materials, fundamentals of movement, or contexts, for instance), while making students aware that both elements are related and based on the same learning's principles (Viciana & Mayorga-Vega, 2016). Alternated teaching units are based on the concept of learning transfer (Yañez & Castejón, 2011). Positive transfer occurs when prior learning facilitates the acquisition of new learning, for which it is necessary that the activities carried out have some kind of relationship and that the teacher uses a reflexive teaching approach to develop them (e.g., using interrogative feedback) (Yañez & Castejón, 2011). For example, PE teachers could connect in-school physical fitness work (inside the school) with one that could be practiced in the immediate environment (outside the school), facilitating students a tool for developing and maintaining their physical fitness levels autonomously in their out-of-school time (Ferkel, Judge, Stodden, & Griffin, 2014). Moreover, this learning may help students to solve perceived barriers toward the PA practice such as the lack of facilities (Niñerola, Capdevila, & Pintanel, 2006), which have been shown to be associated with a higher prevalence of physical inactivity during their leisure-time (Dias, Loch, & Ronque, 2015). Previous empirical literature has shown the effectiveness of this innovative teaching unit structure using a reflexive teaching approach for improving behavioral tactical skills in primary schoolchildren alternating related invasion sports (Viciana, Mayorga-Vega, Guijarro-Romero, & Martínez-Baena, 2017). However, to date it has not been applied alternating contexts of PA practice in order to teach students how to use their immediate environment for autonomously developing their physical fitness.

Furthermore, implementing effective PA interventions in the PE setting requires an understanding of the determinant factors that influence students' PA behavior (Sheeran, Klein, & Rothman, 2017). The Social Cognitive Theory postulates that health-related fitness knowledge (e.g., fitness and PA knowledge) is a core determinant on the design of PA interventions with the aim of promoting an improvement in physical fitness (Bandura, 2004). This knowledge, which can be easily acquired by students, represents the first step toward generating a behavior change (Bandura, 2004). Demetriou, Sudeck, Thiel, and Höner (2015) found that school-based PA interventions can improve students' health-related fitness knowledge levels, and the acquisition of this knowledge leads to a change in students' out-of-school PA (Wang & Chen, 2020). Moreover, the Self-Determination Theory (SDT) is a motivational theory widely used to understand the antecedents and consequences of students' motivation toward PA (Ryan & Deci, 2020). The SDT considers motivation as a multidimensional construct 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 (Ryan & Deci, 2020). In addition, the SDT postulates that everyone has three basic psychological needs (autonomy, competence, and relatedness) whose satisfaction leads students to acquire more

autonomous forms of motivation toward PA (Ryan & Deci, 2020). The SDT also postulates that autonomy support is an important factor for encouraging higher levels of autonomous motivation (Ryan & Deci, 2020). Specifically, teachers who support students' autonomy are favoring the satisfaction of the three psychological needs (i.e., autonomy, competence, and relatedness) and, consequently, encouraging the students' most self-determined forms of motivation, while in settings where autonomy support is not provided, these needs are thwarted (Ryan & Deci, 2020). The autonomy support in educational context is characterized by making students feel that they can participate in their own learning (Ryan & Deci, 2020). Previous studies in the PE setting have shown that autonomy-supportive teaching styles are effective for improving students' self-determined motivation toward PA, as well as their intention to continuous practicing of PA out-of-school (Cheon & Reeve, 2013; Yli-Piipari, Layne, Hinson, & Irwin, 2018). Thus, basing school interventions aimed at promoting students' lifelong PA on psychological frameworks whose core points are the improvement of autonomy and motivation through the application of autonomy-supportive teaching styles seems appropriate.

The Trans-Contextual Model (TCM; Hagger & Chatzisarantis, 2016; Viciana et al., 2019) offers an ideal framework for designing PE interventions aimed at promoting motivation toward PA and encouraging participation in out-of-school PA. Hagger and Chatzisarantis (2016) presented three empirically testable propositions to explain the mechanisms by which PE teachers can promote students' involvement in PA in out-of school settings. In the first place, students' perceptions of PE teachers' autonomy support can develop their autonomous motivation toward activities performed in PE. The second proposition hypothesizes that, autonomous motivation in PE will predict autonomous motivation toward similar activities in out-of-school settings. Thirdly, autonomous motivation toward activities in the out-of-school settings will predict students' future intentions to participate in similar activities, as well as actual behavioral engagement (Hagger and Chatzisarantis, 2016; Viciana et al., 2019). In this sense, in a systematic review carried out by Hagger and Chatzisarantis (2016) showed empirical evidence of the TCM across multiple studies conducted in the PE setting, highlighting significant relationships in the three above-mentioned propositions. Therefore, the combination of autonomy-supportive settings in PE with the improvement of students' knowledge of the possibilities offered by the environment for PA practice might be an effective way to promote students' motivation toward PA and therefore the autonomous development and maintenance of physical fitness levels out-of-school (Ferkel et al., 2014; Wang & Chen, 2020). Unfortunately, to the best of our knowledge, no previous studies have examined the effect of two alternated teaching units based on a reflexive and autonomy-supportive teaching style on the environmental knowledge for the development and maintenance of physical fitness, perceived barriers toward PA practice, motivation, and PA participation transferred from the PE class to real-life settings.

Consequently, the main aim of the present study was to examine the effect of two PE-based inside-outside school alternated teaching units developed following a reflexive and autonomy-supportive teaching style on students' environmental knowledge for physical conditioning in the out-of-school time, their perceived barriers toward the PA practice, teacher autonomy support, self-determined motivation towards PA, intention to be physically active, habitual and extracurricular PA, and the regular use of their environment for practicing PA. The main hypotheses were that students who carried out the alternated teaching units will show a) higher environmental knowledge for physical conditioning; b) lower perceived barriers; c) higher perceptions of autonomy support and, in consequence, higher self-determined motivation toward PA; and d) higher intention to be physically active, habitual and extracurricular PA, as well as higher use of their environment for practicing PA compared with students who performed the traditional teaching unit.

2. Materials and Methods

Experimental 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 Granada. Recruitment of participants was carried out in June of 2019, and the intervention was done from September 2019 to December 2019. 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 (Guijarro-Romero, Mayorga-Vega, Casado-Robles, & Viciana, 2020). This study was non-blinded (treatments were not masked from the students or teacher), parallel-grouped (study with two different treatments; Spieth et al., 2016), and had two evaluation phases.

Participants —The principal and the PE teacher of a state high-school center from an urban area situated in the province of Ciudad Real (Castilla-La Mancha Region, Spain) chosen by convenience were contacted and informed about the project, requesting its permission to conduct the study. After obtaining the approval to carry out the present study, all 146 students (50% female) from the seventh to ninth grades of secondary education (i.e., aged 11–15 years old) were invited to participate in the present study. Adolescents and their legal tutors were fully informed about the study features. Participants signed written informed assent and their legal guardians' signed written informed consent were obtained before taking part in the study. According to the center's reports, all of the students' families had a middle-class socioeconomic level.

The inclusion criteria were: a) being enrolled in the seventh to ninth grade at the secondary education level (grades in which approval of the school was obtained); b) participating in the normal PE classes; c) being exempt of any health problem that would make them unable to engage in PA normally; d) presenting the corresponding signed written consent by their legal tutors, and e) presenting their own corresponding signed written assent. The exclusion criterion

was defined as not having performed the evaluation of the dependent variables correctly at the beginning and/or at the end of the intervention program following the administration rules.

