PSYCHODIDACTIC VARIABLES AND ACADEMIC PERFORMANCE IN PHYSICAL EDUCATION

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PSYCHODIDACTIC VARIABLES AND ACADEMIC PERFORMANCE IN PHYSICAL EDUCATION

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EDITORIAL
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Editorial: Psychodidactic Variables and Academic Performance in Physical Education

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Editorial on the Research Topic

Psychodidactic Variables and Academic Performance in Physical Education

Research in recent years has demonstrated that various psychological and didactic variables can significantly affect students, even affecting academic performance. Among these variables are techniques such as creating a positive class climate, encouraging intrinsic motivation to study school subjects, providing autonomy to the student in undertaking their homework, using various teaching-learning models, and even promoting an active lifestyle. It is also important to point out that scientific literature on this subject has shown that many of these variables can be approached from the point of view of the teacher or that of the student and that there is a close relationship between the development and evolution of the students' lives and their future school performance.

The articles collected in this Research Topic cover a huge variety of approaches (both qualitative and quantitative), including countries (such as Germany, Italy, Mexico, Romania, and Spain, etc.), and different types of studies (e.g., empirical research, research-action, training, validation of instruments, etc.).

This wealth of innovative material is offered with the aim of not only deepening knowledge on the subject but also offering practical ways to improve the psychological and didactic variables that could affect students.

Articles were submitted between November 2019 and June 2020, and involving 67 authors. The special issue includes 14 papers, discussed here according to the chronological order of article publication.

Granero-Gallegos et al. use multilevel regression models to understand differences in school satisfaction, disruptive behaviors, and teaching competencies according to the gender of students. They analyze school satisfaction and disruptive student behaviors based on perceived teaching competence. The study highlights that boys showed higher levels of negative behaviors than girls. In addition, it highlights that physical education (PE) teacher competence influences disruptive behaviors in the classroom, and that this is also related to school satisfaction.

Chiva-Bartoll et al. use a quasi-experimental design to analyze the effects of a service learning program on subjective happiness, prosocial behavior, and professional learning perceptions of Physical Education Teacher Education students, to examine correlations among these variables. This investigation provides educational researchers with valuable information to better understand how service-learning influences the training of Physical Education Teacher Education students.

Zamarripa et al. asses the psychometric properties, structure, and factorial invariance by gender of the adaptation of Basic Psychological Need Satisfaction and Frustration Scale to the PE context in Mexico. The authors demonstrate that this scale can be used to measure the satisfaction and/or

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frustration of the basic psychological needs of students in PE class and to assess differences between boys and girls.

Salvador-García et al. analyze the impact of content and language integrated learning (CLIL) on PE lessons through qualitative and quantitative approaches. The authors found that levels of moderate to vigorous physical activity are higher in the experimental group (CLIL) than in the control group, a result that clarifies the divergent viewpoints of the interviewees. However, they did not find differences related to social relationships.

Manzano-Sánchez et al. evaluated a program based on Hellison's Teaching Personal and Social Responsibility Model using qualitative methodologies. This study concludes that the model can be applied to all participants in the curriculum and is adaptable to any content and type of student body. The authors suggest the application of the model by all teachers involved in the same school year and including the participation of students' families.

Through a longitudinal study, Gentile et al. assess the effects of a PE program, elaborated within the Enriched Sports Activity Program (ESA Program) of an Erasmus + Project, on executive functions, namely, visuospatial working memory, inhibitory control, cognitive flexibility, and task switching. The authors conclude that the introduction of a sports program enriched with cognitive stimuli has beneficial effects on the working memory and cognitive flexibility of children.

Segura-Robles et al. analyze the effects of a flipped and gamified program on autonomy, competence, relatedness, satisfaction/enjoyment, intrinsic and extrinsic motivation, and boredom of students in PE. This study was carried out through experimental and pre-post design. The results indicated that autonomy students' satisfaction, enjoyment, and intrinsic motivation have improved based on the interaction with gamification and flipped learning.

Hortigüela-Alcalá et al. assess to what extent future PE teachers can apply the training they received at university in the classroom, deepening their fears, insecurities, and problems when carrying it out. A qualitative methodology was used and the results showed how the future teachers did not see their expectations of success fulfilled, encountering resistance from both students and teachers in PE.

Fernández-Espínola et al. check a model that analyzed the prediction of the satisfaction of the need for autonomy, competence, relatedness, and novelty, as well as the motivation experienced in PE on the intention to be physically active. A questionnaire was administered to 1665 PE students and path analysis were performed to conclude the importance of satisfying all the basic psychological needs (including novelty) and give special emphasis to the need for competence, since it predicts autonomous motivation and the intention to be physically active outside of the educational context.

Gea-García et al. analyze the mediating role of integrated regulation on the relationship between physical activity and physical fitness in children and adolescents. The authors conclude that mediation of the integrated regulation could be decisive in predicting and explaining the relationship between the practice of physical activity and physical fitness at these ages, highlighted its importance for greater adherence to the practice.

Claver et al. determine a predictive model of disciplined behaviors and academic performance in Physical Education students using achievement goal theory and self-determination theory as the theoretical framework. The results highlight the importance of the task-oriented motivational climate and the mediating role of basic psychological needs and autonomous motivation to generate these positive student outcomes (discipline and academic performance) in PE.

Crisol-Moya et al. focus their research on active methodologies in higher education. They analyze the opinions about active methodologies among university professors and students, describing perception and opinion of the modes of organization, methodological focuses, and evaluation systems that define the teaching-learning process. The results show that professors and students think they are making progress toward a learning-centered model, and that implementation of active methodologies implies new functions in their teaching practice.

Vergara-Torres et al. test a model of multilevel mediation that examines the relationships between the perception of corrective feedback with its degree of acceptance (perceived legitimacy) at the team level and the subjective vitality of students at the individual level, mediated by the satisfaction of three psychological needs, in the context of physical education. Based on self-determination theory, this research concludes that students who perceive their basic psychological needs to be met experience an increase their subjective vitality.

Mosoi et al. conduct a cross-sectional study to test the differences between organized physical activity and non-organized physical activity in an after-school program. A multivariate analysis of variance was used to conclude that not participating in an organized physical activity program results in a reduced level of physical mobility and consequently is associated with maladaptive social and psychological outcomes.

In conclusion, these 14 papers contribute to current scientific knowledge related to psychodidactic variables and academic performance in the field of PE. This Research Topic responds to the concerns of the different agents that intervene in the teaching-learning process through different stages, from elementary school to university

AUTHOR CONTRIBUTIONS

All authors contributed to the article and approved the submitted version.

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ORIGINAL RESEARCH
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Analysis of Misbehaviors and Satisfaction With School in Secondary Education According to Student Gender and Teaching Competence

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Effective classroom management is a critical teaching skill and a key concern for educators. Disruptive behaviors disturb effective classroom management and can influence school satisfaction if the teacher does not have the competencies to control them. Two objectives were set in this work: to understand the differences that exist in school satisfaction, disruptive behaviors, and teaching competencies according to the gender of the students; and to analyze school satisfaction and disruptive student behaviors based on perceived teaching competence. A non-probabilistic and convenience sample selection process was employed, based on the subjects that we were able to access. 758 students participated (male = 45.8%) from seven public secondary schools in the Murcia Region (Spain). The age range was between 13 and 18 years (M = 15.22; DT = 1.27). A questionnaire composed of the following scales was used: *Competencies Evaluation Scale for Teachers in Physical Education, School Satisfaction* and *Disruptive Behaviors in Physical Education.* Mixed Linear Models performed with the SPSS v.23 was used for statistical analyses. The results revealed statistically significant differences based on gender and physical education teaching competencies. In conclusion, the study highlights that physical education teacher skills influence disruptive behaviors in the classroom, and that this is also related to school satisfaction. Furthermore, it highlights that boys showed higher levels of negative behaviors than girls.

Keywords: physical education, disruptive behavior, indiscipline, high school, satisfaction

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INTRODUCTION

Undisciplined behaviors in the classroom are a serious problem for the teaching and learning process during adolescence (Medina and Reverte, 2019), and may have an impact on feelings regarding school satisfaction, the relationship with teachers or even on school failure (Baños et al., 2017). These types of behaviors commonly occur in the Physical Education (PE) class, producing conflictive situations between peers (students) and even with the teacher himself/herself. It is therefore advisable to solve the problem in a rapid and effective fashion (Müller et al., 2018).

Faced with these situations, the competencies of the PE teaching staff play an important role (Baños et al., 2017; Trigueros and Navarro, 2019; Granero-Gallegos et al., 2020); the way in which teachers design, organize and control their sessions can affect the students' disruptive behaviors and class outcome.

As evidenced in research by authors such as Goyette et al. (2000) and Kulinna et al. (2006), adolescents often show certain problematic behaviors in the classroom, such as idleness, disrespect, talking out of turn and/or avoiding or skipping classes, which have a negative impact on the learning environment. Even aggressive behaviors can sometimes arise in PE classes, such as bullying and peer fighting (Weiss et al., 2008). Studies looking at inappropriate behaviors in PE have demonstrated that the students' negative behavior not only affects the quality of teaching, but also interferes with peer learning (Kulinna et al., 2006; Cothran et al., 2009). Moreover, disruptive behaviors are more common at the secondary school level than in primary education classes, as evidenced by various works (e.g., Kulinna et al., 2006; Cothran and Kulinna, 2007). Adolescence, in particular, is characterized by a rebellious, non-conformist stage, a fight against authority, irresponsibility and low personal self-control. At this age, a disengagement with the school can occur, with a decreased willingness to comply with the rules and with expected behavior (Fredericks et al., 2004).

In addition, gender has been used to analyze these behaviors, both in students and in teachers. Specifically, the female gender (both teachers and students) are those who report the highest incidence of inappropriate behaviors (Kulinna et al., 2006), with females being the ones likely to receive this negativity (Cothran and Kulinna, 2007). There are several studies that have found higher levels of inappropriate behaviors among boys than among girls (Beaman et al., 2006; Kulinna et al., 2006; Cothran and Kulinna, 2007; Driessen, 2011). Boys tend to be more boisterous and disruptive with their peers (Glock and Kleen, 2017) whereas girls tend to be more proactive and less problematic (Driessen, 2011), albeit with more shy and introverted behaviors (Glock and Kleen, 2017). Furthermore, boys are often more influenced by their peers than girls are, resulting in higher levels of truancy, punishments and challenging behaviors that teachers have to face (Hadjar and Buchmann, 2016; Geven et al., 2017). Other authors (i.e., Baños et al., 2018) found that students claimed to have more aggressive behaviors during PE sessions.

Among the attributions made by the students regarding inappropriate behaviors when doing PE, the boredom they experience stands out, finding the classes monotonous, as well as expressing a certain discontent with the teacher. However, it should be noted that these are students with usually disruptive behaviors (Cothran and Kulinna, 2007). In relation to the teachers, some recent studies have linked disruptive behaviors to teacher competence as perceived by the students (Baños et al., 2019; Granero-Gallegos et al., 2019; Granero-Gallegos et al., 2020). This research related the high levels of teaching competencies with low levels of negative behavior in PE classes although the study did not cover the effect of the teaching staff's competence.

In addition, the scientific literature has stated that school satisfaction reduces student misbehavior, making it advisable to develop social and emotional skills, cognitive ability, behavioral and moral competencies, the recognition of positive behavior, belief in the future and prosocial norms (Sun, 2016). In contrast, ineffective classroom management causes disarray and interruptions produced by a few adolescents, affecting both the anxiety and stress of their peers and that of the teachers (Cothran et al., 2009).

In this way, the work of PE teachers plays a relevant part in developing good classroom behaviors. Depending on the skills that the teachers develop, they may increase or decrease negative behaviors (Rasmussen et al., 2014). Thus, teachers who have a wide repertoire of teaching styles, and who know how to adapt them to different environments and learning content, manage to improve the students' satisfaction with the school (Invernizzi et al., 2019); this is also influenced by the orientations toward learning (Agbuga et al., 2010).

Regarding the study of satisfaction, Diener's theory of subjective well-being (Diener, 2009) could be of great help. This theory consists of two dimensions, the cognitive dimension and the affective dimension. The cognitive dimension relates to the evaluative judgments of global satisfaction with life and its specific areas, while the affective dimension is identified with emotions and attachments such as fun, boredom and concern (Diener and Emmons, 1985). In this vein, Baena-Extremera and Granero-Gallegos (2015) highlight the importance of the student being satisfied and at ease in school. An adolescent who is satisfied with the school is associated with higher levels of life satisfaction (Scharenberg, 2016), with an adequate school climate managed by the teacher (Varela et al., 2018) and with better social relationships among his/her peers (Persson et al., 2016). However, a student who gets bored at school decreases the efficiency of any learning style (Ahmed et al., 2013). This is associated with higher school dropout rates (Takakura et al., 2010), and with low teacher competencies (Sun, 2016), which in turn relates to greater disruptive behavior (Baños et al., 2019).

Scientific evidence has demonstrated the impact of negative behaviors and student satisfaction on both the learning and teaching processes. However, there is not enough literature that links the skills of the PE teacher with either student satisfaction with the school or with classroom misbehavior. Therefore, this work sets out two important objectives: (1) to understand the differences that exist in terms of school satisfaction, disruptive behaviors and teaching competencies according to the gender of the students; and (2) to analyze school satisfaction and disruptive student behaviors based on perceived teaching competence. From a review of the literature, the following hypotheses are made:

(1) There will be a significant and positive correlation between school satisfaction, disruptive student behaviors and the perceived competencies of the PE teacher; however, there will be a significant and negative correlation between boredom with school, disruptive student behaviors, and the perceived competencies of the PE teacher.
(2) Boys will show more negative behaviors than girls although girls will score higher in school satisfaction and in the perception of teaching competencies.

(3) Students who perceive that PE teachers are competent will show less disruptive behavior and greater school satisfaction.

MATERIALS AND METHODS

Participants

The design of this cross-sectional study was observational and descriptive selecting a non-probabilistic convenience sample according to the people that could be accessed from public high schools located in areas of medium socioeconomic level (from Murcia and Cartagena cities). No educational center is included in the program of Teaching Compensatory, program that allocates specific, material and human resources to guarantee access, permanence and promotion in the educational system for socially disadvantaged students. A total of 758 students participated (males = 45.8%) from seven public secondary schools in the Murcia region of Spain (94% Spanish, Caucasian; 4% Arab origin; 1% East European, Caucasian; 1% South American). All students of these educational centers from 2nd, 3rd, 4th of ESO and 1st of Baccalaureate (PE is also subject compulsory) were requested to participate in this research. Incomplete answers due to errors or omissions in their responses (28) were dismissed for analysis and 34 students did not obtain parental consent to participate in this investigation. The age range was between 13 and 18 years (M = 15.22; SD = 1.27); the average age for the boys was 15.2 (SD = 1.29) and for the girls was 15.18 (SD = 1.26). The distribution in terms of course levels was as follows: 45.3% at ESO 2nd level; 20.1% at ESO 3rd level; 27.2% at ESO 4th level; and 7.5% in the 1st year of Baccalaureate. As PE is a compulsory subject for all students of the 1st year of Baccalaureate, these students were also included in this research. There were no statistically significant differences in gender × age between the included participants (p = 0.501) (see **Table 1**).

Instruments

To carry out this investigation, the next instruments have been used.

Teaching Competence

The Spanish version of the *Competencies Evaluation Scale for Teachers in Physical Education* (ETCS-PE) by Baena-Extremera et al. (2015) was used, adapted from the original *Evaluation of Teaching Competencies Scale* by Catano and Harvey (2011). It consists of eight items that measure the students' perception of teacher effectiveness. A seven-point Likert scale ranging from *low* (1, 2), *medium* (3, 4, 5), and *high* (6, 7) was used for the responses. The internal consistency indices were: Cronbach alpha (α) = 0.86; composite reliability = 0.86; Average Variance Extracted (AVE) = 0.59.

TABLE 1 | Distribution of the sample (n) according to Gender × Age (p = 0.501).

		Age			
		13 and 14 years	15 and 16 years	17 and 18 years	Total
Gender	Girl	210	164	37	411
	Boys	166	153	28	347
	Total	376	317	65	758

School Satisfaction

The Spanish version of the *Intrinsic Satisfaction Classroom Questionnaire* (ISC) by Castillo et al. (2001) was used, adapted from the original *Intrinsic Satisfaction Classroom Scale* by Nicholls et al. (1985), Nicholls (1989), and Duda and Nicholls (1992). It consists of eight items that measure the degree of school satisfaction using two subscales that measure *satisfaction/fun* (five items) and *boredom with school* (three items). For the responses, a Likert scale ranging from 1 (*totally disagree*) and 5 (*totally agree*) was used. The internal consistency indices were: *satisfaction/fun* α = 0.76, composite reliability = 0.76, AVE = 0.54; *boredom*, α = 0.70; Composite reliability = 0.72; AVE = 0.52.

Disruptive Behaviors in Physical Education

The Disruptive Conduct in Physical Education Questionnaire (CCDEF) by Granero-Gallegos and Baena-Extremera (2016) was used, which is the Spanish version of the original *Physical Education Classroom Instrument* (PECI) by Krech et al. (2010). This version consists of 17 items that measure disruptive behaviors in PE students in five subscales: (a) *Aggressive* (2 items), (b) *Low engagement or irresponsibility* (4 items), (c) *Fails to follow directions* (4 items), (d) *Distracts or disturbs others* (4 items), and (e) *Poor self-management* (3 items). A five-point Likert scale ranging from 1 (*never) to 5* (*always)* was used for the responses. The internal consistency indices were: *aggressive,*α = 0.58, composite reliability = 0.81, AVE = 0.54; *low engagement or irresponsibility*, α = 0.73, composite reliability = 0.84, AVE = 0.74; *fails to follow directions*, α = 0.77, composite reliability = 0.94, AVE = 0.65; *distracts or disturbs others*, α = 0.81, composite reliability = 0.92, AVE = 0.80; *poor self-management*, α = 0.84, composite reliability = 0.96, AVE = 0.92. Given the low index achieved by Cronbach's alpha, and that the AGR subscale consists of only two items, this factor was ignored in the analyses performed.

Procedure

Permission to carry out the work was obtained from the competent bodies, be they at the secondary schools or the university. Parents and adolescents were informed about the protocol and the study's subject matter. Informed consent by both was an indispensable requirement to participate in the research. The tools measuring the different variables were administered in the classroom by the researchers themselves, without the teacher present. All participants were informed of the study objective, the voluntary and confidential nature of the responses and the data handling, as well as their rights as participants under the Helsinki Declaration (2008). This research has been approved by the Ethics Committee of the University of Murcia (REF-45-20/01/2016).

The questionnaires where completed in the classroom in about 25–30 min with the same researcher always present who

expressed the possibility of consulting him about any doubts during the process, respecting the Helsinki Declaration (2008).

Data Analysis

The descriptive statistics of the items, the correlations and the internal consistency of each subscale were calculated, as well as the asymmetry and kurtosis with values close to 0 and <2.0. It is important to note that the data from this work were collected in schools so that the students could be nested based on the center, course and/or class, that is, violating the independence of observations principle. Therefore, the Mixed Linear Models analysis (MLM) were conducted, bearing in mind the individual characteristic variables of the participants and context variables. The dependent variables were the different ETCS-PE, ISC and CCDEF subscales, and the grouping or level of the school was considered a random effect, as were the student courses. The analyses were performed using the SPSS 23.0 MIXED procedure with the Restricted Maximum Likelihood Estimation Method. The Logarithm of Likelihood -2 (-2LL) (Pardo et al., 2007) was used to estimate the effects of the school and course variable on each estimated model. Different models were tested according to the different combinations of school levels and course with each of the dependent variables, including a null model. The "school" variable proved statistically significant ($p < 0.05$) in all cases, so it was estimated that the context variable "school" had an effect on each model. In addition, the intraclass correlation coefficient (ICC) was calculated for each of the compared variables. The results showed that the variance explained was greater than 6.14% in all cases, which allows us to say that a percentage of the differences between the dependent variables can be attributed to the school. The estimation method used was the restricted maximum likelihood estimation method. In light of the above, gender differences in relation to the various ETCS-PE, ISC and CCDEF subscales were calculated, in this case, the independent variable (mixed model factors) was the gender of the students. To calculate the differences according to teaching competence, the responses of this scale were categorized into three groups, low (responses 1 and 2 on the Likert scale), medium (responses 3, 4, and 5) and high (responses 6 and 7). The calculation of the differences between the three categorized groups of teaching competence in relation to satisfaction and boredom with school and disruptive behaviors was also conducted and, in this case, the independent variable (mixed model factors) was the teaching competence categorization.

Additionally, the factorial structure of each instrument was evaluated with confirmatory factor analysis (CFA) using the Maximum Likelihood method with the bootstrapping procedure, since the Mardia coefficient was high in each of the scales (16.71 in ETCS-PE; 12.51 in ISC and 292.55 in CCDEF). The different analyses were performed using the SPSS v.23 and AMOS v.22 statistical packages.

Psychometric Properties of the Instruments

Based on recommendations that discourage the use of a single overall model-fit measure (Bentler, 2007), each model was assessed using a combination of absolute and relative fit indices. The chi-squared ratio (χ^2) and the degrees of freedom (df) (χ^2/df), the comparative fit index (CFI), the Tucker-Lewis index (TLI) the incremental fit index (IFI), the root mean square error of approximation (RMSEA) with its confidence interval (CI 90%) and the Standardized Root Mean Square Residual (SRMR) were calculated. In the (χ^2/df) ratio, values < 2.0 are considered very good model fit indicators (Tabachnick and Fidell, 2007), although values < 5.0 are considered acceptable (Hu and Bentler, 1999). According to Hu and Bentler (1999), for the incremental indices (CFI, IFI, and TLI), values ≥ 0.95 are considered to indicate a good fit, although values of ≥ 0.90 are considered acceptable. These same authors consider that, for RMSEA, a value of ≤ 0.06 is considered to indicate a good fit, while for the RMSR values ≤ 0.08 are considered acceptable. As can be observed in **Table 2**, the different values for the goodness-of-fit indices of each instrument (ETCS-PE, ISC, and CCDEF) are acceptable.

RESULTS

Descriptive and Correlation Analysis

Table 3 shows that *teaching competence* presented moderately high average values, that for the ISC, the average values were higher for *bored* than for *satisfaction with school*, and that for disruptive behaviors, the average values were moderately low, oscillating between *low engagement or irresponsibility* and *poor self-management*, which presented the lowest average.

The correlations show that *teaching competence* only presented positive, moderate, and statistically significant values for *satisfaction with school*. Disruptive behaviors presented high, positive and statistically significant correlations between the same CCDEF subscales although positive correlations with more moderate values were also found between the different disruptive and *boredom with school* subscales (see **Table 3**).

Differences According to the Gender Variable

The differences were analyzed between the various subscales of teacher competence, school satisfaction and disruptive behaviors according to the gender variable. As shown in **Table 4**, the analyses indicate that there are statistically significant differences in the *boredom with school* and the four CCDEF subscales, and that, in all of them, the average values are higher for boys.

Differences According to Teaching Competence

In order to check the differences in the *satisfaction with school* and the *disruptive behaviors* subscales, according to the three *teaching competence* groups (low, medium, and high), the analysis performed indicates that the *p*-value associated with the comparative statistical tests of marginal averages has been calculated and corrected for multiple comparisons using SIDAK (**Table 5**).

Table 5 shows that there are statistically significant differences in all the subscales studied. In the case of satisfaction with school, the highest averages correspond to the high teaching competence

TABLE 2 | The goodness of fit index of the models.

	χ^2	df	χ^2/df	IFI	TLI	CFI	RMSEA(CI90%)	SRMR
ETCS-PE	36.04	20	1.80	0.99	0.99	0.99	0.03(0.01;0.05)	0.02
ISC	86.17	18	4.79	0.96	0.93	0.96	0.06(0.05;0.08)	0.04
CCDEF	303.09	84	3.61	0.96	0.95	0.96	0.06(0.05;0.07)	0.03

χ^2, chi-squared; df, degrees of freedom; IFI, incremental fit index; TLI, Tucker-Lewis index; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual; CI, confidence interval.

TABLE 3 | Descriptives and correlations of the ECTS-PE, ISC, and CCDEF subscales.

Subscales	*M*	*SD*	1	2	3	4	5	6	7
(1) Teaching competence	5.36	1.16	–	0.19**	−0.13**	−0.19**	−0.08	−0.08	−0.09
(2) Satisfaction with school	2.80	0.97	0.23**	–	−0.40**	−0.06	0.01	−0.03	−0.03
(3) Boredom with school	3.03	1.04	−0.14**	−0.23**	–	0.30**	0.21**	0.26**	0.19**
(4) Low engagement or irresponsibility	2.00	0.90	−0.23**	0.06	0.21**	–	0.65**	0.53**	0.41**
(5) Fails to follow directions	1.65	0.94	−0.21**	0.10	0.11*	0.73**	–	0.62**	0.55**
(6) Distracts or disturbs others	1.49	0.99	−0.14*	0.08	0.20**	0.69**	0.75**	–	0.69**
(7) Poor self-management	1.42	0.83	−0.09	0.08	0.16**	0.68**	0.69**	0.83**	–

$^*p < 0.05$; $^{**}p < 0.01$; M = mean; SD = standard deviation. The upper diagonal corresponds to the girls. The lower diagonal corresponds to the boys.

TABLE 4 | Gender differences based on the ETCS-PE, ISC, and CCDEF subscales according to the mixed regression model.

				CI95%		Statistical tests adjusted mixed model			Effect size
	Gender	Adjusted average	Typical error	Lower	Higher	*F*	df	*p*	*d*
Teaching competence PE	Girl	5.43	0.06	5.31	5.54	2.49	756	0.115	0.115
	Boy	5.29	0.06	5.17	5.41				
Satisfaction with school	Girl	2.80	0.04	2.71	2.89	0.00	756	0.978	0.000
	Boy	2.79	0.05	2.70	2.89				
Boredom with school	Girl	2.89	0.05	2.79	2.99	17.36	756	0.000	0.304
	Boy	3.20	0.06	3.10	3.31				
Low engagement or irresponsibility	Girl	1.88	0.04	1.80	1.97	15.86	756	0.000	0.291
	Boy	2.14	0.05	2.05	2.23				
Fails to follow directions	Girl	1.53	0.04	1.45	1.61	20.06	756	0.000	0.327
	Boy	1.80	0.04	1.71	1.89				
Distracts or disturbs others	Girl	1.37	0.04	1.29	1.44	24.45	756	0.000	0.361
	Boy	1.65	0.04	1.56	1.73				
Poor self-management	Girl	1.25	0.04	1.17	1.33	42.74	756	0.000	0.477
	Boy	1.63	0.04	1.55	1.72				

df, degrees of freedom; d, Cohen's d.

group, whereas for boredom with school and the four CCDEF subscales, the highest average values are presented by the low teaching competence group.

Regarding satisfaction with school and boredom with school, comparison tests show statistically significant differences between low and high teaching competence and between those of medium and high teaching competence, corrected using SIDAK (see **Table 5**). In the cases of disruptive behaviors, for low engagement or irresponsibility and fails to follow directions, statistically significant differences are notable between medium and high teaching competence; in the case of the Distracts or disturbs others subscale, statistically significant differences were found between high teaching competence and the other two groups, while in poor self-management, they were only found between low and high teaching competence.

DISCUSSION

This study set out two objectives: to understand the differences that exist in school satisfaction, disruptive behaviors and teaching competencies according to the gender of the students; and to analyze school satisfaction and disruptive behaviors based on teaching competence.

The results of this work relate teaching competence, satisfaction with school and inappropriate behaviors in

TABLE 5 | Differences in teaching competence (ETCS-PE) based on the ISC and CCDEF subscales according to the mixed regression model.

				CI95%		Mixed model adjusted			SIDAK[b]	Effect size
	Groups ETCS-PE[a]	Adjusted average	Typical error	Lower	Higher	*F*	df	*p*	*p*	*d*
Satisfaction with school	1	2.38	0.15	2.08	2.68				3***	0.779
	2	2.69	0.04	2.61	2.77	16.77	755	0.000	3***	0.315
	3	3.02	0.05	2.92	3.13					
Boredom with school	1	3.39	0.18	3.03	3.75				3**	0.624
	2	3.14	0.05	3.04	3.23	10.74	755	0.000	3***	0.252
	3	2.81	0.06	2.68	2.93					
Low engagement or	1	2.35	0.16	2.04	2.66				3**	0.764
irresponsibility	2	2.12	0.04	2.04	2.20	16.13	755	0.000	3***	0.309
	3	1.76	0.05	1.66	1.87					
Fails to follow directions	1	1.84	0.15	1.55	2.13					
	2	1.74	0.04	1.67	1.82	9.42	755	0.000	3***	0.236
	3	1.48	0.05	1.38	1.58					
Distracts or disturbs others	1	1.78	0.14	1.51	2.06				3*	0.456
	2	1.54	0.04	1.47	1.61	5.74	755	0.003	3*	0.184
	3	1.38	0.05	1.29	1.47					
Poor self-management	1	1.73	0.15	1.44	2.02				3*	0.421
	2	1.47	0.04	1.39	1.54	4.96	755	0.007		
	3	1.32	0.05	1.22	1.47					

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; d, Cohen's d. [a]Groups: 1 = low teaching competence (n = 31), 2 = medium teaching competence (n = 459), 3 = high teaching competence (n = 268); [b]Comparison of marginal means statistical tests corrected by multiple comparisons using SIDAK. To simplify the presentation of data, only groups with statistically significant differences are displayed.*

the classroom. As in other studies (e.g., Kulinna et al., 2006; Cothran and Kulinna, 2007), the children presented higher levels of disruptive behavior. These results might be due to the boredom experienced by adolescents coming from a lack of attachment to social institutions and from disruptive behaviors at school (Feinberg et al., 2013; Granero-Gallegos et al., 2020). It is essential that students do not experience boredom in school, given that it is related to school violence, and this in turn can contribute to reduced academic performance, mental health and general well-being of the students (Huebner et al., 2014; Olweus and Breivik, 2014). In addition, boredom has been associated with high-risk behaviors such as drinking, drug use, joyriding and criminal activity (Yang and Yoh, 2005; Wegner and Flisher, 2009). Therefore, it is important that teachers work on their social skills with students and acquire sufficient competency as educators so that, amongst other things, both feel satisfied in classes (Allen et al., 2015; Trigueros and Navarro, 2019). Accordingly, this confirms Hypothesis 1.

If one looks at the mixed regression model, no significant differences were found in the teacher competence and school satisfaction variables based on gender. However, significant differences were found in the boredom with school, low engagement or irresponsibility, fails to follow directions, distracts or disturbs others and poor self-management variables, with boys presenting higher values than girls. These results are similar to those obtained in previous studies (e.g., Beaman et al., 2006; Kulinna et al., 2006; Cothran and Kulinna, 2007; Driessen, 2011), in which higher levels of disruptive behavior were also found in boys. They may be due to boys being more defiant with the teacher and more competitive with their peers, seeking to get the attention of the girls. In addition, it has been observed that males tend to engage in louder and more intentional behaviors to distract their peers in class (Glock and Kleen, 2017). Also, a possible cause for the increased level of negative behaviors has been linked to low emotional support from the teacher (Shin and Ryan, 2017). All this can be the basis for proposing more comprehensive teacher training, not only at the technical level, but also in the management of emotions, both in the initial training and in the continuous workplace training. In contrast, the girls presented more positive and less problematic behaviors, as was the case in other studies (e.g., Driessen, 2011). This may be because girls tend to demonstrate more introverted behavior, being uninvolved, shy and avoiding working as a group to give their opinion on a topic (Glock and Kleen, 2017). Therefore, this does not confirm Hypothesis 2 in its entirety.

The model analyzed based on teacher competencies found that when students perceived PE teachers as being competent, they felt more satisfied with the school, less bored and that their disruptive behavior level fell. Conversely, when students perceived their teachers as being incompetent, they became

more bored and inappropriate behaviors increased. Similar results were found in the study by Baños et al. (2019), which was conducted in the same country as our work. These results suggest that the way teachers interact with their students affects classroom behavior (Ryan et al., 2015). This highlights the importance of PE teachers acquiring a great deal of skills to control and manage the sessions, creating a proactive environment among students, thus decreasing the likelihood of bad behaviors (Shin and Ryan, 2014; Fortuin et al., 2015). However, teachers reporting high levels of concern regarding how to effectively manage discipline issues in the classroom are common (Evertson and Weinstein, 2006; Tsouloupas et al., 2010) as they feel incompetent in the face of certain situations and this can be related to academic failure (Jurado-de-los-Santos and Tejada-Fernández, 2019). The inability to prevent and control student misbehavior is one of the main generators of teacher stress and anxiety, resulting in teachers burning out and increasing the likelihood of student truancy – with all the expenses that this involves for the educational system in terms of having to find substitute teachers (Tsouloupas et al., 2010; Ervasti et al., 2011). Therefore, this confirms Hypothesis 3.

PE teachers affirm that they find it more difficult to manage the boys' behavior (Jackson and Smith, 2000). These higher management issues may be due to the fact that teachers assess the temperament and educational competence of boys more negatively than those of girls (Mullola et al., 2012) and that boys more frequently show emotional opposition behaviors than girls do (McClowry et al., 2013). These differential behaviors in students and the teachers' perceptions are reflected in less intimate and more conflictive relationships between teachers and boys (Spilt et al., 2012). As a result, male students receive more reprimands (Beaman et al., 2006) than female students, making it harder to manage the boys' behavior (McClowry et al., 2013). This implies less effective classroom management with respect to males, as research has emphasized the importance of positive relationships between the teachers and the students to promote good classroom management (Marzano and Marzano, 2003). Therefore, teacher training is needed to better support trust and good management in the classroom.

CONCLUSION

The results obtained from this study identify males as having higher levels of inappropriate behaviors and the importance of students perceiving their teachers as being competent, that teachers have a command of the pedagogical content (Voss et al., 2011) and knowledge of classroom management techniques (Emmer and Stough, 2001) so that they can help reduce misbehavior in PE. Therefore, it is essential that adolescents perceive the PE teacher as competent, providing emotional support to his/her students, and that he/she continues to train in areas such as conflict resolution in the classroom, didactics and teacher pedagogy.

From this study, some recommendations can be made to bring, both to the classroom and to school. In general, the creation or strengthening of classrooms for school coexistence that improves the reflection, help, and accompaniment by other selected students can be recommended; it would be a program based on responsibility and without punishments or sanctions, and contribute to the resolution of conflicts in a positive way. By law, all educational centers must have a School Coexistence Plan, which must be implemented. More particularly, it is possible to focus on approaches that imply an enhancement of the motivation among students, especially in boys. Also, the enhancement of teaching competence in several topics (e.g., communication, work awareness, individual consideration of the student, problem-solving, social awareness, etc.), although the educational administration should supply teachers continuous training to improve social skills and capacity to solve conflicts among students.