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 α = 0.05, number of participants per cluster n = 25, effect size δ = 0.50, intra-class correlation coefficient ρ = 0.01 and statistical power (1 – β) = 0.80. A total number of six clusters was estimated.

Randomization —Randomization was conducted at the class-level, using a computerized random number generator, even though the school center had already assigned the students randomly and balanced by gender to each class, before starting the scholar year. This was done before the pre-intervention evaluation was administered, and the six pre-established classes (i.e., two 7th, two 8th, and two 9th grade classses) were randomly assigned, balanced by grade, by an independent researcher blinded to the study aim, and following a 1:1 ratio into the traditional group (TG) or alternated group (AG).

Intervention—Figure 1 shows the general scheme of the intervention. Before the intervention, the PE teacher (16 years of experience) responsible for teaching all of the control and experimental lessons received two teacher-training sessions regarding the specific features of the teaching units. Specifically, as part of these teacher-training sessions, the main research explained the PE teacher the basic theoretical fundamentals of the SDT. That is, what types of motivation distinguishes the SDT, what are the three basic psychological needs, and what is the autonomy support style. Moreover, the different motivational strategies based on SDT framework that will be applied during the intervention were explained providing examples to the PE teacher and solving possible doubts about how to correctly apply them in the AG. Both teaching units were carefully designed by the research group, providing guidelines to the PE teacher for correctly delivering the lessons. The main researcher supervised all the lessons and made sure all guidelines were taken into account during the program (Table 1). The intervention was adjusted to 100% of what was planned according to the recorded results of the application of the fidelity control sheet.

Both TG and AG students carried out a physical fitness-based teaching unit twice a week for four weeks. Each PE lesson lasted approximately 50 minutes and consisted of the following parts: a 5-to-10-minute warm-up (performing low-to-moderate aerobic activities followed by some joint mobility); a 35-to-40-minute main part; and a five-minute cool-down (performing stretching exercises).

Table 1. Strategies applied during the intervention and fidelity checklist.

	Alternated Group		Traditional Group	
Warm-up	-Implementation of low-to-moderate aerobic activities and joint mobility exercises are performed			
Main part	-Interrogative feedbacks are given with the aim of making students reflect on the similarities between the elements of inside-outside contexts regarding the work of endurance and strength (e.g., What elements of the immediate environment could you use to perform the same terrain fartlek that you did at the school facilities?)	☐	-Instructional feedbacks are given regarding how to perform the endurance and strength exercises	☐
	-Individualized tasks are given according to students' level (e.g., in a circuit of strength work, the abdominal exercise could be straight sit-ups, inclined sit-ups or declined sit-ups, increasing the difficulty of the exercise with different levels)	☐	-No individualized tasks are given	☐
	-Physical activity benefits are explained (e.g., regular practice of physical activity is associated with a better cardiovascular profile)	☐	-Physical activity benefits are not explained	☐
	-Daily physical activity habits are asked, empathizing and showing concern regarding students' difficulties for practicing physical activity outside the class (e.g., How many days per week do you practice any type of physical activity during your leisure time?)	☐	-Daily physical activity habits are not asked	☐
	-References regarding the physical activity barriers are mentioned and solved (e.g., if students do not have time to do physical activity because of the volume of daily homework, the teacher suggests doing short periods of physical activity when students finished an activity, such as five minutes of going up and down stairs)	☐	-There are no references regarding physical activity barriers	☐
	-Improving fitness levels applying lesson tasks into the free time is encouraged (e.g., Physical Education teacher suggests spaces outside of school to continue running in students' leisure time-with their classmates listening to the music they liked the most)	☐	-There are no references in regard to leisure time physical activity	☐
	-Music chosen by the students is used (e.g., Survivor: Eye of the tiger)	☐	-No music is used	☐
Cool-down	-Interrogative feedbacks are given with the aim of making students reflect on the similarities between the elements of inside-outside contexts regarding the work of flexibility (e.g., How could you use the bench of the street to perform the same hamstring extensibility exercises as in the school gym?)	☐	-Instructional feedbacks are given regarding how to perform the flexibility exercises	☐
	-Students are expressing themselves about what they think about the lesson (e.g., Physical Education teacher asks questions such as: What did you learn?, What difficulties did you find during the lessons?, or Did you have a good time?)	☐	-Students do not have the opportunity to express their thinking	☐

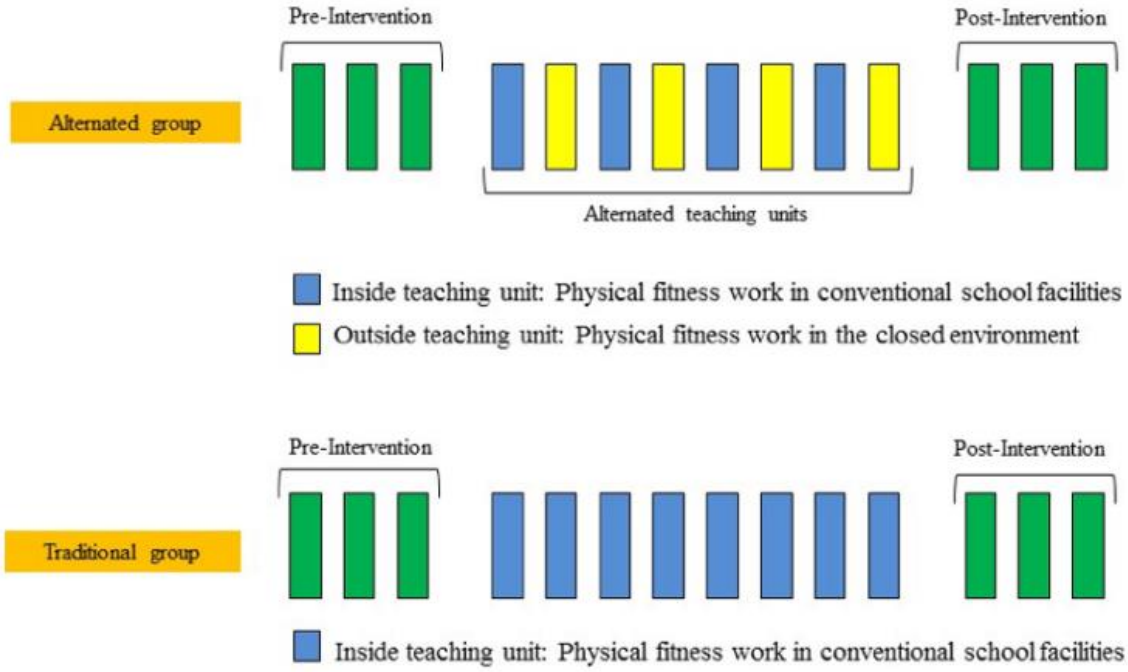

Figure 1. General scheme of the intervention

The AG students carried out two alternated teaching units (Viciana & Mayorga-Vega, 2016) for the work of inside and outside school physical fitness (specifically of the basic physical capacities of endurance, strength, and flexibility). It consisted of delivering one inside lesson (i.e., in school teaching unit, using conventional school facilities like a sports court or a gym) followed by another outside lesson in the immediate environment (i.e., out-of-school teaching unit, using green zones, outside facilities and features, or a municipal sports center) during the whole program (four of each modality). The main part of the lessons was focused on the work of physical fitness. During both in-school and out-of-school lessons of the same week, students worked the same contents (i.e., tasks and methods for working physical fitness). The main difference was the space and the material used in each of them. This teaching unit structure was developed with the purpose of establishing a learning transference from the PE class to the out-of-school context, making the immediate environment known to the students for the autonomous development and maintenance of their physical fitness. That is, during inside PE lessons, the teacher explained to students how they could do the same exercises in the out-of-school context using the elements of their immediate environment. To reinforce this aspect, interrogative feedbacks were given with the aim of making students reflect on the similarities between the elements of inside-outside contexts regarding the work of the different physical fitness capacities (see examples in Table 1). In addition to the connection between inside-outside school contexts through the reflexive teaching approach, the teaching style was also focused on motivational strategies and support of students' autonomy in order to encourage

PA participation through the increase of autonomous motivation (See Table 1) (Teixeira et al., 2020; Wang & Chen, 2020). To do that, based on Teixeira et al. (2020) classification of motivational strategies which are based on SDT framework (Ryan & Deci, 2020) the PE teacher developed the lessons applying the following strategies: a) individualized the different activities carried out during the lessons providing different levels of difficulty in order to make students feel they were competent enough to accomplish the activities; b) showed interest regarding the students' PA practice outside PE lessons and the barriers they encountered, and provided them some solutions to overcome these barriers; c) prompted students to put into practice what they were learning during PE lessons in their out-of-school time in order to obtain higher benefits for their health; and d) used empathetic listening at the end of the lessons to know students' opinion about the lesson.

Regarding the TG students, they received the same contents, lesson structure, and tasks as the AG. Similar to the AG, the main part of the lesson was focused on improving physical fitness. Nevertheless, unlike the AG, students only received in-school lessons using conventional school materials and facilities. Additionally, the TG group did not receive any of the specific strategies developed in the AG (i.e., knowledge of the environment, physical fitness concepts, nor specific motivational strategies). Thus, no transference of learning from the PE context to the out-of-school context in the immediate environment was promoted.

Measures—Before the intervention, general characteristics of the participants (i.e., age, grade, gender, body mass, and height) were registered during one PE lesson. Body mass and height were measured following the *International Standards for Anthropometric Assessment* protocol (Stewart, Marfell-Jones, Olds, & Ridder, 2011). Then, the body mass index was calculated as body mass divided by height squared (kg/m^2). Finally, students' body weight status was categorized by the body mass index thresholds (Cole, Bellizzi, Flegal, & Dietz, 2000).

Afterward, three PE lessons were used to administrate the knowledge test and questionnaires both at the beginning (pre-intervention) and at the end of the teaching unit (post-intervention). The students filled out the knowledge test and questionnaires in an ordinary classroom under silent conditions. Students were asked for their maximum sincerity, and they were guaranteed the confidentiality of the obtained data. Although instructions on how to correctly respond to the questionnaire were printed at the top, the researcher was present during the entire evaluation session to clarify any question that might arise.

Knowledge of the environment for the practice of physical fitness test. Students' knowledge was measured through the Knowledge about the Environment for Physical Conditioning in schoolchildren test (CENAFI) (Guijarro-Romero, Mayorga-Vega, Casado-Robles, & Viciana, 2024). It consisted of 30 questions with four possible answers where only one was correct (e.g., "In which of the following spaces could you work endurance using a distance and terrain fartlek?"). The three knowledge dimensions (i.e., declarative, procedural, and causal) and contents were balanced (10 questions for each

knowledge dimension: Two about the basic physical capacity of endurance, four on strength and four on flexibility). The Spanish version of the CENAFI test has shown adequate reliability and validity among high-school students (ICC = 0.65; adequate difficulty and discrimination indices; discriminant validity, intervention vs. control: $p < 0.001$, $d = 1.41$) (Guijarro-Romero et al., 2024).

Barriers toward physical activity. Students' perceived barriers toward PA practice were measured through the Spanish version of the Self-Perceived Barriers for PA (SPBPA) questionnaire (Niñerola et al., 2006). It consists of 17 items that measure specific barriers in PA in relation to four dimensions. Due to the purpose of the present study, only the environment and facilities dimension was used (e.g., "Being too far from the place where I can exercise"). The items were preceded by the sentence: "I do not usually do physical exercise because...". A 10-point Likert-type scale, ranging from 1 ("Low probability") to 10 ("High probability") was used in order to facilitate the evaluation of the items, making them similar to the qualifications that Spanish school-aged children receive in their scholar marks (Guijarro-Romero et al., 2020). The Spanish version of the SPBPA has shown adequate psychometric properties among high school students (Cronbach's α = 0.69) (Niñerola et al., 2006).

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 (e.g., "My PE teacher understands why I decide to do physical exercise in my free time") that evaluate a single factor of autonomy support. The items were preceded by the sentence: "In my PE classes...". A 10-point Likert-type scale, ranging from 1 ("Totally disagree") to 10 ("Totally agree") was used. 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; Cronbach's 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 (e.g., "Because it agrees with my way of life") distributed into six dimensions (intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and amotivation). The questionnaire was preceded by the sentence: "I do PA...". A 10-point Likert-type scale, ranging from 1 ("Not true for me") to 10 ("Very true for me") was used. The autonomous (i.e., averaging intrinsic, integrated, and identified regulation) and controlled (i.e., averaging introjected and external) motivations were also calculated (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; Cronbach's α = 0.66-0.87) (González-Cutre et al., 2010).

Intention to be physically active. Students' intention to be physically active during their free time was measured using the Spanish version of the Intention to partake in leisure-time PA questionnaire

(Granero-Gallegos, Baena-Extremera, Pérez-Quero, Ortiz-Camacho, & Bracho-Amador, 2014). It is composed of three items. Due to the purpose of the study, the original items were slightly modified (e.g., "I intend to do physical exercise using the urban environment at least three times a week next month"). The items were preceded by the sentence: "In my free time, outside of high school...". A 10-point Likert-type scale, ranging from 1 ("very unlikely") to 10 ("most likely") was used. The Spanish version of this questionnaire has shown adequate psychometric properties among high-school students (GFI = 1.00; RMR = 0.02; NFI = 1.00; NNFI = 0.99; CFI = 1.00; RMSEA = 0.03; Cronbach's α = 0.93; modified version: Cronbach's α = 0.94) (Granero-Gallegos et al., 2014).

Habitual physical activity. Students' habitual PA was measured using the Physician-based Assessment and Counseling for Exercise (PACE) questionnaire (Martínez-Gómez et al., 2009). It consists of two questions that measure how many days in the last week (PACE 1, "In the last 7 days, how many days did you do PA for 60 minutes or more?") and in a habitual week (PACE 2, "In a normal week, how many days do you do PA for 60 minutes or more?") at least 60 minutes of PA are performed. An 8-point Likert-type scale, ranging from 0 to 7 was used. The PACE questionnaire has shown adequate convergent validity (accelerometer) properties (r = 0.43) (Martínez-Gómez et al., 2009) and high reliability (Cronbach's α = 0.82) among high-school students.

Extracurricular physical activity. Students' extracurricular hours of PA practice were measured through the enKid questionnaire (Martínez-Gómez et al., 2009). It consists of one question: "How many hours do you spend on extracurricular sport activities weekly?". A 6-point Likert-type scale, ranging from 0 to "more than 5" was used. The enKid questionnaire has shown convergent validity (accelerometer) properties (r = 0.43) (Martínez-Gómez et al., 2009) and high reliability (Cronbach's α = 0.91) among high-school students.