Limitations and Strengths

The notable strengths of this work are the sample size and the theme, which can contribute to remedying one of the main problems found on a day-by-day basis in secondary schools. However, despite the novelty and interest of the topic and the results provided in this study such as the relationship between teaching competence and disruptive behaviors, as well as the implications this might have at the pedagogical and teacher-training level, certain limitations should be taken into account. The sample is composed of secondary school students from a single autonomous region and, in addition, no probabilistic sample design was carried out, so the results cannot be generalized and the method used does not allow to deeper into the disruptive causes in the classroom. Further studies should be performed in which other research designs are proposed, such as experimental studies with intervention programs to reduce disruptive behaviors in the classroom, and which consider other variables related to teacher, or mixed quantitative and qualitative research designs could be proposed, focusing on all subjects, not just PE. Some of these studies could also include private schools and public schools located in different socioeconomic level areas. On the other hand, it would also be convenient to perform longitudinal researches, with various data collections, in which the effectiveness of coexistence programs is valued.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by REF-45-20/01/2016. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AG-G, RB, and AB-E conceived the hypothesis of this study. RB, AB-E, and MM-M participated in data collection. RB and AG-G analyzed the data. AG-G, AB-E, and MM-M wrote the manuscript with the most significant input from AB-E. All authors contributed to data interpretation of statistical analysis and read and approved the final manuscript.

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Mexican Basic Psychological Need Satisfaction and Frustration Scale in Physical Education

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Basic psychological needs are an energizing state that, if satisfied, will produce an increase in confidence and a healthy motivational orientation that leads to wellness. Frustration of these needs is the opposite concept of satisfaction, which refers to the negative sensation experimented by an individual when he or she perceives that their psychological needs are being actively limited by the actions of the significant other. To date, we have not found instruments validated in Spanish that measure both the satisfaction and the frustration of basic psychological needs in the physical education (PE) context. Therefore, the aims of this study are adapting the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) to the PE context in Mexico; and examine its psychometric properties, structure, and factorial invariance by gender in a sample of fifth- and sixth-grade elementary school students. This study included a total of 1,470 fifth- and sixth-grade students from elementary schools in the metropolitan area of Monterrey, Nuevo Leon, Mexico. The results support the reliability, validity, structure, and strict invariance of the sixth Mexican version of the BPNSFS in physical education (BPNSFS-PE). The BPNSFS-PE can be used to measure the satisfaction and/or frustration of the basic psychological needs of students in PE class and to perform comparisons between groups of boys and girls.

Keywords: self-determination theory, autonomy, competence, relatedness, physical education, invariance, gender, Mexico

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INTRODUCTION

The self-determination theory (SDT) (Deci and Ryan, 1985, 2002, 2014; Ryan and Deci, 2017) is a macro theory that provides a clear overview of motivational processes and their consequences in different contexts, such as education. It proposes that in individuals that develop a motivation that brings them closer to an activity (e.g., actively participate in classes), their participation in the said activity will satisfy three basic psychological needs (BNP), which are autonomy, competence, and relatedness.

Autonomy refers to the feeling of willfulness that can accompany any act, whether dependent or independent, collective, or individual (Ryan and Deci, 2000); in other words, it refers to the desire of the individual to be the origin of their behavior, and therefore, it is related with the freedom granted to make decisions while the activity takes place.

Competence refers to the ability to effectively interact with their environment to assure the conservation of the organism. Satisfaction of the need for competence provides the energy for learning (Deci and Ryan, 1985). This leads people to look for challenges that are optimal for those skills and abilities related to the activity (e.g., the skills and content of subjects); in the same way, the need for competence refers to the feeling people have to act effectively in the environment surrounding them with the aim of developing feelings of achievement.

Relatedness refers to being connected and respected by others (e.g., with the professor and classmates) and having a feeling of belonging to the group (Ryan, 1995).

By definition, *basic psychological needs* are an energizing state that, if satisfied, will produce an increase in confidence and a healthy motivational orientation that leads to wellness and facilitates the development of enjoyment, effort, persistence, commitment, and well-being (Deci and Ryan, 2000).

But these needs can also be decreased by a negative context. Therefore, for several years, a construct of frustration of the psychological needs has been developed by Bartholomew et al. (2011), which refers to the negative sensation experimented by an individual when he or she perceives that their psychological needs are being actively limited by the actions of a significant other (e.g., the class teacher).

The *frustration* of these needs is the opposite concept to their *satisfaction* (Bartholomew et al., 2011). For example, a student may not have a good social relationship with his or her classmates because he or she does not feel close and is not compatible with them; however, another student may not have a good relationship with his or her classmates because they reject or bother him or her. Obviously, both cases are different: the first case refers to low satisfaction of the need for a relationship, while the second is related to the frustration of this need. Thus, to value the frustration of the psychological needs, it is necessary to refer to the effect caused by the significant others in these needs.

In recent years, different instruments have been used to measure the satisfaction of basic psychological needs (BPNS) in physical education (PE), and these have been validated in different cultures, such as British (Standage et al., 2005), Spanish (Moreno Murcia et al., 2008), Brazilian (Pires et al., 2010), Greek (Vlachopoulos et al., 2011), Chinese (Liu and Chung, 2014), and Mexican (Zamarripa et al., 2017).

On the other hand, to measure the frustration of basic psychological needs (BPNF), the *Psychological Need Thwarting Scale* (*PNTS*) has been used (Bartholomew et al., 2011), which has been adapted and used in the context of PE in the Chinese (Liu and Chung, 2015) and Spanish populations (Cuevas et al., 2015, 2016).

The number of items that must be used to measure satisfaction, on the one hand, and frustration, on the other, limits the studies along these lines. Instruments that measure BPNS use a considerable number of items that vary from 16 to 33. If we add the 12 items needed to measure BPNF, the number of items needed to measure both constructs would vary between 28 and 45.

As an alternative to these instruments, Chen et al. (2015) created an instrument that measures both constructs with a smaller number of items. The instrument called the *Basic Psychological Need Satisfaction and Need Frustration Scale* (BPNSNFS) was validated with a sample in four different cultures and languages (Belgium, China, United States, and Peru). The sample consisted of 1,051 university students with a mean age of 20 years. The study authors showed evidence that the scale, composed of 24 items, presented a multidimensional structure of six factors that measure satisfaction and frustration, respectively, in each of the psychological needs. The results obtained in a cross-validation recognized four necessary items, such as an internal consistency for each dimension that ranged from 0.64 to 0.89. The model of the six factors proposed by the authors had a good fit, $SB\chi^2$ (231) = 441.99, CFI = 0.95, RMSEA = 0.04, and SRMR = 0.04.

Within the educational context, the PE class was one subject that was intimately linked to adopting a healthy lifestyle. In line with Telama et al. (2005), the main objective of PE in many countries must be the promotion of health in young population, and Mexico is not an exception. The high rates of sedentary and obesity in the population, in addition to a large number of children and teens that can be accessed through PE, makes this the ideal medium for promoting health and healthy fitness from an early age. For this reason, the study of the BNP in PE could contribute to achieving this objective since different studies have demonstrated that satisfying these needs leads to more positive results of physical activity; in other words, PE students that have their needs satisfied show greater commitment (Parish and Treasure, 2003), effort (Bagøien et al., 2010; Taylor and Lonsdale, 2010; Taylor et al., 2010), and amount of physical activity, as well as a better perception of quality of life related to health (Standage et al., 2012).

In this sense, Haerens et al. (2015) translated the BPNSNFS into Dutch and adapted it to the context of PE. A total of 499 students (boys = 43.8%, M_{age} = 15.76, SD = 1.16) from secondary schools in Flanders, Belgium participated. The structure of the instrument was examined with a high-order confirmatory factorial analysis (CFA) where the items were used as indicators of six first-order factors (satisfaction of autonomy, competence, and relatedness, and frustration of autonomy, competence, and relatedness), which also served as indicators of two higher-order factors, that is, BPNS and BPNF. The two-dimension model (BPNS and BPNF) had acceptable fit indexes, χ^2 (243) = 530.49, $p < 0.001$, RMSEA = 0.05, CFI = 0.91, and SRMR = 0.06. The internal consistency of the high-order factors of satisfaction (α = 0.87) and frustration (α = 0.84) was acceptable, as well as each one of the six first-order factors (α = 0.71–0.80).

To date, we have not found instruments validated in Spanish that measure both the satisfaction and BPNF in the context of PE. The aforementioned limits the study of this area in Spanish-speaking cultures such as Mexico, and due to the importance and repercussion that the BPNS has on different

aspects related to the learning and well-being of students, it becomes necessary to have reliable instruments with an adequate number of items and that measures both constructs in the context of PE. Therefore, the aims of this study are to adapt the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) (Chen et al., 2015) to the context of PE in Mexico and examine its psychometric properties, structure, and factorial invariance by gender, in a sample of fifth- and sixth-grade Mexican elementary school students.

MATERIALS AND METHODS

Design and Type of Study

This was a quantitative study with an instrumental design to evaluate the psychometric properties of a scale that measures the satisfaction and BPNF in the context of PE (Ato et al., 2013). This was a non-probabilistic convenience sample.

Participants

Study participants included 1,470 students (boys = 50.6% and girls = 49.4%) from fifth (49.3%) and sixth (50.7%) grade from federal (89.3%) and state (10.7%) elementary schools of the metropolitan area of Monterrey in the morning (70.6%), afternoon (24.3%), and (5.2%) fulltime shift, with ages from 10 to 14 years (M_{age} = 10.56; SD = 0.77) who attended PE class twice a week with a duration of 50 min per session, and in which 68% said they practiced at least one sport outside of school. Fifth- and sixth-grade students were chosen because children who belong to the final years of third childhood and early adolescence are at the highest level of cognitive development and will not have any complications when responding to the instruments (Papalia et al., 2009).

Instrument

To measure the students' satisfaction and frustration, the BPNSFS (Chen et al., 2015) was translated and adapted to the PE context. The scale is composed of 24 items grouped into two factors: basic psychological needs satisfaction (BPNS) and basic psychological needs frustration (BPNF). These two factors are composed of three variables each; the BPNS is composed of satisfaction of autonomy (SA), satisfaction of competence (SC), and satisfaction of relatedness (SR). In contrast, the BPNF is composed of frustration of autonomy (FA), frustration of competence (FC), and frustration of relatedness (FR). Each one of these variables was measured by four items. The instrument has as a heading "En mi clase de Educación Física." One example of a SA item is "...siento que tengo la libertad y posibilidad de elegir las actividades de la clase." and of the FA "...siento que la mayoría de las actividades que hago, las hago porque tengo que hacerlas." One example of an SC item is "...siento que puedo hacer bien las actividades." and of FC "...tengo serias dudas acerca de que pueda hacer bien las actividades.". One example of an SR item is "...siento que le importo a mis compañeros que me importan." and of the FR "...me siento excluido del grupo al que quiero pertenecer." The 24 items are answered on a Likert scale of five points that go from 1 (*Not True at All*) to 5 (*Completely True*).

Procedure

This study was carried out according to the ethical guidelines recommended by the American Psychological Association (APA). Authorization was requested in writing from the school zone authorities and from each of the principals of the schools explaining the objectives of the research and the procedure that would be performed together with a model of the instrument. Afterward, authorization was requested for application from the teachers of each group and from the selected students taking into consideration the inclusion criteria: be a regular student in their respective group, regularly have PE class at least twice a week, be voluntarily willing to complete the questionnaire, and deliver the informed consent to participate in the research signed by their parents or tutors. The students were informed of the objective of the study, their willingness to volunteer, the absolute confidentiality of their answers, and the management of the data. They were also told that there were no correct or incorrect answers and they were asked for maximum sincerity and honesty. The questionnaire was anonymous and self-administered collectively in the classroom during school hours. To homogenize the data collection conditions, the administrators received prior preparation and training. The protocol was approved by the Ethics Committee of the Universidad Autónoma de Nuevo León (No. 16CI19039021). All subjects gave written informed consent in accordance with the Declaration of Helsinki.

The BPNSFS was translated into Mexican Spanish following the translation-back-translation procedure (Hambleton and Kanjee, 1995). The translation was carried out by a professional translation agency hired by the study team. To adapt the translation to the context of PE, a group of experts was formed with two Ph.D. specialists and with previous experience in the validation of psychological instruments, a PE teacher, and a translator specialized in the area of physical activity and sports; they discussed the translation discrepancies until the first version of the Mexican Spanish-language instrument was achieved. This version was retranslated into English by a professional translation agency different from the first and both versions were contrasted: the original and the translation. Again, the differences in the versions were analyzed and necessary changes were introduced to facilitate the comprehension of the items achieving a final version of each of the scales. This version was administered as a pilot application to a group of 72 students of different school levels to verify comprehension of each of the items; the results of this pilot application did not show any comprehension problems. The items that comprise the scale are presented in **Table 1**.

Data Analysis

First, a descriptive analysis was performed for all the scales and the factors that comprise them. To test the factorial structure of the questionnaire, a confirmatory factor analysis (CFA) was performed of the two proposed models (of two and four factors). Taking into consideration its ordinal nature, the sample size, the number of response options (k = 5), and the symmetry and kurtosis values of the items (see **Table 1**), the CFA was performed with the *maximum likelihood* (ML) method and

TABLE 1 | Descriptive and standardized solution of the items and subscales of the instrument.

Subscales						Factorial saturations	
	En mi clase de Educación Física. . . [In my Physical Education class. . .]	***M***	**SD**	**Asymmetry**	**Kurtosis**	**Two factors**	**Six factors**
	Basic psychological needs satisfaction	3.73	0.69	−0.61	0.63		
	Autonomy satisfaction	3.56	0.83	−0.54	0.14		
1	. . . siento que tengo la libertad y posibilidad de elegir las actividades de la clase. (. . .I feel a sense of choice and freedom in the things I undertake.)	3.19	1.40	−0.25	−1.19	0.33	0.29
7	. . . siento que mis decisiones reflejan lo que realmente quiero. (. . .I feel that my decisions reflect what I really want.)	3.69	1.17	−0.74	−0.16	0.54	0.51
13	. . . siento que mis elecciones expresan lo que realmente soy. (. . . I feel my choices express who I really am.)	3.63	1.27	−0.72	−0.48	0.61	0.57
19	. . . siento que he estado haciendo lo que realmente me interesa. (. . .I feel I have been doing what really interests me.)	3.76	1.22	−0.83	−0.26	0.63	0.61
	Relatedness satisfaction	3.67	0.87	−0.53	−0.06		
3	. . . siento que le importo a mis compañeros que me importan. (. . . I feel that the people I care about also care about me.)	3.70	1.22	−0.79	−0.25	0.54	0.57
9	. . . me siento conectado con los compañeros que se preocupan por mìi y por los cuales yo me preocupo. (. . . I feel connected with people who care for me, and for whom I care.)	3.74	1.24	−0.81	−0.33	0.56	0.60
15	. . . me siento cerca y conectado(a) con otros compañeros que son importantes para mí. (. . . I feel close and connected with other people who are important to me.)	3.73	1.24	−0.80	−0.31	0.66	0.68
21	. . . tengo una sensación de calidez cuando estoy con los compañeros con los que paso tiempo. (. . . I experience a warm feeling with the people I spend time with.)	3.51	1.29	−0.53	−0.76	0.58	0.59
	Competence satisfaction	3.94	0.81	−0.79	0.47		
5	. . . siento que puedo hacer bien las actividades. (. . .I feel confident that I can do things well.)	4.15	1.05	−1.35	1.34	0.60	0.62
11	. . . me siento capaz en las actividades que hago. (. . .I feel capable at what I do.)	3.92	1.15	−1.00	0.24	0.63	0.67
17	. . . siento que soy capaz de alcanzar los objetivos de la clase. (. . .I feel competent to achieve my goals.)	3.88	1.20	−0.93	−0.06	0.64	0.66
23	. . . siento que puedo cumplir con éxito las actividades difíciles. (. . .I feel I can successfully complete difficult tasks.)	3.81	1.20	−0.88	−0.10	0.60	0.62
	Basic psychological needs frustration	2.75	0.81	0.02	−0.30		
	Autonomy frustration	2.83	0.95	−0.12	−0.54		
2	. . . siento que la mayoría de las actividades que hago, las hago porque tengo que hacerlas. (. . .most of the things I do feel like “I have to”.)	3.26	1.35	−0.37	−1.06	0.41	0.43
8	. . . me siento obligado(a) a hacer muchas actividades que yo no elegiría hacer. (. . .I feel forced to do many things I wouldn’t choose to do.)	2.73	1.37	0.16	−1.22	0.52	0.56
14	. . . me siento presionado(a) a hacer muchas actividades. (. . .I feel pressured to do too many things.)	2.58	1.38	0.38	−1.12	0.68	0.72
20	. . . siento que las actividades de la clase son una serie de obligaciones. (. . .my daily activities feel like a chain of obligations.)	2.75	1.40	0.17	−1.25	0.56	0.62
	Relatedness frustration	2.75	0.94	0.12	−0.62		
4	. . . me siento excluido del grupo al que quiero pertenecer. (. . .I feel excluded from the group I want to belong to.)	2.75	1.45	0.14	−1.38	0.51	0.53
10	. . . siento que los compañeros que son importantes para mií son fríos y distantes conmigo. (. . .I feel that people who are important to me are cold and distant toward me.)	2.59	1.35	0.34	−1.08	0.61	0.65
16	. . . tengo la impresión de que le disgusto a los compañeros con los que paso tiempo. (. . .I have the impression that people I spend time with dislike me.)	2.67	1.35	0.29	−1.11	0.62	0.65
22	. . . siento que la relación con mis compañeros es superficial. (. . .I feel the relationships I have are just superficial.)	2.98	1.34	−0.09	−1.15	0.49	0.51
	Competence frustration	2.68	0.98	0.14	−0.70		
6	. . . tengo serias dudas acerca de que pueda hacer bien las actividades. (. . .I have serious doubts that I can do the activities well.)	3.14	1.38	−0.25	−1.18	0.51	0.51
12	. . . me siento decepcionado(a) con muchas de mis participaciones. (. . .I feel disappointed with many of my performance.)	2.57	1.35	0.35	−1.11	0.66	0.67
18	. . . me siento inseguro(a) de mis habilidades. (. . .I feel insecure about my abilities.)	2.60	1.38	0.31	−1.20	0.69	0.70
24	. . . me siento como un(a) fracasado(a) por los errores que cometo. (. . .I feel like a failure because of the mistakes I make.)	2.41	1.42	0.53	−1.09	0.61	0.62

All saturations were significant, $t > 1.96$, $p < 0.05$

as output the asymptotic covariance matrix of the polychoric correlations was used.

Model adequacy was analyzed with different fit indexes, such as the CFI, NNFI, and RMSEA. CFI and NNFI values greater than or equal to 0.95 indicate an acceptable fit (Hu and Bentler, 1999). For RMSEA, negative values or equal to or lower than 0.08 are considered satisfactory (Cole and Maxwell, 1985).

To determine which of the two models (two and six factors) adjusted better to the data, the differences between the goodness-of-fit indexes of the models were analyzed. Differences no greater than 0.01 between the CFI and NNFI values (Widaman, 1985; Cheung and Rensvold, 2002) and of 0.015 between the RMSEA values (Chen, 2007) were considered irrelevant in the models comparison, and therefore, claim support for the more constrained (parsimonious) model.

To determine if the Mexican version of the BPNSFS in physical education (BPNSFS-PE) shows invariance by gender, a multigroup CFA was performed. Incremental goodness-of-fit indexes of the alternative models were estimated. A difference of 0.01 or less between the CFI (Cheung and Rensvold, 2002) and of 0.05 between the NNFI values (Little, 1997) reflects practically irrelevant differences between the models. Regarding the RMSEA, a value of 0.015 or less between the alternative models indicates irrelevant differences (Chen, 2007).

Internal consistency of the instruments was evaluated with Cronbach's alpha (Cronbach, 1951); also, Pearson's correlation analysis was performed between all the variables. These were carried out using the statistical package SPSS Statistics V.21 and the program LISREL 8.80 (Jöreskog and Sörbom, 2006).

RESULTS

Descriptive Analysis and Normality

The descriptive analysis (mean, standard deviation, asymmetry, and kurtosis) of each of the items, variables, and factors that compose the scale is shown in **Table 1**. The results reveal that BPNS values are higher than the BPNF in the PE class. Particularly, competence is the psychological need that had the highest satisfaction values. On the other hand, autonomy was the psychological need that had the highest frustration values. Most of the asymmetry and kurtosis values were outside the range (−1.5 to 1.5), indicating a normal distribution of data (Shumacker and Lomax, 2004).

Confirmatory Factorial Analysis and Model Comparison

The goodness-of-fit of the two- ($SB\chi^2/df$ = 5.112, NNFI = 0.951, CFI = 0.955, and RMSEA = 0.053) and six-factor model ($SB\chi^2/df$ = 4.94, NNFI = 0.953, CFI = 0.960, y RMSEA = 0.052) was satisfactory. The values obtained from the differences between the fit indexes of both were irrelevant (ΔNNFI = 0.002, ΔCFI = 0.005, y ΔRMSEA = 0.001), which suggests that both models fit in a similar way; therefore, a more parsimonious model should be selected, in this case, the two-factor model (see **Table 2**). All estimated factorial saturations for the two- and six-factor model were significant (see **Table 1**).

Reliability

The results of the reliability analysis revealed alpha values of 0.55–0.66 for the SA, SR, and SC. This situation was similar to those of the FA, FR, and FC, which had alpha values of 0.62–0.66. Nevertheless, the internal consistency of the scales that measure BPNS and BPNF as a global measure presented good reliability with alpha values of 0.81 and 0.83, respectively.

Correlation Between Factors

The Pearson correlation analysis between the study variables revealed that BPNS had strong positive and significant correlations with SA, SR, and SC, and weak negative correlations with BPNF and FC. On the other hand, BPNF had strong positive and significant correlations with FA, FR, and FC; weak with SA; and negative with SC and SR (see **Table 3**).

Measurement Invariance

Based on the results of the CFA, invariance was evaluated based on the gender of the two-factor model. A preliminary analysis was performed that separately examined the structure of the BPNSFS-PE in the sample of boys (Model M0a) and girls (Model M0b). As shown in **Table 4**, the goodness-of-fit indexes of the models M0a and M0b were satisfactory with all the estimated parameters being statistically significant ($p < 0.01$).

Later, a multisample analysis was carried out. Model 1 (M1) examined the structural invariance of the BPNSFS-PE in both of the analyzed groups showing that the goodness-of-fit was satisfactory; therefore, we concluded that the factorial structure of the instrument is invariant in the two compared groups (see **Table 4**). The M1 was used as the basis for the nesting of restrictions.

Model 2 (M2), which tested the equivalence of factor saturations across the group of boys and girls, showed adequate fit indexes. After comparing these indexes with those of M1, the differences did not exceed the criteria values (ΔCFI < 0.01 and ΔNNFI < 0.05; ΔRMSEA < 0.015); therefore, this work presents evidence of the invariance of the factorial saturations of BPNSFS-PE across the evaluated sample.

Model 3 (M3) or the "strong factorial invariance model" (Meredith, 1993), which adds the equivalence of the intercepts, showed satisfactory goodness-of-fit indexes. The values obtained from the differences between the NNFI and the RMSEA from M3 and M1 did not exceed the criterion values. However, this did not happen with the CFI (see **Table 4**); nevertheless, it can be concluded that the equivalence of factorial saturations and

TABLE 2 | Goodness of fit indices of the confirmatory factor analysis of the two proposed models.

Models	χ^2/df	RMSEA	ΔRMSEA	CFI	ΔCFI	ΔNNFI	ΔNNFI
Two factors	5.11	0.053		0.955		0.951	
Six factors	4.94	0.052	0.001	0.960	0.005	0.953	0.002

df, degrees of freedom; RMSEA, root mean square error of approximation; NNFI, non-normed fit index; CFI, comparative fit index.

TABLE 3 | Bivariate correlations and internal consistency of the all variables of study.

	α	1	2	3	4	5	6	7
1. BPN. S	0.81	1						
2. Autonomy satisfaction	0.55	0.82**	1					
3. Relatedness satisfaction	0.65	0.85**	0.53**	1				
4. Competence satisfaction	0.66	0.83**	0.51**	0.58**	1			
5. BPN. F.	0.83	−0.06*	0.05*	−0.08**	−0.14**	1		
6. Autonomy frustration	0.64	−0.05	0.06*	−0.05*	−0.12**	0.83**	1	
7. Relatedness frustration	0.62	−0.02	0.06*	−0.04	−0.08**	0.84**	0.52**	1
8. Competence frustration	0.66	−0.10**	0.01	−0.10**	−0.15**	0.87**	0.58**	0.63**

*S, satisfaction; F, frustration; BPN, basic psychological needs; α, Cronbach alpha; *p < 0.05; **p < 0.01.*

TABLE 4 | Goodness of fit indexes of invariance models.

Model	Model description	*df*	SBχ^2	RMSEA	90% CI	NNFI	CFI	ΔNNFI	ΔCFI	ΔRMSEA
M0a	Baseline model boys	251	815.88**	0.055	0.051–0.059	0.950	0.955			
M0b	Baseline model girls	251	737.67**	0.052	0.048–0.056	0.950	0.955			
M1	Structural invariance (baseline model)	503	1554.54**	0.053	0.050–0.056	0.950	0.955			
M2	FL invariance	526	1694.45**	0.055	0.052–0.058	0.947	0.950	0.003	0.005	0.002
M3	FL + INT invariance	548	2009.23**	0.060	0.058–0.063	0.937	0.937	0.013	0.018	0.007
M4	SF + Inv. + Error invariance	572	2305.58**	0.064	0.062–0.067	0.928	0.925	0.022	0.03	0.011

*df, degrees of freedom; RMSEA, root mean square error of approximation; 90% CI, 90% confidence interval for the RMSEA; NNFI, non-normed fit index; CFI, comparative fit index; Inv., Invariance; FL, factor load; INT, intercepts. All comparisons in the Δ indices are made with respect to the baseline model (M1). **p < 0.01.*

intercepts can be accepted when the invariance is fulfilled for two parameters, although not for the CFI.

Finally, Model 4 (M4) or the "strict factorial invariance model" (Meredith, 1993), which adds invariance to the factorial saturations, intercepts, and errors, also presented satisfactory fit indexes. As in the previous comparison, the difference obtained between the NNFI and the RMSEA of the M4 and M1 did not exceed the criterion values, except for the CFI; however, it can be concluded that the strict factor equivalence of the BPNSFS-PE is accepted across gender when the invariance in two of the three parameters examined is fulfilled.

DISCUSSION

The aims of this study were to adapt the BPNSFS (Chen et al., 2015) to the context of PE in Mexico and examine its psychometric properties, structure, and factorial invariance by gender, in a sample of fifth- and sixth-grade Mexican elementary school students.

The results of the CFA revealed a good fit of the data for the two proposed models (two and six dimensions). Regarding the two-dimensional model (BPNS and BPNF), our results were consistent with those obtained from the Dutch translation adapted to PE by Haerens et al. (2015). Likewise, the goodness-of-fit indexes of the six-factor model (SA, SR, SC, FA, FR, and FC) found in this study were also consistent with the satisfactory fit of the PE version used by Cuevas et al. (2018) and in the version for the general context developed by Chen et al. (2015).

Regarding model comparison (two and six factors), the product obtained from the incremental differences of both models did not exceed the criterion values; this indicates irrelevant differences between both models; therefore, the most parsimonious model was selected, that is, the two-factor model for the invariance analysis. These results differ from those found by Cordeiro et al. (2016), where the six-factor model presented better goodness-of-fit indexes that coincide with those found by Chen et al. (2015). However, the instrument used in both studies measured need satisfaction and frustration in a general context (instead of a specific domain). Nevertheless, within the context of PE, the results of the study by Haerens et al. (2015) coincide with this work using the two-factor model (satisfaction and frustration).

The internal consistency of the factors that correspond with satisfaction (SA, SR, and SC) and frustration (FA, FR, and FC) did not reach the criterion value recommended by some authors (Nunnally and Bernstein, 1994; Bland and Altman, 1997). Schmitt (1996) has suggested that there is no general level (e.g., 0.70) in which the alpha becomes "acceptable," but the instruments with a very low alpha can still be useful in some circumstances, for example, when a scale is composed of a small number of items (Dall'oglio et al., 2010) and in the first stages of studies such as in this work (Nunnally, 1967). However, the internal consistency of the scales that measure BPNS and BPNF presented adequate reliability, even without reaching the maximum acceptable alpha, since according to Streiner (2003), instruments with high values (e.g., >0.90) could suggest that the items are redundant and that they are measuring the same question but in a different way.

The results of the correlation analysis between dimensions (BPNS and BPNF) and their respective factors (SA, SR, SC, FA, FR, and FC) revealed positive and significant relatedness

between them, as well as a negative and significant correlation between BPNS and BPNF. These correlations similarly coincide with the results reported in other studies that have used the same instrument (Chen et al., 2015; Haerens et al., 2015; Nishimura and Suzuki, 2016; Cuevas et al., 2018).

Finally, the results of the multigroup CFA revealed a strict factorial invariance of the BPNSFS-PE across sex in the two-factor structure. No recent studies have been found that examine the invariance of this instrument through gender groups in the context of PE. In the general context, the results of the study by Tóth-Király et al. (2018) revealed invariance by gender in the Hungarian version of the instrument; however, this analysis was performed on a model composed of two factors (BPNS and BPNF) and on a global one called *global need fulfillment*, which differs from the model we propose.

CONCLUSION

After examining the psychometric properties, structure, and factorial invariance of the Mexican version of the BPNSFS in the context of PE (BPNSFS-PE), it can be concluded that it is a reliable and valid instrument that can be used to measure the satisfaction and/or frustration of students' BPNs in PE class and make comparisons between groups of boys and girls, either as a two-factor (BPNS and BPNF) or a six-factor (SA, SR, SC, FA, FR, and FC) model according to the research purpose and question of each study, in order to increase the generation of knowledge and scientific production of this area in Mexico, since its factorial structure coincides with that used in previous studies and it is consistent with the assumptions of the SDT (Deci and Ryan, 1985, 2002, 2014; Ryan and Deci, 2017).

This study also has some limitations. The study participants only include fifth- and sixth-grade students from elementary schools in the metropolitan area of Monterrey; therefore, future research should include population from different school levels and sectors in the country. In addition, the study of the psychometric properties of the instrument could be expanded to include population from other Spanish-speaking countries, and in this way, contribute to the conduction of cross-cultural studies. Lastly, we suggest including in the study of factorial invariance the educational grades and levels, areas and populations of other sectors of the country, as well as population from different Spanish-speaking countries to determine its function and facilitate the comparison of results.

PRACTICAL APPLICATIONS

This instrument can be used by teachers, school principals, institutions responsible for PE, and researchers to perform studies with Mexican population with the aim of knowing the levels of satisfaction and frustration of students during PE class and to make comparisons between boys and girls. The aforementioned is of vital importance for learning because, as mentioned before, when needs are satisfied, there is an increase in confidence and a healthy motivational orientation that leads to health and that facilitates the development of enjoyment, effort, persistence, commitment, and well-being (Deci and Ryan, 2000).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee of the Universidad Autónoma de Nuevo León (No. 16CI19039021). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

JZ, RR-M, and FO-S conceived the hypothesis of this study. JP-G and MD participated in data collection and methodology. JZ and MD analyzed the data. JZ and RR-M wrote the manuscript with significant input from JZ. JZ took charge of funding acquisition. All authors contributed to data interpretation of statistical analysis, and read and approved the final manuscript.

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Effects of Service Learning on Physical Education Teacher Education Students' Subjective Happiness, Prosocial Behavior, and Professional Learning

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Purpose: This study aims to analyze the effects of a service learning (SL) program on the subjective happiness (SH), prosocial behavior (PB), and professional learning (PL) perceptions of Physical Education Teacher Education (PETE) students as well as to examine the correlations among these variables.

Methods: The study used a quasi-experimental design of two non-equivalent groups (control and experimental) comparing pre-test and post-test data. The instruments used were the Subjective Happiness Scale, the Prosocial and Civic Competence questionnaire, and the Impact of Service Learning during Initial Training of Physical Activity and Sports questionnaire.

Results: Data indicated that SL only had a significant influence on SH when the students compared themselves with their peers. On the other hand, the effect of SL on promoting PB and PL perceived was significant in several of their dimensions. Finally, the results showed a greater correlation of the perceived PL with the PB than with the SH.

Discussion/Conclusion: The results of the study provide educational researchers with valuable information to better understand how SL influences the training of PETE students.

Keywords: physical education, service learning, teacher training, social skills, personality

Abbreviations: IMAPS-AFD-FI, impact of service learning during initial training of physical activity and sports; PB, prosocial behavior; PCC, prosocial and civic competence; PETE, physical education teacher education; PL, professional learning; SH, subjective happiness; SHS, subjective happiness scale; SL, service learning.

INTRODUCTION

Physical Education Teacher Education (PETE) students require a break from traditional methodologies and demand new avenues that give them maximum prominence. Furthermore, there is no doubt that one of the aims of the current Physical Education lies in responding to the needs of the society of the XXI century (Metzler, 2017). In accordance with this view, SL is a teaching methodology that seeks to develop academic and professional competencies while providing community service to meet social needs (Capella-Peris et al., 2020).

The framework of SL is mainly based on the experiential learning theory proposed by Dewey (1938), which states that learning happens within a particular environment. In this regard, SL stimulates the acquisition of knowledge in a constructive way, favoring sociocultural learning and promoting active learning with the promotion of social justice (Jones and Kiser, 2014).

Various works in the field of PETE have shown that SL increases the students' knowledge of the curriculum as well as perceived applied skills (Galvan et al., 2018). This fact reinforces the idea that SL represents a great opportunity to develop professional skills combining both theory and practice. Several studies have also analyzed the effect of SL academically and professionally (Galvan et al., 2018; Capella-Peris et al., 2020), while other works have focused on the impact of this teaching method from a social standpoint (Domangue and Carson, 2008; Gil-Gómez et al., 2015; Whitley et al., 2017).

The present work intends to go a step further, not only analyzing the social and professional skills developed through SL but also considering its influence on the subjective happiness of PETE students. The SL intervention analyzed in this study was implemented in the particular context of Melilla, an autonomous Spanish city located in the north coast of the African continent. Due to its geographical position, this city has many unique features, chief among which is the composition of its population. High immigration rates, together with a high number of people from disadvantaged sociocultural environments and/or at risk of social exclusion as disabled older adults, create a context where the well-being of a large segment of its inhabitants is in question.

In disadvantaged social contexts like this, SL could help students gain not only well-being but also a deeper understanding of the community they live in. In this sense, students who have participated in SL programs have improved on their engagement with and learning about the community (Pak, 2018). This issue is relevant because students learn to develop a sense of belonging to a place when they are given the opportunity to help build their community, and this process not only improves their well-being but also helps instill a belief that they can make a valuable impact in their community (Williams, 2016).

The most important aspect of well-being – but at the same time the most controversial – is happiness. It is subject to debate because it can vary according to each person. In addition, happiness is associated with other concepts such as satisfaction, pleasantness, goodness, positivity, and a meaningful and/or full life (Ruysschaert, 2014).

Some studies have confirmed a positive effect of SL on student happiness in different social environments, for example, a SL intervention carried out by university students with adolescents with low resources in Mongolia (Shu-Chin and Tzong-Heng, 2016) or a SL intervention carried out by pre-service teachers with minors with special educational needs in Spain (Capella-Peris et al., 2020).

On its part, PB in SL contexts refers to a wide range of attitudes motivated by a genuine desire to benefit others without any expectation of benefit to oneself (Gil-Gómez et al., 2016). These include altruism, empathy, cooperation, honesty, humility, kindness, the ability to share and help others, and the desire to volunteer and make donations (Padilla-Walker and Carlo, 2014). This leads to a positive relationship between the implementation of SL and the development of PB of the participant students (Gil-Gómez et al., 2016). In this vein, SL activities, even programs with limited intensity and duration, have been found to be related to a number of positive outcomes related to the participants' sense of social responsibility as well as self-efficacy and prosocial behavior (Lim, 2007). However, it is necessary to deepen our understanding of this issue by specifically focusing on PETE students in multicultural contexts.