Habitual use of the environment for practicing physical activity. Students habitual use of the environment for practicing PA was measured using a modified version of the PACE questionnaire. It consists of two questions that measure how many days in the last week ("In the last 7 days, how many days did you use the nearby urban environment to practice PA autonomously?) and in a habitual week ("In a normal week, how many days do you use the nearby urban environment to practice PA autonomously?") the urban environment is used to practice PA autonomously. A 7-point Likert-type scale, ranging from 0 to 7 was used. Reliability of this questionnaire was adequate (Cronbach's α = 0.87).

Statistical Analysis—Descriptive statistics (mean ± standard deviation or percentage) for the general characteristics of the participants and dependent variables were calculated. Statistical test assumptions were checked and met by common procedures (e.g., histograms and normal Q-Q plots for normality). 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 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). All the participants that did not follow protocol had failed to sustain a 100% attendance rate. Because the unit of intervention was the class, a Multilevel Linear Model (MLM) with participants nested within classes was selected [i.e., one-way nested analysis of variance (ANOVA)] (Li, Xiang, Chen, Xie, & Li, 2017). The maximum likelihood estimation method was used (Field, 2017). The –2 log-likelihood was used to compare the models fit (i.e., comparing the change in the chi-square test). From all the potential confounding variables explored (i.e., gender, age, body mass, height, body mass index, habitual PA, intervention attendance, and pre-intervention scores), pre-intervention scores of each dependent variable were used as a covariate for its corresponding dependent variable. Age was used as a covariable for extracurricular PA and perceived barriers toward the environment/facilities; and body height was used as covariable for autonomous motivation (see Tables 3, 4, and 5 footnotes) (i.e., one-way nested analysis of covariance (ANCOVA)]. Effect sizes were estimated using the Cohen's *d* for pairwise comparisons. Finally, although an intention-to-treat approach was followed in the present study, as a sensitivity analyses, all the above-mentioned analyses were also carried out with a per-protocol approach (i.e., including the participants, taking into consideration their adherence to the protocol, that is, eight lessons). All statistical analyses were performed using the SPSS version 25.0 for Windows (IBM® SPSS® Statistics). The statistical significance level was set at $p < 0.05$.

3. Results

Final sample and general characteristics - Figure 2 shows the flow chart of the participants included in the present study. All the invited 146 students (50.0% females) agreed to participate and satisfactorily met the inclusion and exclusion criteria. No participants were lost because of the rejection to continue in the study or change of school. Table 2 shows the general characteristics of the participants. 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 ($p > 0.05$). Regarding the attendance rate, the AG and TG participants obtained an average of 98.3% and 98.4%, respectively (overall = 98.4%). The results of the chi-square test did not show statistically significant differences on the percentage of students with attendance equal or not to 100% (i.e., 8 lessons) between the AG (92.0%) and TG (88.7%) ($\chi^2 = 0.449$, $p = 0.503$). In the sample of the present study, the internal consistency of all the dependent variables measured by dimensional questionnaires was above 0.70 (except for the knowledge test, $\alpha = 0.65$; controlled motivation, $\alpha = 0.53$; and environment/facilities perceived barriers, $\alpha = 0.54$).

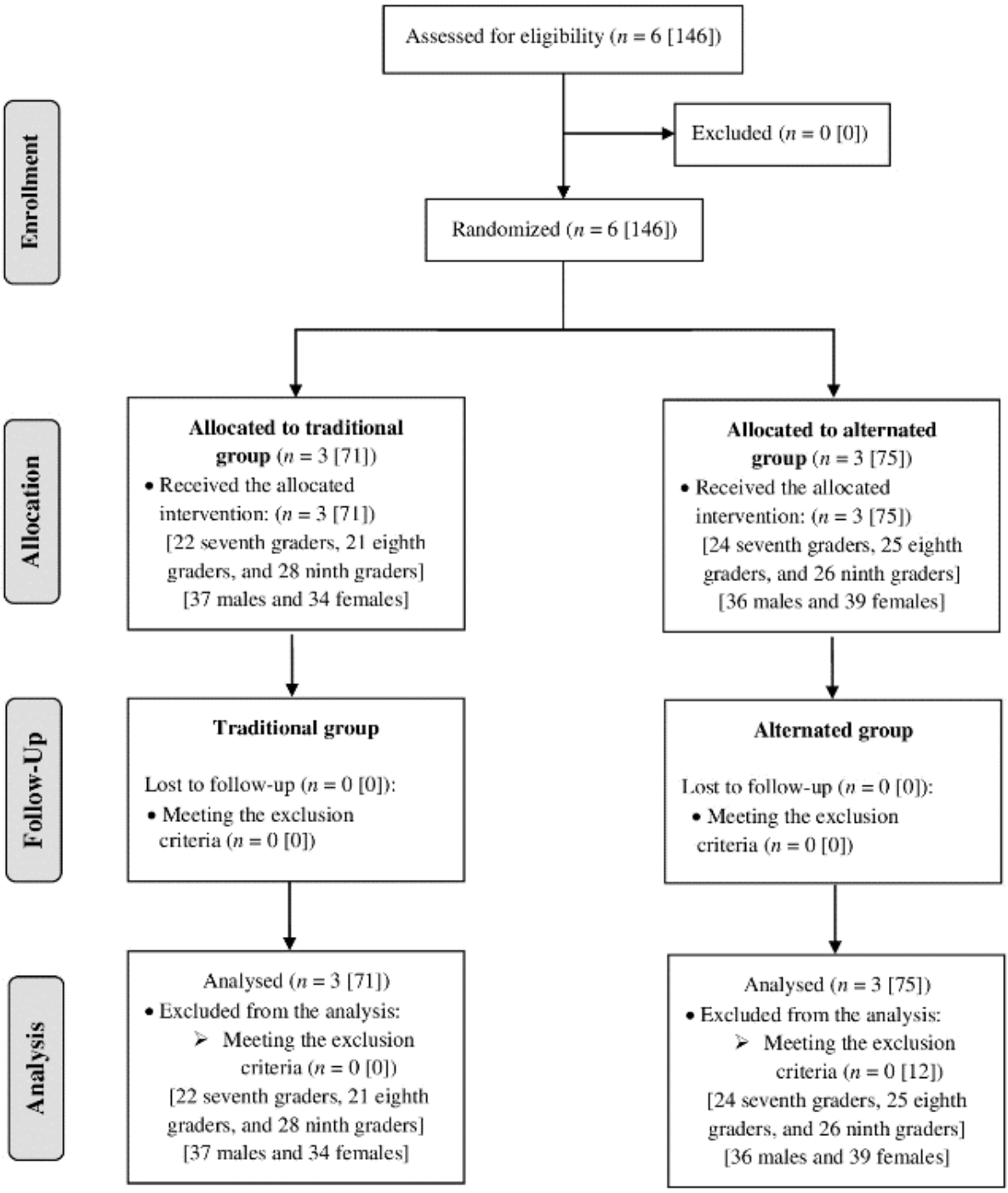

Figure 2. Flow chart of the school classes and students of the present study. All numbers are school classes [students].

Table 2. General characteristics of the participants and differences between the two groups.