In addition, in PETE training settings, evidence supports that SL can develop PL such as evaluation skills, emotional engagement, and cognitive readiness with the community (Chambers and Lavery, 2012; Seban, 2013), perceived competency as teachers, and several teaching strategies (Galvan et al., 2018). Moreover, SL stands as a favorable opportunity to develop Physical Education competencies, combining theory and practice in the same activity (Wilkinson et al., 2013).

The objective of the study is to analyze the effects of SL on the SH, PB, and PL perceptions of PETE students as well as to examine the correlations among these variables.

MATERIALS AND METHODS

Research Settings

This study follows the model-based practice within Physical Education to investigate pedagogical models. Thus, it presents the three key elements stated by Hastie and Casey (2014): description of the curricular elements, validation of model implementation, and a description of the program context.

The SL project was implemented at the Faculty of Education and Sport Sciences, Melilla campus, which is part of the University of Granada (Spain). The contents of the courses involved were: (1) body expression and games, (2) evaluation of teaching of Physical Education and Sport, and (3) planning and organizing sport systems and activities. These are the subjects of the PETE program and, among others, they aim to develop the following competencies detailed in the curriculum:

- Design, develop, and evaluate the teaching-learning processes related to physical activity and sport, considering the individual and contextual characteristics of people.
- Evaluate physical condition and prescribe health-oriented physical exercise.

- Promote and evaluate the creation of long-lasting and autonomous physical activity and sport habits among different populations.
- Plan, develop, and evaluate the performance of recreational physical activities.
- Select and know how to use appropriate sports equipment for each recreational physical activity.

The service that the students offered consisted of providing the disadvantaged population of Melilla with opportunities for the practice of healthy, recreational, and educational physical activity. The structure of the SL program, following the recommendations of Jacoby (2015), was based on Kolb's learning stages (Kolb, 1984). Initially, a stage of concrete experience was carried out, focused on establishing the students' initial contact with specific community problems (involving a broad range of cultural, social, religious, and physical characteristics). After this phase came the reflection stage, in which the pupils had to focus on observation and reflection to propose an action plan based on the academic subjects involved. After that, the students defined the specific needs to be met. Therefore, they theoretically examined the topics and concepts worked to link the tasks proposed with the academic contents. The execution of the tasks made up the program's active experimentation phase.

Design

Given the aims of the study, this work implemented a quasi-experimental design of two non-equivalent groups (experimental and control) with pre-test and post-test measures to compare how the participation in a SL program based on physical activity promotion affected the SH, PB, and PL of PETE students. In addition, to deepen on the analysis, the correlations among these variables were also analyzed.

Participants

A total of 104 students (average age was 22.9 ± 2.5 years) from the Sport Science and Primary School Bachelor Degree participated in the study. They belong to the fifth year – "Assessment of the Physical Activity and Sports Teaching" – and third year – "Body Expression and Games" – of the Bachelor Degree subjects. The control group, which took the course following traditional methodologies, consisted of 55 students (53%), with an average age of 22.7 ± 3.5 years. On the other hand, 49 students (47%), with an average age of 23.2 ± 1.4 years, participated in the SL program. These composed the experimental group. **Table 1** shows the most outstanding sociodemographic characteristics of the participants.

TABLE 1 | Sociodemographic characteristics of the sample.

	Control group (*n* = 55)	Experimental group (*n* = 49)
Sex		
Female	8 (15%)	6 (12%)
Male	47 (85%)	43 (88%)
Religion		
Catholic	37 (67%)	31 (63%)
Muslim	8 (15%)	3 (6%)
None	10 (18%)	15 (31%)
Attendance rate		
Has not attended class	–	–
Less than 25%	–	–
Between 25–50%	–	–
Between 50–75%	3 (6%)	2 (4%)
Between 75–90%	15 (27%)	6 (12%)
More than 90%	37 (67%)	41 (84%)
Previous experience of volunteering or SL		
With previous experience	19 (35%)	11 (22%)
No previous experience	36 (65%)	38 (78%)

Instrument and Procedures

Subjective Happiness Scale

The Spanish version of the SHS has been used to assess the degree of SH of the participating students (Extremera and Fernández-Berrocal, 2014). This version has been validated for use with youngsters and adults. The four-item instrument measures subjective happiness, asking the participants either to self-rate themselves or to compare themselves to others. Each item is scored on a Likert-type scale from one (the lowest value) to seven (the highest value).

Prosocial and Civic Competence

This instrument has been used to analyze the promotion of PB in the implementation of SL projects in the field by PETE students (Gil-Gómez et al., 2016); it was thus deemed to be an ideal tool for the current study. The PCC questionnaire consists of 31 items distributed along six dimensions: compliance with social norms (three items), social sensitivity (six items), help and collaboration (four items), security and firmness in interaction (eight items), prosocial leadership (four items), and social responsibility (six items). As in the previous case, the answer options are presented on a Likert-type scale from one (strongly disagree) to five (strongly agree).

Impact of Service Learning During Initial Training of Physical Activity and Sports

This questionnaire was designed specifically to assess the PL perceptions of students when participating in SL programs. The IMAPS-AFD-FI is a validated tool to analyze SL experiences in the context of Physical Education (García-Rico et al., 2019). This instrument consists of 41 items distributed across seven categories: context identification (nine open questions), learning (five items), pedagogical value (seven items), social impact (six items), professional development (four items), professional skills (seven items), and experience opinion (three items and one open-ended question). With the exception of the first part and the last open-ended question, the remainders of the items are answered using a five-point Likert-type scale from 1 (totally disagree) to 5 (totally agree). Given the quantitative nature of our research, the open questions of the IMAPS-AFD-FI were not used in this work.

Data Analysis

The Kolmogorov–Smirnov test was used to determine the normality of the data. After extracting the mean and standard deviation as descriptive statistics, the *p*-value was calculated using the Wilcoxon test for related samples in order to identify significant differences. Regarding the pre-test and post-test differences between the control and the experimental groups, the Mann–Whitney U test was used for two independent samples. This process was carried out with regard to the SHS and the PCC instrument in the control and the experimental groups and with respect to the PL perceived in the SL program (IMAPS-AFD-FI) in the experimental group. The effect size was calculated using Cohen's *d* value. It can be interpreted as small ($0.2 < d < 0.5$), medium ($0.5 < d < 0.8$), or large ($0.8 < d$) (Cohen, 1992). The Spearman correlation coefficient was used to determine the relationships between the dimensions of the SHS, PCC, and IMAPS-AFD-FI. The correlation can be interpreted as very weak ($0 < \text{rp} < 0.2$), weak ($0.2 \leq \text{rp} < 0.4$), moderate ($0.4 \leq \text{rp} < 0.6$), strong ($0.6 \leq \text{rp} < 0.8$), and very strong ($0.8 \leq \text{rp} < 1$). All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS, v.23.0 for Windows, SPSS Inc., Chicago, IL, United States).

RESULTS

The data analysis showed that the SL program slightly improved the SH of the students, obtaining significant results ($p < 0.05$) in one of the four items of the SHS scale ("compared with most of my peers, I consider myself."). In contrast, in the control group, there was no significant difference in any item. On the other hand, while analyzing the effect of SL on PB, it was found that improvement in the students of the experimental group was notable. There were significant differences in four of the six items of the PCC questionnaire: accordance with social norms and prosocial leadership (both $p < 0.01$), social sensitivity, and security and firmness in interaction (both $p < 0.05$). The improvement is much less noticeable in the control group, where significant improvements are obtained only with respect to compliance with social norms. All of these points to a marked effect of SL on the promotion of students' PB. **Table 2** presents the results of the different variables of the SHS and PCC questionnaires in both groups, analyzed before and after the intervention.

Regarding the PL perceptions of the SL program, the experimental group showed significant improvements ($p < 0.05$) in four of the six items of the IMAPS-AFD-FI instrument: learning, social impact perceived, professional skills, and opinion. This suggests that the impact of the SL program was notable in the PL perceived by the students. **Table 3** shows the results related to the analysis of this variable (IMAPS-AFD-FI) in the experimental group.

Regarding the relationship of the analyzed aspects, it was significant in 34 of 60 possible cases. Of those, 20 had a level of significance of $p < 0.01$, while 14 had a level of significance of $p < 0.05$. All were positive; there was a moderate degree of correlation ($0.4 \leq \text{rp} < 0.6$) in 25 cases and a strong degree of correlation ($0.6 \leq \text{rp} < 0.8$) in nine cases. When

TABLE 3 | Analysis of the satisfaction of SL on the experimental group.

	Experimental group (*n* = 49)			
	Pre-test	**Post-test**	***p***	***d***
Professional learning perceived (IMAPS-AFD-FI)				
Learning	3.84 (0.18)	4.45 (0.45)	0.001*	−0.664
Pedagogical value	4.12 (0.42)	4.33 (0.46)	0.147	−0.231
Social impact	3.91 (0.45)	4.02 (0.52)	0.027*	−0.112
Professional development	3.22 (0.81)	3.40 (0.78)	0.389	−0.112
Professional skills	3.71 (0.48)	4.01 (0.56)	0.031*	−0.276
Opinion	3.29 (1.02)	3.94 (0.83)	0.003*	−0.329

*$p < 0.05$.

TABLE 2 | Analysis of subjective happiness and prosocial and civic competencies in control and experimental groups.

	Control group (*n* = 55)				Experimental group (*n* = 49)			
	Pre-test	**Post-test**	***p***	***d***	**Pre-test**	**Post-test**	***p***	***d***
Subjective happiness (SH)								
In general, I consider myself...	4.58 (0.22)	4.74 (1.06)	0.769	−0.103	5.44 (0.65)	5.59 (0.87)	0.46	−0.097
Compared with most of my classmates, I consider myself...	4.43 (1.19)	4.76 (1.48)	0.316	−0.121	4.96 (1.01)	5.41 (1.42)	0.046*	−0.179
Some people are generally very happy...	4.91 (1.18)	5.01 (1.54)	0.714	−0.036	5.07 (1.69)	5.53 (1.71)	0.262	−0.134
Some people are generally not very happy...	2.67 (1.49)	2.83 (1.43)	0.144	−0.054	2.37 (1.34)	2.51 (1.55)	0.541	−0.048
Prosocial and civic competencies (PCC)								
Compliance with social norms	4.38 (0.39)	4.56 (0.34)	0.030*	−0.238	4.43 (0.33)	4.77 (0.55)	0.004**	−0.351
Social sensitivity	4.21 (0.35)	4.37 (0.46)	0.250	−0.192	4.02 (0.11)	4.34 (0.25)	0.039*	−0.637
Help and collaboration	4.03 (0.65)	4.34 (0.61)	0.126	−0.238	4.03 (0.31)	4.08 (0.41)	0.509	−0.068
Security and firmness in interaction	3.63 (0.61)	3.91 (0.67)	0.210	−0.213	3.74 (0.57)	3.87 (0.53)	0.024*	−0.117
Prosocial leadership	3.51 (0.90)	3.76 (0.64)	0.413	−0.158	3.61 (0.59)	3.92 (0.51)	0.008**	−0.271
Social responsibility	3.11 (0.24)	3.35 (0.43)	0.139	−0.325	3.19 (0.38)	3.35 (0.31)	0.152	−0.224

*$p < 0.05$; **$p < 0.01$.

analyzing separately the relationship between each scale of the IMAPS-AFD-FI and SHS, eight significant records of 24 possible are obtained, four of them with a level of significance of $p < 0.01$ and four with a level of significance of $p < 0.05$. All of them were positive, with a moderate degree of correlation ($0.4 \leq rp < 0.6$) in seven cases and with a strong degree of correlation ($0.6 \leq rp < 0.8$) in one case. In contrast, the relationship between IMAPS-AFD-FI and PCC instrument items was significant in 26 of 36 possible cases – 16 of them with a level of significance of $p < 0.01$ and 10 with a level of significance of $p < 0.05$; all of them were positive, with a moderate degree of correlation ($0.4 \leq rp < 0.6$) in 18 cases and strong degree of correlation ($0.6 \leq rp < 0.8$) in eight cases. When analyzing these data, it is verified that the results of the IMAPS-AFD-FI instrument show a greater link with the PCC questionnaire than with the SHS. **Table 4** presents the analysis performed which display the relation between the PL perceived in SL (IMAPS-AFD-FI) on SH and PCC in the experimental group.

DISCUSSION

Results related to SH indicated that, in our study, SL had a limited influence on it, although the literature presents mixed positions. On the one hand, several studies show that spending time helping other people is associated with improvements in one's well-being due to the promotion of social integration (Musick and Wilson, 2003; Gil-Gómez et al., 2016; Mesurado et al., 2019). On the other hand, there are studies in line with our results (i.e., indicating that SL is not always associated with an improvement in the students' well-being). These studies highlight different causes that can affect this variable. Standing out above all others, SL may make students recognize the problems suffered by the people receiving the service, which, consequently, could produce a feeling of unhappiness after the SL participation (Chiva-Bartoll et al., 2018). In the present investigation, the results could have been influenced by the fact that people who live in areas with higher rates of social inequality tend to consider themselves unhappier (Laurence, 2019). Thus, the fact that the SL program had been developed in a city with high rates of inequality could have affected the SH of the students, too.

Despite having found that SL has little influence on the SH of the students, it is interesting to emphasize that one of the four variables that comprise the SHS questionnaire obtained a significant improvement. It was the one that referred to the feeling of happiness compared with other people. In this case, as previously stated, it could be due to the increase of cultural and social awareness generated by the participation in the SL program (Sewry and Paphitis, 2018). In fact, one of the basic objectives of SL lies in the acquisition of a deeper knowledge of the problems that a disadvantaged sector of the population must face (Kronick et al., 2011). Thus, participating in the SL program could have made the students aware of the difficult situation in which the recipients of the service live, generating a rethinking of their own well-being in comparison to those of others (Sewry and Paphitis, 2018).

With regard to the effect of SL on the promotion of PB, the outcome for the members of the experimental group was notable. These findings are in line with those of other studies which have proposed that PB is incentivized through empathy and practical experience (Mesurado et al., 2019). Thus, this approach is also in line with various studies that found a positive impact of SL on the development of empathy (Lee et al., 2018).

Analyzing the elements of the PCC scale individually, the improvements in items relating to *security* and *firmness in interactions* are linked to a loss of uncertainty and fear caused by working with disadvantaged groups in the SL program as well as the breaking of preconceived stereotypes (Cabedo et al., 2018; Chiva-Bartoll et al., 2019, 2020). Previous studies have indicated effects in this regard when working with groups at risk of social exclusion in Uganda (Grain et al., 2019) and through raising the students' awareness of their similarities with the service beneficiaries (Andreoletti and Howard, 2018). Normally, the students tend to show prior suspicion toward the intervention. After several sessions though, their safety tends to increase and they end up requesting a greater number of SL practices (Reynaud et al., 2013). This fact also has precedents in the field of Physical Education.

Improvements in *prosocial leadership*, as were seen in this investigation, are thought to be closely linked to concepts such as humility and social equality (Owens et al., 2019). Moreover, effective communication is also key to promoting prosocial leadership when educational entities provide services to the community (Sanders et al., 2019). In our case, the development of both constructs was associated with the management and direction of game sessions and physical exercises with migrant children and youth and the older adults. The use of SL as well as the implementation of other active methodologies has also been reported to have positive effects on prosocial leadership skills (Celio et al., 2011; Dingel and Wei, 2014; Sun et al., 2017).

In relation to the improvement of the students' *social sensitivity*, the results of a study with Colombian university students who worked with 540 pupils point in the same direction as that of ours (Duque, 2018). In addition, due to indirect effects, the development of social sensitivity has been suggested to be linked to the development of social justice (Jones and Kiser, 2014) as well as social skills and citizen participation (Whitley et al., 2017). In any case, this result is not surprising since there are previous findings about the social impact of SL in the sensitivity and the social interpretation of the students involved (Mesurado et al., 2019).

Some studies have found improvements in the *accordance with social norms* (Gil-Gómez et al., 2016). Thus, the students could have understood and accepted the rules of coexistence that govern or function the recipients of the service. However, the control group also showed a significant improvement related to this dimension. This could be due to Melilla's special social context (i.e., in that living in a place with obvious social inequality can produce respect for people with authority and acceptance of the rules of coexistence) (Kronick et al., 2011). Therefore, it cannot be assumed that the improvements in the experimental group were exclusively due to the implementation of the SL program.

TABLE 4 | Spearman correlation between the PL perceived on SL (IMAPS-AFD-FI), subjective happiness (SH), and prosocial and civic competencies (PCC) in the experimental group (post-test).

SL impact (IMAPS-AFD-FI)	Subjective happiness (SH)				Prosocial and civic competencies (PCC)					
	1	2	3	4	5	6	7	8	9	10
Learning	0.553**	0.382	0.414*	−0.254	0.607**	0.752**	0.497*	0.534**	0.629*	0.409*
Pedagogical value	0.599**	0.276	0.372	−0.384	0.589**	0.744**	0.469*	0.491*	0.578**	0.331
Social impact	0.418*	0.204	0.340	−0.165	0.347	0.485*	0.398	0.298	0.436*	0.181
Professional development	0.247	0.169	0.376	−0.193	0.233	0.208	0.381	0.532**	0.430*	0.095
Professional skills	0.609**	0.423*	0.557*	−0.373	0.562**	0.681**	0.652**	0.637**	0.683**	0.419*
Opinion	0.563**	0.374	0.371	−0.245	0.555**	0.583**	0.522**	0.525**	0.487*	0.306

*$p < 0.05$; **$p < 0.01$. SH = 1 – In general, I consider myself . . .; 2 – Compared with most of my classmates, I consider myself . . .; 3 – Some people are generally very happy . . .; 4 – Some people are generally not very happy . . .; CCP = 5 – Compliance with social norms; 6 – Social sensitivity; 7 – Help and collaboration; 8 – Security and firmness in the interaction; 9 – Prosocial leadership; 10 – Social responsibility.*

It would therefore be appropriate to carry out further research on this issue.

Finally, the results related to the factors of *help and collaboration* and *social responsibility* were surprising as no significant differences were found, while previous studies found improvements in both aspects after implementing SL (Whitley et al., 2017). As in the previous case, this result evinces a need for additional research on the topic.

Regarding the PL perceived by the students of the SL program, numerous works have addressed this issue before with similar results (Domangue and Carson, 2008; Ward et al., 2017; Whitley et al., 2017; Galvan et al., 2018; Capella-Peris et al., 2020).

A separate analysis of the elements of the IMAPS-AFD-FI scale revealed a prominent effect on student-applied learning (Kassabgy and El-Din, 2013). This improvement has been linked to the value of the practical experience gained from SL (Baldwin et al., 2007; Robinson and Meyer, 2012). Likewise, the interventions in small groups, where all members provide efficient solutions and give reciprocal feedback, lead to the consolidation of curricular learning in a globalized way (Short et al., 2019). Recent studies indicate that SL facilitates the acquisition of knowledge related to inclusive pedagogy and social values. In a more personal way, other studies argue that SL is very useful for students as it helps them imagine the future that awaits them in their work and/or social life and arouses curiosity about working with different groups in their closest social context. University students benefit the most from any type of SL intervention since it will help them step outside of their comfort zone (Kassabgy and El-Din, 2013). Thus, thanks to their participation in the project, PETE students were able to learn more about the different groups that make up Melilla's particular social reality.

Regarding *professional skills* – a dimension closely linked to learning – it appears that such competence has been developed thanks to the implementation of different teaching strategies (that allowed students to self-assess in real-life situations). Therefore, it is understood that real-world experiences play a decisive role in the development of professional skills (Brown and Bright, 2017). Another variable of great importance in this regard is the intrinsic motivation of the students, establishing that those with greater motivation can develop professional skills in a more effective way (Shin et al., 2018). However, not all SL programs stimulate professional skills in the same way. Some studies indicate that this improvement may be limited by a lack of connection between the curriculum of the course and the service provided (Segal-Engelchin et al., 2017). Therefore, the relationship between academic content and the intervention must be clear to maximize the benefits of SL.

The effect of SL on the *opinion* dimension refers to various issues. On the one hand, there is an improvement of *critical and reflective thinking*, a widely documented result in research on the application of SL (Carrington et al., 2015). On the other hand, there is a positive change regarding the students' vision on various issues, such as the beneficiaries of the service or the methodology itself. It is thus recommended that, in order to improve the opinion of students regarding the SL implementation, it must have the support of the institutions. In addition, collaboration agreements should be set up as soon as possible and students should be involved as much as possible in all decision processes (Playford et al., 2019).

The results across the three previous dimensions indicate the potentially significant impact of SL on PETE students. Such findings have been confirmed academically and socially, suggesting that SL is an optimal tool for educational institutions for addressing social transformation issues (Whitley et al., 2017; Capella-Peris et al., 2020). On the other hand, despite observing improvements in the variables of pedagogical value and professional development, they were not statistically significant. This was unexpected since they are closely related to the dimensions of both learning and professional skills. Thus, it seems to be appropriate to deepen on the investigation of these variables in order to derive new results.

Lastly, the results obtained by Spearman correlations reinforce the results described in the preceding lines. Thus, the results have shown that there are certain significant correlations between SH and SL, mainly, the one referring to their own *happiness* and *professional skills*. The reason for this may be that, as mentioned in previous paragraphs, participation in SL makes them reconsider their own happiness (Sewry and Paphitis, 2018). They recognize their comfortable social position in comparison to

the recipients of the service and see the benefits related to the professional skills linked to their university studies they are gaining (Celio et al., 2011).

On the other hand, many correlations between the PCC and the impact of SL show a close relationship between the impact produced by SL and the development of PB (Lim, 2007). Although most of the components had significant correlations, the dimension of *professional skills* of the IMAPS-AFD-FI and *prosocial leadership* on the PCC obtained the strongest correlations. This suggests that SL can have a positive effect on prosocial leadership and the development of professional skills in the students. It also suggests that the greater the impact of SL, the more PB the student develops (Celio et al., 2011).

Although promising results have been obtained in this research, there are several limitations that must be considered. It is true that the results cannot be generalized categorically because of the sample size in the present study. In addition, the fact that the students were selected by means of convenience sampling must be considered, as a randomized controlled trial would have strengthened the validity of this study (Zirkel et al., 2015). However, this work – which used validated questionnaires – has allowed us to deepen our knowledge about the impact of SL in the field of teacher training and to provide relevant information to the academic world.

Regarding future research opportunities, these results also open the door to new research in the field of SL since, although there are clear improvements (especially in terms of the development of PB and about the impact of SL), it would be interesting to continue deepening on this field by analyzing SL programs of different lengths and intensities. It would also be helpful to use larger samples that would allow generalizing the results. In addition, in order to continue studying the relationship between SH and SL, investigations could be carried out in different social contexts. Those results could be contrasted with ours, which would help to reveal the circumstances where SL is an effective tool for helping to improve student welfare. Similarly, it would be promising to open research lines that analyze the impact of this educational approach throughout the entire teaching–learning process and analyzing its long-term effects on students, recipients, and society.

CONCLUSION

Overall the application of the SL program had a positive impact on PB and perceived PL of PETE students. In addition, it was found that both effects were highly interrelated, indicating a reciprocal relationship between them. On the other hand, there were no improvements in SH, which could be due to the awareness of the social problems that the SL caused in the students involved.

SL programs are being increasingly used at different levels and educational stages (Celio et al., 2011), so more research in order to deepen our understanding of its implications on PETE students is needed. The present study has contributed in this regard by providing relevant information for all those academics and/or professors interested in this pedagogical method. In addition, it has introduced new and interesting lines of research that can favor the improvement of SL, the understanding of the effects on the individuals' well-being, and the personal development of the students involved.

DATA AVAILABILITY STATEMENT

All datasets generated for this study are included in the article/supplementary material.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethics Committee on Human Research of the University of Granada. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

OC-B and PR conceived the presented idea and designed the study. PR and CC-P organized the database and performed the statistical analysis. OC-B wrote the first draft of the manuscript. OC-B, PR, and CS-G reviewed the methodological sections of the manuscript. All of the authors contributed to the manuscript revision and read and approved the submitted version.

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Applying the Personal and Social Responsibility Model as a School-Wide Project in All Participants: Teachers' Views

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The present study aims to apply a program based on Hellison's Teaching Personal and Social Responsibility Model (TPSR), traditionally used in Physical Education, to other educational participants and examine the assessment of the teachers who carried it out during the 2018–2019 school year. The program was applied over 8 months of one academic year and during at least 60% of the weekly class hours. Initially, 30 teachers participated, of whom 16 were involved in the interviews carried out, all of them being Secondary Education teachers. We used qualitative methodology through content analysis carried out with ATLAS.ti 7.1.3. The instruments used to collect information were semi-structured recorded group interviews. The conclusion is that the Personal and Social Responsibility Model can be applied to all participants in the curriculum and is adaptable to any content and type of student body. As a basis for future research, we suggest the application of the model by all teachers involved in the same school year and the participation of students' families.

Keywords: methodology, innovation, teacher training, education, physical education

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INTRODUCTION

Social demand has led to formal education serving to provide tools for learners to be able to adapt to the constant changes demanded by society. To this end, it is necessary to develop the skills and competences that can help them adapt to these different demands (Larson, 2000). A fundamental aspect of responding to this demand is to promote learner autonomy and self-sufficiency (Oriol et al., 2016), improve the learning environment (Legault and Inzlicht, 2013) and influence learner behavior through Teaching Personal and Social Responsibility Model (TPSR) (Hellison and Wright, 2003) to reduce dependence on teachers' characteristics in traditional teaching in order to increase cooperative work with classmates (Walkey et al., 2013), in line with the Project Based Learning approach in Stentoft (2016) and Woods (2016) in which learners are significantly involved in their learning by working on joint projects.

In this regard, current education seeks to incorporate new teaching models that allow for a renewal of teaching methodologies that transform the process into meaningful experiences for students in which aspects such as reflection and active participation in classes are especially encouraged (Pérez-López and Rivera-García, 2017). Therefore, it is intended to focus on an approach that allows students to develop their skills and in which they are the real

protagonists, rather than teachers' explicit teaching (Brockbank and McGill, 2002). In other words, teachers become facilitators of learning and students build their own training process (Pérez-López and Rivera-García, 2017).

Motivation is one of the most important variables for implementing an innovative methodology and achieving greater academic adherence and is fundamental to school performance and grades (Shim and Ryan, 2005). The lack of motivational strategies on the part of teachers results in poorer academic performance among students (Tejedor and García-Valcárcel, 2007).

In order to achieve improvements in teaching, new pedagogical models have been developed in recent years (Menéndez and Fernández, 2016), with the so-called TPSR (Hellison, 1978) being highlighted as one of the most appropriate for encouraging students to develop correctly in their social environment, learning to be responsible for themselves and others (Hellison, 1985). This model is currently one of the most powerful tools for the development of values in adolescents (Escartí et al., 2005), its main limitation is the lack of time to apply it, given that it is restricted to a few Physical Education hours a week, the beliefs of students regarding PE, and their difficulties in reflection and dialog (Llopis-Goig et al., 2011).

Furthermore, responsibility has been proven to have positive relationships with motivational constructs, especially with intrinsic motivation (Escartí et al., 2011; Belando et al., 2015; Ortiz et al., 2016), which may indicate that teaching based on the transfer of autonomy and the promotion of responsibility can be appropriate for the improvement of motivation and other social factors along with academic performance (Smithikrai, 2013; Baena-Extremera et al., 2016; Calderón et al., 2016; Granero-Gallegos et al., 2020).

The latest trends in TPSR seek to innovate the model, and thus some studies have hybridized it with Cooperative Learning to find out that TPSR is a very useful model when it comes to meeting the demands of the current educational system and the achievement of competencies through active methodologies (Merino-Barrero et al., 2017). The study by Gordon et al. (2016) implements TPSR with social and emotional learning (SEL) (Gould and Carson, 2008) in line with TPSR approaches and strategies and achieves very interesting results in student self-control. Furthermore, the study by Alcalá et al. (2019), in which they applied TPSR with Pre-school, Primary and Physical Education university students in Spain, Costa Rica and Chile is also worth highlighting. The participants' perception of the pedagogical possibilities was very positive with regard to their future as teachers, and they agreed on the capacity to promote their professional development in the study by Llopis-Goig et al. (2011).

Thus, teacher training is considered a dimension of capital importance because of its decisive impact on the quality of educational inclusion (León Guerrero, 2011). In this context, the professional development of teachers should be understood as any attempt to improve educational practice, beliefs and professional and personal knowledge with the aim of increasing the quality of teaching, research and management, individually and together with colleagues, in order to improve student learning (Imbernón, 2013). However, professional development is more than just training; it is the product of the pedagogical development that teachers acquire throughout their lives, their knowledge and understanding of themselves as teachers, the cognitive and emotional development that they carry out individually and with their colleagues at school, and the theoretical development of educational matters (Pegalajar-Palomino, 2014).

This work was preceded by one (Manzano and Valero-Valenzuela, 2019) in which a pilot study was carried out applying TPSR in a primary school, and which obtained improvements in students' self-concept, responsibility, motivation and autonomy, in addition to high levels of satisfaction with the methodology on the part of the students and teachers involved. In addition to this, there is study (Manzano-Sánchez and Valero-Valenzuela, 2019), in which more than 300 primary and secondary school students obtained improvements in responsibility, intrinsic motivation, basic psychological needs, classroom climate and pro-social behavior by applying the model and in which a series of teacher interviews were conducted with a very positive evaluation of the model by the students.

The main objective of the present study is to apply the TPSR in the general educational context, to examine the perception of the teachers involved in terms of its applicability, future perspectives and positive and negative aspects of the experience.

MATERIALS AND METHODS

Design

A qualitative research study was carried out by using a descriptive and cross-sectional method with semi-structured interviews with teachers participating in the implementation of the TPSR, which were carried out once the model application was completed and with sustained training and assessment for teachers (Montero and León, 2007).

Participants

Participants were selected according to accessibility and convenience. They included 30 Secondary Education teachers from public schools using the Personal and Social Responsibility Model. The teachers who participated in the interviews were a total of 16. None of the participants in the interviews had previous experience with the TPSR. The teachers were recorded in video and their behavior was analyzed by experts qualified in observational methodology and the TPSR.

Instruments

At the same time, a qualitative analysis of teachers was carried out at the end of the process through semi-structured interviews in order to obtain an internal perspective of their experience (Patton, 2002) in their own school, with 13 questions mainly coming from the study Sánchez-Alcaraz et al. (2019): (1) Do you feel that you have more tools available to teach in schools and deal with children with coexistence issues? (2) Do you feel that you are sufficiently trained to implement the TPSR? (3) What are the main problems that have arisen? (4) How do you feel when you apply the TPSR? (5) What are the most innovative aspects

that you feel the TPSR is bringing to your classes? (6) What do you think can be improved in the application of the TPSR? (7) What characteristics of the students do you think could be more adequate for an appropriate application of the TPSR? Do you think teachers' previous experience is important? (8) What improvements do you think could be made to the contents of the TPSR? (9) Do you think that the TPSR actually works in terms of the inclusion of values, attitudes and socially adequate values? (10) Do you think that through the TPSR students learn the contents of the subject as well as attitudes and values? (11) What advantages have you found in the TPSR with respect to the methodology you have used until now? (12) Are the tasks better adapted to the interests of the students? (13) Is there anything else you would like to add?

Procedure

We included Informed consent (confidential treatment of data, participation in the study and filming of sessions) for parents and students and a letter of presentation was sent to schools along with the report of the Ethics Committee of the University of Murcia (1685/2017). The program covered 8 months. The contents were selected in accordance with current educational laws (State Agency State Gazette, 2013).

Intervention Program

The sessions featured a modification of Hellison's session format (Hellison, 2011) given that they included four parts rather than five: (1) initial greeting: the teacher interacted with students to create links with them, (2) awareness talk: the teacher presented the objectives of the session in academic and values terms according to the level of the responsibility model, (3) activity plan, where most of the practical class was carried out, integrating responsibility strategies in the various tasks, and (4) group meeting and self-evaluation: at the end of each session, the teacher and students shared their perceptions regarding responsibility and individual behaviors, the class and the teacher's performance by raising their thumb upward (positive evaluation), to the side (middle) or downward (negative evaluation). Teachers used both general strategies to implement the TPSR (e.g., assigning tasks, providing opportunities for success, defining roles) and specific strategies (e.g., reciprocal teaching, cooperative groups, personal work plan). Similarly, these strategies were also used to resolve individual (e.g., 5 Clean Days) and collective (e.g., Grandma's Law) conflicts, fully integrating the TPSR into all classes in addition to Physical Education (Escartí et al., 2013).

Teacher Training

The implementation of any educational program requires specific teacher training (Li et al., 2008). Teachers were trained in the TPSR in a two-phase approach: (1) A 5 h course on the model's theory and practice in which they were explained how to design classroom climates according to the model and were provided with comprehensive and specific strategies for accountability development, as well as a "model guide" so that they could review the various strategies undertaken as well as others. (2) Continuous training: during the implementation of the program (8 months) the principal researcher met with the teachers on several occasions and through different channels. In the first week, the teachers had to hand in a document reflecting the structure of a session of their own class applying the model at the first level, with their corresponding activities and strategies, with the principal researcher providing feedback to the teachers as appropriate. In the second week, the sessions were implemented in the different participants, and a minimum of one session per month was filmed and evaluated by the research team. In the following week, a report was given with the session and the aspects to be modified, and this sequencing was carried out throughout the intervention, as well as a quarterly meeting to discuss the intervention among the teachers. The students learned responsibility progressively, moving through the different levels (Escartí et al., 2013). However, level 5 was involved from the beginning, in an attempt to transfer it to students' lives.

Interview Preparation

To draw up the interview questions, the aspects covered in the TPSR were taken into account, as well as those that could be of interest as an object of the investigation. For this purpose, several questions were selected and analyzed by various researchers and/or teachers who had applied the TPSR, ending with the selection of the 13 questions above.

The interviews were carried out dividing the teachers into two groups of seven and nine people who were interviewed by two researchers who only intervened during the interview to formulate the questions in order to avoid possible biases. The duration of the interviews was 75 min and the answers were recorded through a wireless microphone in order to analyze the results later.

Data Analysis

The results were analyzed using ATLAS V. 7.1.3, powerful software for the qualitative analysis of large bodies of textual, graphical, audio and video data (Morales-Sánchez et al., 2014).

To analyze the qualitative content of the interviews, the video recordings of the interviews (primary documents) were incorporated for analysis in multimedia format, having been organized and stored in a single file (Hermeneutic Unit). This file contains all the information produced in the course of the analysis in addition to the primary documents and contains codes, notes and memos, quotations and network views.

Each of the primary documents corresponded to one of the participants and the answers they gave. It should be noted that the answers were recorded literally and that some participants did not contribute to all the answers by agreeing with the rest of the participants or not answering at all. The quotes are each of the phrases or sentences that have been included in the study. The notes or memos correspond to segments of the recordings that were noteworthy from the primary documents and that are associated with different codes. The codes were the different aspects of the main analysis, reflected in 13 families of codes corresponding to each of the questions and eight new codes referring to the analyzed variables that emerged from the previous ones that were the object of interest (**Figure 1**).