	Total (N = 146)	Alternated (n = 75)	Traditional (n = 71)	F/ χ^2	p^a
Age (years)	13.1 (1.0)	13.1 (1.0)	13.1 (1.0)	0.140	0.709
Gender (females/males)	50.0/50.0	48.0/52.0	52.1/47.9	0.247	0.619
Grade (7^{th}/8^{th}/9^{th})	31.5/31.5/37.0	32.0/33.3/34.7	31.0/29.6/39.4	0.400	0.819
Body mass (kg)	52.9 (11.8)	52.8 (13.2)	52.9 (10.2)	0.001	0.977
Body height (cm)	160.6 (8.9)	160.3 (9.9)	160.9 (7.7)	0.181	0.672
Body mass index (kg/m^2)	20.4 (3.9)	20.4 (4.2)	20.4 (3.5)	0.002	0.961
Overweight-obese (no/yes)	78.1/21.9	77.3/22.7	78.9/21.1	0.051	0.822
Habitual physical activity (days/week)	3.2 (1.7)	3.3 (1.7)	3.1 (1.6)	0.255	0.615

Note. Continous variables (i.e., age, body mass, height, body mass index, and habitual physical activity) are reported as mean (standard deviation) and categorical variables (i.e., gender, grade and overweight-obese) as percentage.
[a] Significance level from the one-way analysis of variance for continous variables and the chi squared test for categorical variables.

Table 3. Effect of the inside-outside alternated teaching units on knowledge about their environment for physical conditioning.

Variable	Group	Pre-intervention	Post-intervention	Difference	Multilevel Linear Model[a]			Effect size
		M (SE)	M (SE)	M (SE)	-2LL	F	p	d
Declarative[b]	Alternated	3.3 (0.2)	5.8 (0.2)	2.7 (0.2)	533.319	65.081	< 0.001	1.34
	Traditional	3.4 (0.2)	3.9 (0.2)	0.6 (0.2)				
Procedural[b]	Alternated	4.5 (0.2)	6.4 (0.2)	1.8 (0.2)	572.647	25.507	< 0.001	0.88
	Traditional	4.7 (0.2)	5.0 (0.2)	0.4 (0.2)				
Causal[b]	Alternated	4.0 (0.2)	5.7 (0.2)	1.9 (0.2)	560.341	13.348	< 0.001	0.64
	Traditional	3.3 (0.2)	4.4 (0.2)	0.9 (0.2)				
Overall[b]	Alternated	11.8 (0.4)	17.9 (0.5)	6.1 (0.4)	763.063	58.884	< 0.001	1.30
	Traditional	11.4 (0.4)	13.3 (0.4)	1.8 (0.4)				

Note. M = Adjusted mean; SE = Standard error; - 2LL = -2 log-likelihood; d = Cohen's d effect size; Alternated, n = 75, Traditional, n = 71. [a]One-way nested analysis of covariance (ANCOVA). [b]Covariables: Pre-intervention scores.

Knowledge of the environment for the practice of physical fitness - Table 3 shows the effect of inside-outside alternated teaching units on students' knowledge of the environment for physical conditioning. The MLM results showed that the AG participants had a statistically significant improvement to their declarative (p < 0.001; d = 0.64-1.34), procedural, causal, and overall knowledge compared with those from the TG.

Perceived barriers, perceived autonomy support, and self-determined motivation toward physical activity - Table 4 shows the effect of inside-outside alternated teaching units on environment/facilities perceived barriers, perceived autonomy support in PE, and self-determined motivation toward PA. The MLM results showed that the AG participants had a statistically significant improvement to their perceived autonomy support (p < 0.001; d = 0.27), integrated regulation (p < 0.05; d = 0.24), and autonomous motivation (p = 0.05; d = 0.19) compared with those from the TG. However, for the perceived barriers (p = 0.271; d = -0.36), intrinsic motivation (p = 0.109; d = 0.25), identified (p = 0.620; d = 0.07), introjected (p = 0.584; d = 0.06), and external regulations (p = 0.386; d = -0.01), amotivation (p = 0.071; d = -0.20), and controlled motivation (p = 0.970; d = -0.04) statistically significant differences were not found.

Table 4. Effect of the inside-outside alternated teaching units on perceived barriers, perceived autonomy support, and self-determined motivation toward physical activity.

Variable	Group	Pre-intervention	Post-intervention	Difference	Multilevel Linear Model[a]			Effect size
		M (SE)	M (SE)	M (SE)	- 2LL	*F*	*p*	*d*
Perceived barriers								
Environment/Facilities[b,c]	Alternated	2.4 (0.2)	1.7 (0.1)	-0.5 (0.2)	380.017	4.601	0.271	-0.36
	Traditional	1.9 (0.1)	2.0 (0.1)	0.0 (0.2)				
Perceived autonomy support								
Autonomy[b]	Alternated	7.2 (0.2)	8.2 (0.2)	1.0 (0.2)	514.601	49.186	< 0.001	0.27
	Traditional	7.1 (0.2)	5.7 (0.2)	-1.4 (0.2)				
Self-determined motivation								
Intrinsic[b]	Alternated	8.1 (0.2)	8.3 (0.2)	0.1 (0.2)	408.320	3.518	0.109	0.25
	Traditional	8.5 (0.2)	8.1 (0.2)	-0.4 (0.2)				
Integrated[b]	Alternated	7.5 (0.2)	7.5 (0.3)	0.1 (0.2)	509.323	4.706	0.032	0.24
	Traditional	7.6 (0.3)	7.2 (0.3)	-0.4 (0.2)				
Identified[b]	Alternated	8.0 (0.2)	8.0 (0.2)	0.0 (0.2)	473.659	0.278	0.620	0.07
	Traditional	7.8 (0.2)	7.8 (0.2)	-0.1 (0.2)				
Introjected[b]	Alternated	3.7 (0.3)	3.8 (0.3)	0.0 (0.2)	510.646	0.302	0.584	0.06
	Traditional	3.4 (0.3)	3.4 (0.3)	-0.1 (0.2)				
External[b]	Alternated	2.3 (0.2)	1.9 (0.2)	-0.3 (0.2)	401.315	0.755	0.386	-0.01
	Traditional	2.0 (0.1)	1.9 (0.2)	-0.2 (0.1)				
Amotivation[b]	Alternated	2.1 (0.2)	1.7 (0.2)	-0.3 (0.1)	373.363	3.313	0.071	-0.20
	Traditional	1.6 (0.1)	1.7 (0.1)	0.0 (0.1)				
Autonomous[b, d]	Alternated	7.8 (0.2)	7.9 (0.2)	0.0 (0.1)	394.657	4.138	0.044	0.16
	Traditional	8.0 (0.2)	7.7 (0.2)	-0.3 (0.1)				
Controlled[b]	Alternated	3.0 (0.2)	2.9 (0.2)	-0.1 (0.1)	408.101	0.001	0.970	-0.04
	Traditional	2.7 (0.2)	2.7 (0.2)	-0.1 (0.1)				

Note. M = Adjusted mean; SE = Standard error; - 2LL = -2 log-likelihood; d = Cohen's d effect size; Alternated, n = 75, Traditional, n = 71. [a]One-way nested analysis of covariance (ANCOVA). Covariables: [b]Pre-intervention scores; [c]Age; [d]Body heigh.

Table 5. Effect of the inside-outside alternated teaching units on intention to be physically active, habitual and extracurricular physical activity, and habitual environment use for practicing physical activity.