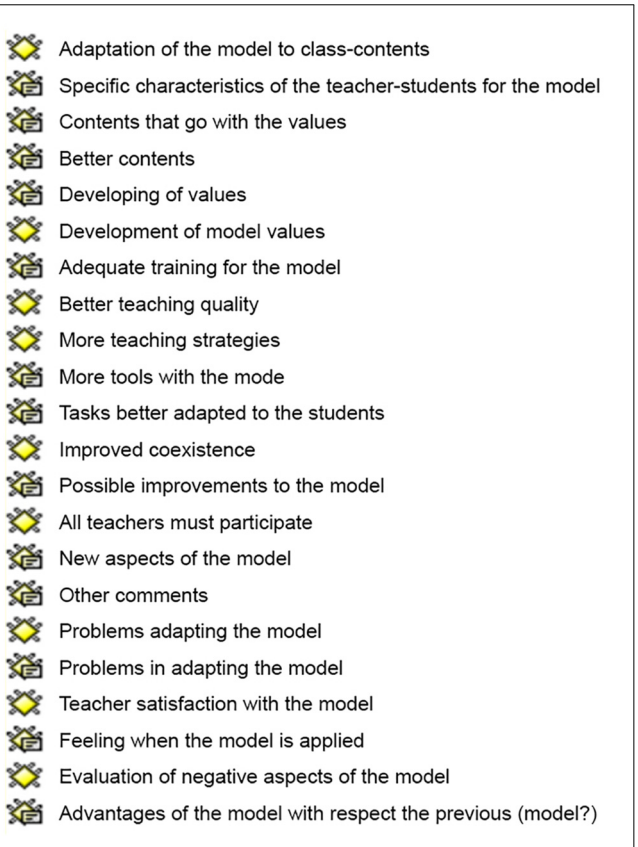

FIGURE 1 | Code families and new codes.

Finally, the network views reflect the connection between the different codes.

RESULTS

The analysis of the content of the interviews was carried by reducing the different citations in the different codes elaborated according to the objectives of the present research regarding the characteristics of the TPSR and the contributions for future research and aspects to be highlighted and improved (**Figure 2**).

The "Teacher Satisfaction with the Model" code had a frequency of 41 and was the one most reflected in the interviews. In this regard, it is worth noting some statements in relation to satisfaction such as, "Thanks to the model, I feel useful, I mean what we said before, I see that I am spending my energy or investing it in a productive way". Also noteworthy is the contribution in one of the interviews by a teacher who said that, "The Responsibility Model is the best-kept secret".

Worthy of further note are those least related to "Improving Coexistence", "Promoting Model Values" and "Positive Adaptation of the Model to the Class-Content". In this regard, it has been a very positive contribution to have a high level of rationale for this last code, given that one of the main objectives of the application of the TPSR to all participants is to determine its capacity to adapt to these and the different students, with some comments such as "I have not had to modify any content, nothing different, so really totally adapted to them and giving the contents" (sic) or others such as "It is valid for any course, it is necessary for motivation and attention and these are the two variables that we have to promote as much as possible".

On the other side of the coin is the fact that the negative aspects had a very low number of mentions. Specifically, the "Negative Assessment of Model Aspects" occurred on two occasions, specifically in reference to the systematic nature of the application and the importance of leaving time for the final part of the session, for example, "You have to be careful to really comply systematically with the structure of the session or it will remain that way, simply strategies that you apply as you can, you must be systematic". As for the "Model Adaptation Problems", only two results were found, with reflections related to the Second year of High School, "I have had problems with Second year of High School, they have difficulties in many areas. We have taught these students since they were little. . . and we always complain that they are good but very talkative".

Finally, another of the objectives was to see the future perspectives of the model and suggestions; we created a new Code called "Need for participation of all teachers" which had 29 mentions, 26 of these referring to teachers and three to the importance of including families. By way of example, the following reflection, "It should be a uniform thing and if possible, unify reward, levels. . . something essential, that they always know that from the beginning of the course they have an ID card that works for all the teachers and all the participants".

A co-occurrence analysis was also carried out, the relationships between codes with similar dimensions being reflected in Table format (**Figure 3**). The maximum co-occurrence was between "higher quality of teaching" and "More Strategies in teaching" with a frequency of 11 and an index of 0.31. Secondly, the co-occurrence between "Promotion of model values" and "Improvement of coexistence" with a frequency of 11 and an index of 0.20 and "Higher quality of teaching" with "Teacher satisfaction with the model", with a frequency of 10 and an index of 0.20 is worth noting.

Finally, it is important to note a network where all the co-occurrences were imported (**Figure 4**). **Figure 4** shows that the highest quality of teaching is associated with teacher satisfaction with the model. In this regard, various codes were part of the highest quality of teaching: the promotion of values, the improvement of coexistence, the greater adaptation of tasks, and the ease of providing content as well as the values of the model.

DISCUSSION

The main objective of the present study was to apply the TPSR in the general educational context to measure the perception of the teachers involved in terms of its application, future perspectives and positive and negative aspects of the experience.

In this regard, it should be noted that of all the codes generated, the one that had the greatest occurrence in the interviews was "satisfaction with the model". Furthermore,

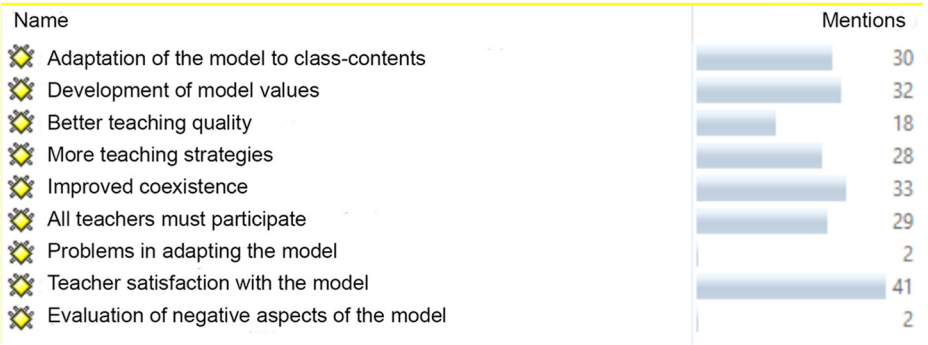

FIGURE 2 | Justification for the codes.

	Adaptation of the model to class-contents	Development of model values	Better teaching quality	More teaching strategies	Improved coexistence	All teachers must participate	Problems in adapting the model	Teacher satisfaction with the model	Evaluation of negative aspects of the model
Adaptation of the model to class-contents		5 - 0.09	4 - 0.09	3 - 0.05	5 - 0.09	2 - 0.04	2 - 0.07	7 - 0.11	1 - 0.03
Development of model values	5 - 0.09		6 - 0.14	7 - 0.13	11 - 0.20	1 - 0.02	n/a	10 - 0.16	n/a
Better teaching quality	4 - 0.09	6 - 0.14		11 - 0.31	5 - 0.11	n/a	n/a	10 - 0.20	n/a
More teaching strategies	3 - 0.05	7 - 0.13	11 - 0.31		2 - 0.03	n/a	n/a	9 - 0.15	n/a
Improved coexistence	5 - 0.09	11 - 0.20	5 - 0.11	2 - 0.03		n/a	n/a	11 - 0.17	n/a
All teachers must participate	2 - 0.04	1 - 0.02	n/a	n/a	n/a		n/a	1 - 0.01	1 - 0.03
Problems in adapting the model	2 - 0.07	n/a	n/a	n/a	n/a	n/a		n/a	n/a
Teacher satisfaction with the model	7 - 0.11	10 - 0.16	10 - 0.20	9 - 0.15	11 - 0.17	1 - 0.01	n/a		n/a
Evaluation of negative aspects of the model	1 - 0.03	n/a	n/a	n/a	n/a	1 - 0.03	n/a	n/a	

FIGURE 3 | Code co-ocurrence table.

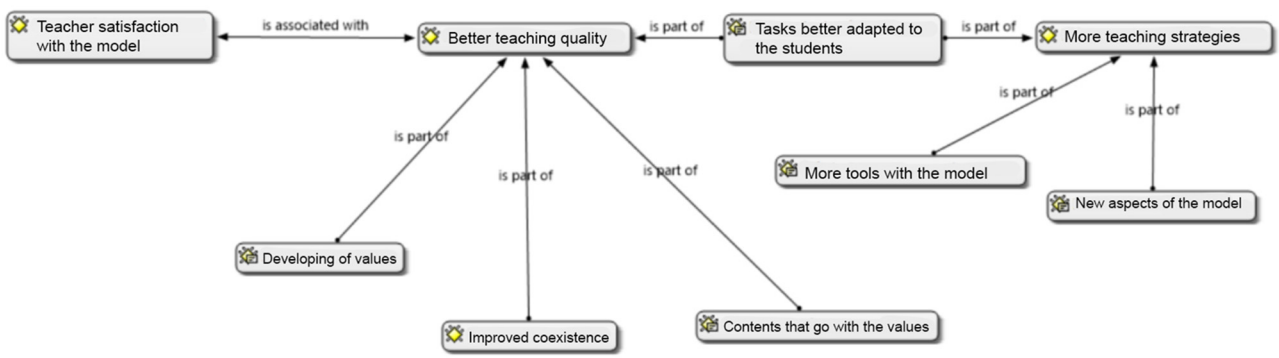

FIGURE 4 | Co-occurence network.

some of the interviews noted the importance of continuing to apply the model for a long time to improve performance and that it should last throughout the school year, in line with the study by Llopis-Goig et al. (2011) which indicates that improvements in the model in terms of responsibility require a long duration, as also indicated by Manzano-Sánchez et al. (2019) where, with an application period of 4 months, improvements were obtained in only some of the variables, its duration being a limitation. Similar is the case of Sánchez-Alcaraz et al. (2019) where the importance of applying the model throughout the school year and in all participants is highlighted in the interviews carried out. In addition to this, it should be noted that Llopis-Goig et al. (2011) have pointed out the importance of involving the entire educational community and the family environment, the latter also being reflected by the teachers participating in this study.

The TPSR was also perceived by the teachers as applicable to all contents and participants, with comments such as "All contents are adapted to one or other levels always, but the question is group level and how to adapt it to this", which is a positive assessment as to the capacity of the TPSR to adapt to the contents while working on educational values." You are no longer limited only to working on the contents of the subject, but you already have a system to measure, evaluate and work on other aspects related to behavior and conduct". All of this is in line with the study by Manzano and Valero-Valenzuela (2019), here the teacher who participated in the study indicated that he was able to adapt the model to all the areas he taught in his group in Primary Education.

It is worth noting that the teachers' perception was that TPSR can be suitable not only for difficult students but for any type of student. Furthermore, certain interviews reflected the importance of teachers participating in the methodology, and that this should increase the time students are taught through the model, "The time of exposure that the student has to the model has an impact and is important, of course". This does not coincide with the study by Sánchez-Alcaraz et al. (2013), in which teachers felt that content, student body and teacher experience are determining factors in the application of TPSR.

With regard to the classroom climate, very positive results were also obtained, with the code "improvement of coexistence" having a total of 33 mentions that represented the second-highest value behind satisfaction, with some comments such as that of a teacher with a difficult group, "With the model now they respect each other and these things, now they let others work and this is already an achievement in itself, it means reaching and surpassing level 1 and that is a lot", thus supporting the study by Caballero (2015) where in applying the TPSR the participants obtained improvements in students' classroom climate with activities in the natural environment. Several teachers referred to aspects related to better student behavior, following the line of the aforementioned author and Carreres (2014) where the TPSR improved not only personal and social responsibility but also pro-social behavior. The study by Escartì et al. (2010) confirms that it helped teachers to structure classes and promoted the learning of responsible student behaviors. A significant increase in self-regulatory and self-efficacy was also observed in the participants of the intervention group.

The only study that has applied the TPSR in secondary schools and that has carried out interviews with teachers found much in line with those of this intervention. Thus, Manzano-Sánchez and Valero-Valenzuela (2019), showed high satisfaction with the model in the interviews conducted, a positive evaluation in terms of its possibilities for promoting values and wanting to continue its application in future courses, aspects also reflected within the different reflections on this study by the teachers. We therefore do not agree with the study by García et al. (2014), where the teaching staff indicate that the innovative methodologies for promoting autonomy and responsibility are perceived as complex to apply due to the limited time available, given that there was only one comment that indicated "the day I get confused I don't get to the evaluation, or I set the alarm on my mobile phone 5 min before the end of the class". Furthermore, the possibility of hybridizing with other pedagogical models such as Cooperative Learning, could improve some of the potential or educational results that TPSR has in a unique way (González-Víllora et al., 2019).

It should be noted that the novelty of this study in terms of its scope (educational context in general) may serve as a reference point for future work in education, since although very good results have been obtained in terms of teacher assessment, they could only be contrasted with studies in Physical Education, extracurricular sports activities or other sports activities, with the exception of the studies by Manzano and Valero-Valenzuela (2019) and Manzano-Sánchez and Valero-Valenzuela (2019). Finally, the use of the mixed methods methodology helps to draw conclusions taking into account different points of view and perspectives.

CONCLUSION

The TPSR can be applied to all participants in the curriculum and is perceived as appropriate for teachers. Its applicability does not have more suitable content or more specific groups than others, but it can be used for any teacher or course independently of these aspects. It was perceived as appropriate to improve educational values without detriment of the contents, indicating even more simplicity to teach contents and a new motivation for teachers. It is suggested that the application of the TPSR should be carried out by all teachers participating with the same class group in order to improve the benefits and involve families in the process. Future lines of research could consider the possibility of replicating this study in other contexts within the educational system (for instance elementary or primary education), using a methodology similar to that of this study, combining quantitative and qualitative instruments.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Committee of the University of Murcia REF-1685/2017. Written informed consent to participate in this study was provided by the participants, participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

DM-S and AV-V developed the methodological proposal and data analysis. MG-L described the conclusions and references. DM-S realized the literature review and wrote the part of the theoretical frame. LC-M collaborated in data analysis and redaction of results.

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ORIGINAL RESEARCH
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A Mixed Methods Study to Examine the Influence of CLIL on Physical Education Lessons: Analysis of Social Interactions and Physical Activity Levels

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Physical Education is often selected for applying multilingual initiatives through the use of a content and language integrated learning (CLIL) approach. However, it is still unclear whether the introduction of such an approach might entail losing the essence of physical education and distorting its basic purposes. The aim of this study is to analyze the impact of CLIL on physical education lessons. Given the purpose of this study, a mixed methodological approach based on a sequential exploratory design divided into two different phases is used. We begin with initial qualitative data collection (phase I), consisting of the analysis of interviews with 12 participants (8 teachers and 4 students). Based on its analysis, two foci are identified: social relationships and physical activity. Then, informed by the results obtained, a quantitative approach is used (phase II), differentiating these two sets of data to make a more in-depth analysis of them. On the one hand, a sociometric questionnaire was applied to analyze the social relationships between CLIL students. On the other hand, a quasi-experimental design (n = 49) was implemented using accelerometry to measure moderate to vigorous physical activity (MVPA) in the physical education sessions. Regarding physical activity, the results show that levels of MVPA are higher in the experimental group (CLIL) than in the control group, a result which clarifies the divergent viewpoints of the interviewees. However, focusing on social relationships, the sociometric questionnaire results show that there were no statistically significative changes, although some signs of a slight effect on students' relationships arise depending on their gender. Therefore, more research would be necessary to further study the effect of CLIL in this regard.

Keywords: physical education, CLIL, moderate-vigorous physical activity, pedagogical approach, mixed methods, social relationships

INTRODUCTION

Currently, Physical Education has been claimed to generate different 'educationally beneficial outcomes for students, across a range of domains' (Kirk, 2013, p. 978). This may be explained by the fact that this subject is defined by the two words that form its name (Kirk, 2010). In other words, Physical Education has the potential to promote learning related to different spheres, not only the physical one, but also the social, personal and cognitive (Dyson et al., 2004; McEvoy et al., 2017). However, there are various historical and philosophical accounts outlining the journey Physical Education has taken throughout its history, and even today there may be different viewpoints on its current understanding. As an example, some purposes of Physical Education may be: (1) development of motor and sport-specific skills, (2) promotion of health-related fitness and active lifestyles, and (3) personal, social and moral development (Hardman, 2011).

Despite Physical Education's holistic power, there is a 'growing movement to develop and adopt classroom-based physical activity in an effort to increase physical activity within the school day' (Quarmby et al., 2019, p. 2). This tendency is related to the aforementioned first and second functions of Physical Education, and responds to the worrisome concern due to the decrease in moderate to vigorous physical activity (MVPA) in school-aged children (Hollis et al., 2017; Viciana et al., 2019). In fact, Physical Education lessons are the only opportunity to engage in physical activity for many adolescents and children (Meyer et al., 2013; Aljuhani and Sandercock, 2019). Therefore, this subject is crucial in contributing to the recommendations on daily amount of physical activity (World Health Organization, 2010; Viciana et al., 2019).

The third purpose of Physical Education stated by Hardman (2011) refers to personal, social and moral development; and it usually constitutes one of the main goals of European Physical Education programs (Opstoel et al., 2019). Indeed, Physical Education is seen as a great opportunity to develop the students' personality and socialization (Weiss, 2011; Andueza and Lavega, 2017) given its social nature and the particular context it generates. However, it is important to mention that simply participating in Physical Education lessons does not automatically lead to the development of such skills (Cryan and Martinek, 2017; Opstoel et al., 2019).

In addition to the aforementioned functions, Physical Education has increasingly been involved in the development of programs devoted to the learning of another language (Baena-Extremera et al., 2017; Lamb and King, 2019), often through the CLIL (Content and Language Integrated Learning) approach (Coral et al., 2017; Salvador-García and Chiva-Bartoll, 2017). This stems from the need to improve second-language education and bilingualism, which is an essential skill in today's society (Marsh, 2002). However, several voices claim that non-linguistic subjects, as is the case of Physical Education, are undervalued when this approach is applied (Pérez-Cañado, 2017). Furthermore, the introduction of CLIL inevitably entails a change in the development of the lessons (Coyle, 2015). Consequently, it is worrisome that Physical Education might lose its identity when introducing another language in class (Merino, 2016), because this subject should ensure that its particular purposes are achieved.