Variable	Group	Pre-intervention	Post-intervention	Difference	Multilevel Linear Model[a]			Effect size
		M (SE)	M (SE)	M (SE)	- 2LL	*F*	*p*	*d*
Intention[b]	Alternated	5.1 (0.3)	5.6 (0.3)	0.3 (0.2)	517.948	2.859	0.148	0.16
	Traditional	4.8 (0.4)	4.2 (0.4)	-0.2 (0.2)				
Habitual PA[b]	Alternated	3.3 (0.2)	3.4 (0.2)	0.2 (0.1)	427.773	0.009	0.923	-0.01
	Traditional	3.1 (0.2)	3.3 (0.2)	0.2 (0.1)				
Extracurricular PA[b, c]	Alternated	3.3 (0.2)	3.6 (0.2)	0.2 (0.1)	409.455	0.307	0.581	0.05
	Traditional	3.3 (0.2)	3.4 (0.2)	0.1 (0.1)				
Environment use[b]	Alternated	1.9 (0.2)	2.2 (0.2)	0.4 (0.2)	504.141	3.992	0.098	0.35
	Traditional	1.6 (0.2)	1.3 (0.2)	-0.2 (0.2)				

Note. PA = Physical activity; M = Adjusted mean; SE = Standard error; - 2LL = -2 log-likelihood; d = Cohen's d effect size; Alternated, n = 75, Traditional, n = 71. [a]One-way nested analysis of covariance (ANCOVA). Covariables: [b]Pre-intervention scores; [c]Age.

Intention to be physically active, habitual and extracurricular physical activity, and habitual environment use for practicing physical activity - Table 5 shows the effect of inside-outside alternated teaching units on intention to be physically active, habitual and extracurricular PA, and habitual environment use for practicing PA. The MLM results did not show statistically significant differences for intention to be physically active (p = 0.148; d = 0.16), habitual (p = 0.923; d = -0.01) and extracurricular PA (p = 0.581; d = 0.05), and habitual environment use for practicing PA (p = 0.098; d = 0.05), between the AG and TG students.

Sensitivity analysis - The sensitivity analysis (i.e., per-protocol approach; one-way nested ANCOVA) found the same outcomes as the main analysis (i.e., intention-to-treat approach) in conceptual, procedural, causal, and overall knowledge, perceived barriers, autonomy support, intrinsic, identified, introjected, and external regulations, amotivation, controlled motivation, intention to be physically active, habitual PA, extracurricular PA, and environment use for practicing PA variables. However, and different from the main analysis, in the sensitivity analysis for the integrated regulation and autonomous motivation statistically significant differences between AG and TG were not found [p = 0.032 (main analysis) vs. p = 0.061 (sensitivity analysis) and p = 0.044 (main analysis) vs. p = 0.050 (sensitivity analysis), respectively] (Table S1).

4. Discussion

The main objective of the present study was to examine the effect of two PE-based inside-outside school alternated teaching units developed following a reflexive and autonomy-supportive teaching style on students' knowledge of their environment for physical conditioning in the out-of-school time, their perceived barriers toward PA practice, teacher autonomy support, self-determined motivation towards PA, intention to be physically active, habitual and extracurricular PA, and the regular use of their environment for practicing PA. Results showed that overall, the alternated teaching units developed following a reflexive and autonomy-supportive teaching style significantly improved AG students' declarative, procedural, and causal knowledge on how to use their immediate surroundings for improving physical fitness. These findings represent an important contribution to the field of the promotion of autonomous physical fitness in the out-of-school context. That is, knowing what, how, and why (i.e., declarative, procedural, and causal knowledge, respectively) to use the immediate environment for physical conditioning might positively influence students' perceptions of competence for working physical fitness autonomously in the out-of-school setting (Bandura 2004). According to the Social Cognitive Theory (Bandura, 2004), the acquisition of knowledge represents the first step toward generating a behavior change in PA practice. In this sense, the alternated teaching units based on a reflexive and autonomy support teaching approach allowed students to transfer the learning from the PE class to their daily life (European Commission/EACEA/Eurydice, 2013; Viciana & Mayorga-Vega, 2018), improving, therefore, their knowledge and making them more autonomous and capable to work on physical fitness autonomously in the out-of-school context. Previous studies have shown the importance of providing students with fitness knowledge during PE lessons to encourage the PA practice during the out-of-school time (Hodges, Kulinna, van de Mars, & Lee, 2016). Nevertheless, these studies were mainly focused on the knowledge of fitness training principles. To our knowledge, this is the first study that examines the effectiveness of this innovative

teaching unit structure developed following a reflexive and autonomy-supportive teaching style on students' knowledge about their nearby environment for physical conditioning.

Regarding perceived barriers toward PA practice, results of this study showed that the alternated teaching units based on a reflexive and autonomy support teaching approach did not improve the AG students' perceived barriers related to environment/facilities. Since environmental barriers are the most common among adolescents (Ferreira Silva et al., 2022), although it was not statistically significant, a light decrease in AG perceived barriers was observed (i.e., from 2.4 to 1.7) even considering the low levels showed before the intervention of the AG (2.4 out of 10). This could be because the knowledge acquired by the students thanks to the reflexive teaching approach followed during the teaching units led them to understand how they can use their nearby environment for physical conditioning, as well as to perceive the autonomy support from their PE teacher, which was also increased in AG students after the intervention. The effect of the various strategies used in the teaching unit could produce this outcome: a) the continuous meaningful reasons provided during the innovative teaching unit explaining why it is important to maintain an active and healthy behavior (e.g., having good fitness levels) (Neil-Sztramko, Caldwell, & Dobbins, 2021); b) the teaching style used, mainly based on fostering students' autonomous motivation and autonomy (e.g., considering students' opinion, encouraging them to put in practice what they have learned in PE lessons) (Cheon & Reeve, 2013; Wang & Chen, 2020); and c) the use of the out-of-school context (i.e., nearby environment) for delivering some PE lessons, where the students could experience authentic and situational PA practices transferable to their daily life (Viciana & Mayorga-Vega, 2018). These results are in line with previous studies that have applied similar autonomy-supportive strategies (Cheon & Reeve, 2013; Yli-Piipari et al., 2018). Additionally, as a consequence of applying these aforementioned strategies, innovative teaching units have also shown a positive effect on students' autonomous motivation toward PA, as well as a decrease in their amotivation. It is in line with the postulates of the SDT (Ryan & Deci, 2020) and the TCM tenets (Hagger & Chatzisarantis 2016) that point out that autonomy support fostered by the PE teacher will predict students' autonomous motivation toward PA in out-of-school settings. Furthermore, these results are also in line with previous studies based on SDT and TCM frameworks in which autonomy supportive teaching styles have been applied showing a positive effect on students' autonomous motivation toward PA (Cheon & Reeve, 2013; Yli-Piipari et al., 2018). Together with the autonomy supportive teaching style, this increase in autonomous motivation could be associated with the students' increment in competence and autonomy, as a consequence of the improvement of the knowledge about the environment for working on physical fitness thanks to the reflexive (Wang & Chen, 2020). In this sense, previous literature found that students' knowledge of how to do physical fitness and how to practice PA out-of-school has a direct effect on their autonomous motivation toward PA (Wang & Chen, 2020). Moreover, these findings are also in line with previous Education Outside programs which have shown to be effective in encouraging students' autonomous motivation through relocating their PE lessons from the conventional classroom to places outside the school center (Bølling, Elsborg, Nielsen, & Bentsen, 2018).

Regarding the effect of the two PE-based inside-outside alternated teaching units on students' intention to be physically active, their habitual and extracurricular PA, and the

regular use of their environment for practicing PA, results of this study showed that the alternated teaching units based on a reflexive and autonomy support teaching approach did not influence any of these variables. Although AG students knew how they might use their knowledge about the environment to practice physical conditioning, and they perceived higher autonomy support, as well as increased their autonomous motivation, this was not translated into an improvement in their present PA behavior nor an increase in the future intention of doing it. These results are contrary to the SDT postulates (Ryan & Deci, 2020), TCM propositions (Hagger & Chatzisarantis 2016), and previous studies carried out in the PE setting that have also applied autonomy-supportive teaching styles in which higher students' autonomous motivation toward PA positively influenced intention to continuously be physically active after the intervention, as well as actual students' PA engagement (Cheon & Reeve, 2013; Yli-Piipari et al., 2018). This could be due to the fact that AG students were specifically asked for their intention to practice PA autonomously using the immediate environment. Furthermore, the transference prediction of intention to be physically active on PA behavior has shown to be small in context and populations similar to the present study (Viciana et al., 2019). Moreover, the short length of the intervention (four weeks) could also be a limitation to achieving better results in the aforementioned actual PA variables. Previous literature suggests applying longer school-based PA interventions (around 12 weeks and up) in order to attain changes in PA behavior (Neil-Sztramko et al., 2021). However, the large number of curricular objectives that have to be developed during the scholar year, together with the low frequency of the PE subject (only two hours per week) (Hardman et al., 2014), make the application of longer interventions difficult for a specific educational objective. Additionally, it is possible that the applied motivational and autonomy-supportive strategies were not enough to achieve a more specific intentionality such as using the environment to practice PA autonomously. Therefore, future studies that do not have this time restriction should apply longer interventions (Hodges et al., 2016), incorporating other strategies such as Epstein's TARGET principles, which have shown to be effective for improving specifically adolescents' intention to be physically active in the out-of-school time (Cecchini, Fernández-Río, & Mendez-Gimenez, 2014). Furthermore, complementing the intervention with an extracurricular PA program where the students could put in practice the learnings acquired during PE lessons with their peers may help them to achieve more easily a PA behavioral change during the out-of-school time (Neil-Sztramko et al., 2021).

The main strength of the present study was that, this is the first study that examines the effect of two inside-outside alternated teaching units developed following a reflexive and autonomy-supportive teaching style on students' environmental knowledge for physical conditioning in the out-of-school context, their perceived barriers, perceived autonomy support, motivation toward PA, students' intention to be physically active, their habitual and extracurricular PA, and the regular use of their environment for practicing PA. Additionally, because of the nature of the context (i.e., school) and with the objective of keeping the ecological validity, the use of a cluster-randomized controlled trial design (balanced by grade) was more appropriate for the present research objective (Campbell et al., 2012). Furthermore, the comparison with a TG that also worked physical fitness, but only inside the school and without a reflexive and autonomy-supportive teaching approach, allows us to check that the innovative teaching units based on a reflexive and

autonomy-supportive teaching approach are more effective than the traditional practice for achieving the main study objective. Finally, the evaluation of the effect of the teaching unit with a MLM with participants nested within classes, represents an advancement with respect to the commonly applied analyses (Li et al., 2017).

This study also has some limitations that should be acknowledged. Firstly, the non-probabilistic and relatively small sample size provides a lower generalization power. This limits the generalizability of the obtained outcomes to the particular studied population and context. However, due to human and material resource restrictions, a probabilistic and larger sample could not be examined. Additionally, the present innovative teaching units were developed with a very specific content (physical fitness), which is one of the more worked 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 teaching unit length could have been a limitation to achieving greater effects on the PA variables. However, considering the large volume of objectives that have to be developed throughout the academic year with a very limited time for the PE subject (Hardman et al., 2014), the purpose was to carry out a real study that would be feasible to perform in the context of PE.

5. Practical Applications

Worldwide, the acquisition of healthy physical fitness levels, as well as the promotion of lifelong PA to maintain them is one of the main PE national standards (European Commission/EACEA/Eurydice, 2013; SHAPE America, 2013). To achieve this objective, it is necessary that PE teachers provide students with tools to become competent in practicing PA autonomously during out-of-school time (Viciana & Mayorga-Vega 2018). In this sense, transferring the learning from the classroom to students' daily life could be a good way to achieve the aforementioned purpose (Viciana & Mayorga-Vega 2018). A strategy for promoting this transferability of learning may be the education outside the classroom. To our knowledge, this is the first study that examines the effectiveness of inside-outside school alternated teaching units (Viciana & Mayorga-Vega, 2016) developed following a reflexive and autonomy-supportive teaching style on students' knowledge about their nearby environment for practicing physical conditioning outside of school, their perceptions of barriers, autonomy support, and motivation towards PA. The findings of the present study showed how alternated teaching units based on a reflexive and autonomy-supportive teaching approach seem to be a good way for improving all the above-mentioned students' variables (except perceptions of barriers). This knowledge may guide PE teachers to design interrelated teaching units with different distribution of the learning time that provide students with the necessary tools for their physical conditioning autonomously in the out-of-school time. Additionally, it could help reducing their high levels of physical inactivity (Guthold et al., 2020), therefore contributing to improve their physical fitness levels. However, it should be taken into account that the school center has green zones, outside facilities and features, or a municipal sports center nearby in order to invest as little time as possible in travelling to them.

6. Conclusions

The results of this study showed that inside-outside alternated teaching units carried out following a reflexive and autonomy-supportive teaching style in the PE setting are effective for improving students' declarative, procedural, and causal

knowledge about the environment for physical conditioning, their perceived autonomy support from the PE teacher, and autonomous motivation towards PA.

However, these innovative teaching units did not change students' perceived barriers, identified, introjected, and external regulations, controlled motivation, intention to be physically active, their habitual and extracurricular PA, nor their regular use of the environment for practicing PA. Future research studies should examine if longer indoor-outdoor alternated teaching units might have an effect on students' psychological PA mediators, as well as in their intention to be physically active.

Supplementary Materials: The following are available online at http://eurjhm.com/index.php/eurjhm.

Funding: This research was funded by the Spanish Ministry of Universities [FPU15/02387 (Santiago Guijarro-Romero) and FPU16/03314 (Carolina Casado-Robles)].

Acknowledgments: Authors want to thank you to all the students and the Physical Education teacher who made this research possible. We also thank Aliisa Hatten for the English revision of the manuscript. This study is part of the doctoral thesis of Santiago Guijarro-Romero carried out in the Department of Physical Education and Sport of the University of Granada (Spain).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

References

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior*, *31*(2), 143–164. doi: 10.1177/1090198104263660

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), 1–20. doi: 10.3390/ijerph14050485

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. doi: 10.1016/j.ijer.2018.03.004

Campbell, M. K., Piaggio, G., Elbourne, D. R., & Altman, D. G. (2012). Consort 2010 statement: Extension to cluster randomised trials. *BMJ*, *345*, 1–21. doi: 10.1136/bmj.e5661

Cecchini, J. A., Fernández-Río, J., & Mendez-Gimenez, A. (2014). Effects of Epstein's TARGET on adolescents' intentions to be physically active and leisure-time physical activity. *Health Education Research*, *29*(3), 485–490. doi: 10.1093/her/cyu007

Chemolli, E., & Gagné, M. (2014). Evidence against the continuum structure underlying motivation measures derived from Self-Determination Theory. *Psychological Assessment*, *26*(2), 575–585. doi: 10.1037/a0036212

Cheon, S., & Reeve, J. (2013). Do the benefits from autonomy-supportive PE teacher training programs endure? A one-year follow-up investigation. *Psychology of Sport and Exercise*, *14*(4), 508–518. doi: 10.1016/j.psychsport.2013.02.002

Cole, T. J., Bellizzi, M. C., Flegal, K. M., & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: International survey. *BMJ*, *1240–1243*, 1–6. doi: 10.1136/bmj.320.7244.1240

Demetriou, Y., Sudeck, G., Thiel, A., & Höner, O. (2015). The effects of school-based physical activity interventions on students' health-related fitness knowledge: A systematic review. *Educational Research Review*, *16*, 19–40. doi: 10.1016/j.edurev.2015.07.002

Dias, D. F., Loch, M. R., & Ronque, E. R. V. (2015). Perceived barriers to leisure-time physical activity and associated factors in adolescents. *Ciência & Saúde Coletiva*, *20*(11), 3339–3350. doi: 10.1590/1413-812320152011.00592014

Eddolls, W. T. B., McNarry, M. A., Lester, L., Winn, C. O. N., Stratton, G., & Mackintosh, K. A. (2018). The association between physical activity, fitness and body mass index on mental well-being and quality of

life in adolescents. *Quality of Life Research*, *27*(9), 2313–2320. doi: 10.1007/s11136-018-1915-3

European Commission/EACEA/Eurydice. (2013). *Physical Education and sport at school in Europe Eurydice Report*. Luxembourg: Publications Office of the European Union.

Ferkel, R. C., Judge, L. W., Stodden, D. F., & Griffin, K. (2014). Importance of health-related fitness knowledge to increasing physical activity and physical fitness. *Physical Educator*, *71*(2), 218–233.

Ferreira Silva, R. M., Mendonça, C. R., Azevedo, V. D., Raoof Memon, A., Noll. P. R. E. S., & Noll, M. (2022). Barriers to high school and university students' physical activity: A systematic review. *Plos One*, *17*(4), e0265913. doi: 10.1371/journal.pone.0265913

Field, A. (2017). *Discovering statistics using IBM SPSS Statistics (5th edition)*. London: SAGE Publications.

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. doi: 10.47197/retos.v0i26.34392

Guijarro-Romero, S., Mayorga-Vega, D., Casado-Robles, C., & Viciana, J. (2020). Does students' self-determined motivation toward Physical Education influence the effectiveness of a fitness teaching unit? A cluster-randomized controlled trial and cluster analysis. *Psychology of Sport and Exercise*, *51*, Article 101768. doi: 10.1016/j.psychsport.2020.101768

Guijarro-Romero, S., Mayorga-Vega, D., Casado-Robles, C., & Viciana, J. (2024). Desarrollo y validación de una prueba escrita objetiva de elección múltiple para evaluar el conocimiento del entorno para el acondicionamiento físico (CENAFI) en escolares. *Retos*, *51*, 426-441. doi: 10.47197/retos.v51.97719

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. doi: 10.3102/00346543155850

Hardman, K., Murphy, C., Routen, A., & Tones, S. (2014). *UNESCO-NWCPEA: World-wide survey of school Physical Education*. París: United Nations Educational, Scientific and Cultural Organization.

Hodges, M. G., Kulinna, P. H., van de Mars, H., & Lee, C. (2016). Knowledge in action: Fitness lesson segments that teach health-related fitness in elementary Physical Education. *Journal of Teaching in Physical Education*, *35*(1), 16–26. doi: 10.1123/jtpe.2014-0102

Li, W., Xiang, P., Chen, Y., 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. doi: 10.1123/jtpe.2016-0169

Martínez-Gómez, D., Martínez-de-Haro, V., Del-Campo, J., Zapatera, B., Welk, G. J., Villagra, A., … Veiga, Ó. L. (2009). Validez de cuatro cuestionarios para valorar la actividad física en adolescentes españoles. *Gaceta Sanitaria*, *23*(6), 512–517. doi: 10.1016/j.gaceta.2009.02.013

Moreno, J., 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.

Neil-Sztramko, S. E., Caldwell, H., & Dobbins, M. (2021). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *Cochrane Database of Systematic Reviews*, 9, Article CD007651. doi: 10.1002/14651858.CD007651.pub3

Niñerola, J., Capdevidla, L., & Pintanel, M. (2006). Barreras percibidas y actividad física: El autoinforme de barreras para la práctica de ejercicio físico. *Revista de Psicología del Deporte*, *15*(1), 53–69.

Raghuveer, G., Hartz, J., Lubans, D. R., Takken, T., Wiltz, J. L., Mietus-Snyder, M., … Edwards, N. M. (2020). Cardiorespiratory fitness in youth: An important marker of health. *Circulation*, *142*(7), e101–e18. doi: 10.1161/CIR.0000000000000866

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. doi: 10.1016/j.cedpsych.2020.101860

SHAPE America. (2013). *Grade-level outcomes for K-12 Physical Education*. Reston, VA: Author.

Sheeran, P., Klein, W. M. P., & Rothman, A. J. (2017). Health behavior change: Moving from observation to intervention. *Annual Review of Psychology*, *68*, 573–600. doi: 10.1146/annurev-psych-010416-044007

Spieth, P. M., Kubasch, A. S., Penzlin, A. I., Illigens, B. M. W., Barlinn, K., & Siepmann, T. (2016). Randomized controlled trials - a matter of design. *Neuropsychiatric Disease and Treatment*, *12*, 1341–1349. doi: 10.2147/ndt.s101938

Stewart, A., Marfell-Jones, M., Olds, T., & De Ridder, J. (2011). *International standards for anthropometric assessment*. New Zealand: International Society for the Advancement of Kinanthropometry.

Teixeira, P. J., Marques, M. M., Silva, M. N., Brunet, J., Duda, J., Haerens, L., … Hagger, M. (2020). Classification of techniques used in Self-Determination Theory-based interventions in health contexts: An expert consensus study. *Motivation Science*, *6*(4), 438–455. doi: 10.1037/mot0000172

Viciana, J., & Mayorga-Vega, D. (2016). Innovative teaching units applied to Physical Education – changing the curriculum management for authentic outcomes. *Kinesiology*, *48*(1), 142–152. doi: 10.26582/k.48.1.1

Viciana, J., & Mayorga-Vega, D. (2018). The three-axes model of planning in physical education. *Retos*, 33, 313–319. doi: 10.47197/retos.v0i33.54533

Viciana, J., Mayorga-Vega, D., Guijarro-Romero, S., & Martínez-Baena, A. (2017). Effect of two alternated teaching units of invasion team sports on the tactical learning in primary schoolchildren. *International Journal of Performance Analysis in Sport*, *17*(3), 256-270. doi: 10.1080/24748668.2017.1331575

Viciana, J., Mayorga-Vega, D., Martínez-Baena, A., Hagger, M. S., Liukkonen, J., & Yli-Piipari, S. (2019). Effect of self-determined motivation in Physical Education on objectively measured habitual physical activity: A trans-contextual model. *Kinesiology*, *51*(1), 141–149. doi: 10.26582/k.51.1.15

Wang, Y., & Chen, A. (2020). Two pathways underlying the effects of Physical Education on out-of-school physical activity. *Research Quarterly for Exercise and Sport*, *91*(2), 197–208. doi: 10.1080/02701367.2019.1656325

World Health Organization, W. (2018). *Global action plan on physical activity 2018–2030: More active people for a healthier world*. Geneva: World Health Organization.

Yáñez, J., & Castejón, F. J. (2011). La utilización de la transferencia para el aprendizaje de la táctica colectiva deportiva en Educación Secundaria. *Infancia y Aprendizaje, 34*, 95–107.

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. doi: 10.1123/jtpe.2017-0099