The main aim of this study is to analyze the impact of CLIL on Physical Education lessons, bearing in mind the essential functions of the subject.

MIXED METHODS

All methods of data collection have limitations. Qualitative methods can provide in-depth information whereas quantitative methods can test predictive associations. Mixed-methods studies collect and combine qualitative and quantitative data in order to build on the complementary strengths of both qualitative and quantitative methods (Creswell and Plano Clark, 2017). In this regard, a considerable amount of literature defends that mixing different types of methods can strengthen a study (Greene and Caracelli, 1997).

In order to utilize the benefits of each method, we employed a sequential exploratory design to integrate qualitative and quantitative methods (Creswell and Plano Clark, 2017). This design was conducted in two phases, with equal status given to both phases of research. The qualitative data collected in Phase 1 informed the design of the quantitative study in Phase II. Such a design was chosen because there was a need to begin with initial qualitative data collection so as to identify the focus of the possible variables to examine (Tashakkori and Teddlie, 1998). In this case, we needed to narrow the possible effects of CLIL on Physical Education in order to analyze them objectively.

Participants in the first phase of data collection were high school students and teachers who had been using the CLIL approach in Physical Education lessons. From the interviews, we identified two main themes related to the influence of CLIL on Physical Education as a subject. Finding out whether there was an effect due to CLIL on these two themes became the two branches investigated in phase II of the study. In this second phase, we used a sociometric questionnaire and accelerometry to test the predictive associations identified in the interviews. This quantitative approach allowed us to examine whether the qualitative findings were supported by objective measures. Both approaches carried equal weight in the resulting discussion. **Figure 1** shows the stages followed in the design. The following sections detail each phase, including participants, method, data analysis and findings of each.

Phase I (Qualitative Study)

Research Question

What impact will CLIL have on Physical Education lessons from the perspective of the students and teachers involved?

Participants

On the one hand, eight Spanish teachers of Physical Education with CLIL (four female and four male) composed the sample of the study. They are teachers in different high schools and they have been implementing the CLIL approach for at least 3 years.

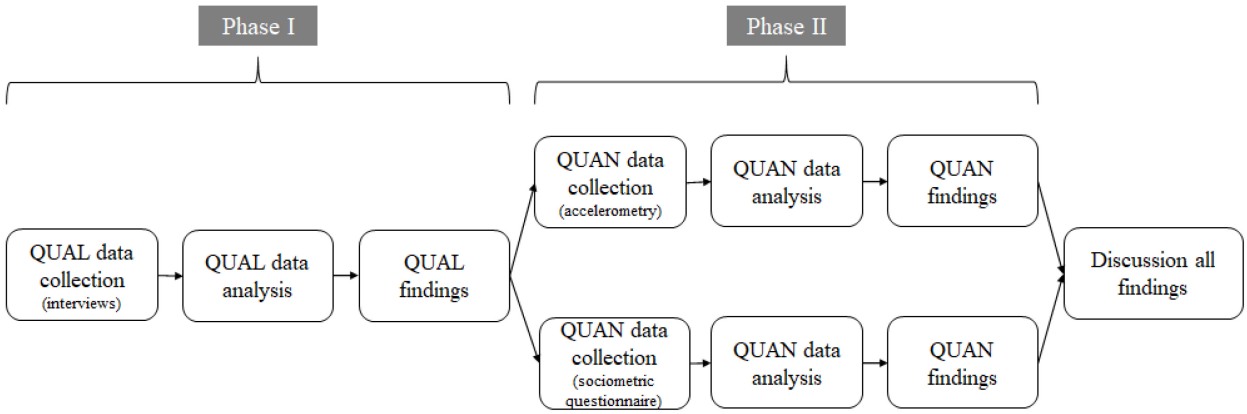

FIGURE 1 | Stages of the sequential exploratory design.

Furthermore, they all have an official certificate that enables them to carry out Physical Education lessons in English. On the other hand, four 15- to 17-year-old Spanish students were also selected. In their case, they had been doing Physical Education through CLIL for at least a term in their high school.

Intentional sampling was chosen in an attempt to achieve representativeness among both teachers and students (Patton, 2002). Therefore, regarding the teachers, we considered features such as age (25–40 $n = 4$; 41–60 $n = 4$), gender (female $n = 2$; male $n = 6$) and CLIL experience (3–5 years $n = 4$; 5–8 years $n = 4$). With respect to the students, the representative quotas of participants were based on their gender (female $n = 2$; male $n = 2$), English marks for the last academic year (high marks $n = 2$; low marks $n = 2$) and Physical Education marks for the last academic year (high marks $n = 2$; low marks $n = 2$).

All the participants had received detailed information about ethical considerations regarding informed consent and confidentiality, building on guidelines of the ethics committee of Universitat Jaume I and had thereafter agreed to participate in the study. In addition, the students' parents or guardians signed an informed consent document.

Method

All participant interviews were carried out by the same interviewer. We used a semi-structured interview format because, according to literature, this instrument allows the participants to describe detailed personal information, but the interviewer still has good control over the information received. In addition, they ensured a degree of comparability across interviews and allowed for different themes to arise (Creswell, 2012). Therefore, the use of this type of data collection was appropriate to identify the possible effects of CLIL on Physical Education, which was the main topic of the interview guide. Previous literature helped us to frame the interview questions, which were organized around the aims of Physical Education (Hardman, 2011), although other questions emerged from the dialog between interviewer and interviewees to probe for more relevant data (Mackey and Gass, 2005; DiCicco-Bloom and Crabtree, 2006). The interviews started with general questions, followed by other more specific ones to reconstruct the interviewees' subjective theories without biasing them (Flick, 2014). The structure of the interviews is presented in **Table 1**.

The initial part of the interview involves the interviewer making a brief presentation, explaining to the interviewees the following points: the confidentiality of their identity, the use of recording exclusively for research purposes, the possibility of stopping the recording at any time during the interview and the non-obligation to answer all questions. They also clarified that the interviews were anonymous, as recommended by the protocols of this technique.

The teachers' interviews were individual, whereas the students were interviewed as a group to combine individual experiences and build a collective discourse, comparing and contrasting different viewpoints and therefore avoiding any distortion of their perceptions. All the interviews were recorded with a SONY ICD-P530F recorder and they were carried out in Spanish. After the data analysis a professional translator translated them into English for publication. Pseudonyms are used to protect the interviewees' identities.

Data Analysis

Initially, the research team read all transcripts to provide a holistic review of the participants' viewpoints on the effects of CLIL on Physical Education. Next, we exported the interviews into NVivo-11 software. Later, we met to discuss initial reactions and develop potential categories related to the essential features of Physical Education. Then, the representative quotes were grouped together within these categories. Finally, a member checking process was carried out to ensure inter-rater reliability (Johnson and Christensen, 2016).

Findings

The research team identified two main categories that pointed to the effects generated by CLIL on Physical Education according to the interviewees' viewpoints. In this respect, 'social relationships' and 'physical activity' were the aspects that could be affected by the use of this innovative approach.

TABLE 1 | Structure of the interviews.

	Issues addressed			
	Teachers' interviews		Students' interviews	
Interview parts	**Issues**	**Basic interview guide**	**Issues**	**Basic interview guide**
"Ice-breaker" questions	Information on personal matters, language proficiency, work experience and educational, and training attainments.	What is your teaching experience (and using CLIL)? What is your English level? What specific training have you undergone to do CLIL?	Information on personal matters, general opinions about the subject.	• What do you think of Physical Education? • How do you feel about the subject?
General questions	Preparation of the classes.	• What is your general opinion regarding Physical Education with CLIL? • How do you prepare your CLIL lessons?	Learning in physical education The acquisition of language skills.	• Has CLIL hindered your learning of the subject? How? Why (not)? • Why was CLIL (not) helpful for language learning?
Specific questions	Class development: strengths, limitations. Differences between using and not using the CLIL approach.	• What are the advantages of using CLIL in Physical Education? • What are the disadvantages of using CLIL in Physical Education? • What are the differences in CLIL and non-CLIL Physical Education? And regarding motor and sport-specific skills/activity or movement/personal, social and moral development?	Advantages and disadvantages of the CLIL approach in physical education classes. Differences regarding classes without the CLIL approach.	• Why can CLIL be beneficial for students in Physical Education? • What are the disadvantages of using CLIL in Physical Education? • What are the differences in CLIL and non-CLIL Physical Education? And regarding motor and sport-specific skills/activity or movement/personal, social and moral development?
Conclusion question	Further observations			

Social relationships

With regard to the 'social relationships' category, the idea that CLIL entails a change was shared by all interviewees. For example, the students clearly stated that '*speaking in English in the lessons helped us to be more attentive with our classmates. If you were able to understand the instructions, you were actively involved in helping the rest of the students*' (Student 2). Consequently, students were led to increase their work as a team or '*group collaboration: since I don't understand, you explain it to me*' (Student 3).

The teachers noticed an increase in the students' helpfulness too, as is illustrated in the following quote:

> '*There is more collaboration among students, of course. I think that any handicap you (the teacher) bring to class will be a challenge for the pupils and, therefore, it will help (to enhance teamwork). In this case, it was English language, but (. . .) any new handicap will lead to an increase in everyone's collaboration*' (Teacher 3).

In addition, according to the teachers, this increase in students' interactions was also a consequence of the type of tasks and the methodology that CLIL entails.

> '*One of the ways of promoting language use is by doing cooperative tasks. When planning the sessions, there is a need to search for cooperative structures to boost language use. In addition, I can help because it is something mandatory at a specific moment of the lesson (. . .) but I believe that showing a weakness and sharing it with your classmates, being conscious of the fact that we are more similar than we had thought, being aware of our sameness. . . Sharing all these feelings generates an emotional atmosphere that truly promotes learning with the other*' (Teacher 4).

All in all, according to the interviewees' perceptions, the use of CLIL increases collaboration and the feeling of sameness within the group while enhancing the number of interactions between students. Therefore, CLIL might entail a change in the social atmosphere of the group.

Physical activity

Physical activity was the second category identified. However, participants reported divergent perspectives regarding this aspect. On the one hand, all students share a common discourse, which is also supported by some of the Physical Education teachers. According to their viewpoint, the implementation of CLIL does not hinder the amount of physical activity carried out in Physical Education lessons. The following quotes illustrate this idea:

> '*I have adapted the theoretical content, but the practical content has not been adapted*' (Teacher 2).

> '*The activities and the practice itself have remained the same*' (Teacher 7).

In the same vein, despite the required methodological changes due to CLIL that were not noticed by students, one of them stated that '*it is exactly the same learning in English or in Spanish. The only difference is that we use a different language*' (Student 1). In fact, none of the adolescents thought that CLIL could diminish their time engaged in physical activity.

On the other hand, some teachers were concerned with this issue and showed an opposing opinion. Specifically, they believed that the use of a different language implied more teacher talking time and a slowing of students' understanding that could also

decrease the students' physical activity time. In the words of one of the teachers:

'*Obviously, the explanations are longer. You have to explain the same thing (compared to a non-CLIL group) and you (the teacher) do not have the same knowledge, skill and speed when speaking in English*' (Teacher 3).

Also, a different teacher reported that although physical activity was still an important part of the lessons, the amount of time that students were engaged in it could be affected because it was more difficult for students to understand an activity and start it. This can be perceived in the following quote, in which the teacher mentions both aspects:

'*I think that the sport's essence, its physical activity, was the same, it (CLIL) was not an obstacle. They may be slower to understand an activity, but once you have performed it, students worked with no difference (compared to non-CLIL students)*' (Teacher 4).

To sum up, despite the fact that all interviewees thought that students' quality of movement was the same regardless of CLIL, some teachers did worry about the amount of time that students were engaged in physical activity.

Phase II (Quantitative Study)

Hypotheses

- The social relationships measured by the sociometric questionnaire conducted by the experimental group will improve after application of the CLIL approach.
- The amount of time that students are engaged in physical activity will be less for the experimental (CLIL) group than for the control (non-CLIL) group.

Participants

Once the findings of the first phase of the study were clear and the foci of the subsequent phase of the study were established (social relationships and physical activity), the participants for the second phase were recruited. In total, the convenience sample for the quantitative study consisted of 49 13- to 14-year-old students. Participants in the accelerometry analysis were divided into the experimental group (CLIL), composed of 13 girls and 10 boys, and the control group (non-CLIL), composed of 19 girls and 7 boys. This sample presented a statistically proportional distribution in terms of the gender variable between the groups $\chi^2(N = 49) = 1.05$, $p = 0.306$. The mean age was 13.8 ($\pm$0.18). Only the experimental group participated in the sociometric questionnaire measures. They did not have prior experience in Physical Education through CLIL. We decided that the group of participants in phase II of the study would not be the same as in phase I in order to avoid their attitudes and behavior being influenced by the interviews carried out in advance. Therefore, a different group of students, without CLIL experience, was selected.

For this part of the study the principal and the Physical Education teacher agreed to participate by establishing a memorandum of understanding. The students' parents or guardians also signed an informed consent document.

Measures

To identify possible changes in the social relationships of the students in the experimental group, a sociometric questionnaire was applied at the beginning and at the end of the term. The three units included within this period were the first time that the students in the experimental group had done Physical Education through the CLIL approach. Sociometric methods are the most common form of measuring the status of individuals within groups to understand their relationships (Chelcea, 2005). The sociometric questionnaire consisted of four questions where students were asked to express sympathetic relationships in terms of their attraction or repulsion to classmates. These questions were: (a) Which classmates do you most like being with in Physical Education lessons? (b) Which classmates do you least like being with in Physical Education lessons? (c) Which classmates can help you to learn more in Physical Education lessons? (d) Which classmates can't help you to learn in Physical Education lessons? A peer nomination technique in which participants were asked to nominate peers in order of importance was used. It is imperative to note that pre-test measures were taken before the first CLIL unit started. In addition, due to the sensitive nature of the questionnaire, students were provided with a private area to individually complete them and asked not to discuss the task with their classmates.

In order to discern whether there was an effect on students' physical activity levels, the instruments selected were accelerometers (a device that measures the acceleration of a body through high-frequency recordings in order to discriminate behavioral patterns of physical activity). They are considered one of the most reliable ways of measuring levels of physical activity and were selected because they do not interfere with Physical Education sessions (Calahorro et al., 2015). In this study, the GENEActiv Original triaxial accelerometer was used. Data recruitment took place during a unit taught in January–February 2017. Both the experimental and control group had two 50-min lessons per week in the morning, in which accelerometer-based outcome measures were taken from all the students. The research design corresponds to a quasi-experimental design based on non-equivalent natural groups to make an objective analysis of physical activity levels in Physical Education lessons. The same Physical Education teacher taught both groups the same content (athletics) in an attempt to control potential 'teacher-related' confounding. Each student wore an accelerometer for the entire lesson on his/her left wrist. To control differing durations of Physical Education lessons, physical activity data were collected during the entire lesson because the English language was used with the experimental group throughout this time. The measurements were taken in six practical sessions of each group.

An experienced external observer conducted practice observations of all the lessons of both groups and completed the CLIL planning and observation checklist (Mehisto et al., 2008) to ensure this approach was properly implemented.

Data Analysis

Regarding the sociometric questionnaire, the data were analyzed to produce descriptive categorical results. The analysis of social relationships was conducted using the student peer

nomination questionnaire with the experimental group (CLIL) in Spanish. After the peer nomination questionnaires were collected, frequency of positive and negative nominations was calculated for each student to determine social dynamics within the group. The mean scores of the ratings were computed for each student. Specifically, the number of nominations was divided by the number of students who took the questionnaire. This analysis let us identify the increase, maintenance or decrease in the number of positive and negative nominations.

For its part, we followed previous literature on accelerometry and we conducted the analyses unifying the moderate and vigorous categories into one variable called Moderate-Vigorous Physical Activity (MVPA). Specifically, the time spent on MVPA was calculated by applying previously calibrated and validated cut-off points for this type of population (Phillips et al., 2013). The data recorded were exported into the statistical package SPSS-24. Then, a multivariate analysis was used to analyze the effect of the group variable on MVPA time.

Findings

With reference to the sociometric questionnaire, a *t*-student analysis was conducted to determine whether there were differences between pre- and post-test measures regarding the four questions about relationships with classmates. This analysis was also performed differentiating by gender. The results do not show significant differences between the students' score pre- and post-test measures. However, **Table 2** also presents some interesting outcomes when comparing the results obtained by males and females. Regarding question (c) "Which classmates can help you to learn more in Physical Education lessons?", girls increased their scores from pre-test (M = 0.96, SD = 0.113) to post-test (M = 0.141, SD = 0.183), whereas boys decreased their scores from pre-test (M = 0.134, SD = 0.226) to post-test (M = 0.061, SD = 0.182). In fact, only one of the questions, (b), shows similar trends between boys and girls. These results suggest that the CLIL program may have different effects on students' relationships depending on their gender.

For its part, the multivariate analysis performed showed significant main effects for the group variable [Wilks' $\Lambda = 0.637$, $F(1,49) = 25.664$; $p < 0.001$; $\eta^2 = 0.363$] on students' physical activity level. In addition, partial eta square showed that the differences between the score obtained by the control group (non-CLIL) and the experimental group (CLIL) in students' physical activity levels (sedentary-light and moderate-vigorous) is 36.3%. **Table 3** presents the mean percentages of time that both groups spent at levels of sedentary-light and moderate-vigorous physical activity throughout the unit.

TABLE 2 | Difference between study samples by gender and total in four sociometric questions about sympathetic relationships in terms of attraction or repulsion to classmates.

Sociometric questions	Female group (n = 13)		p-value	Cohen's d	Male group (n = 10)		p-value	Cohen's d	Total group (n = 23)		p-value	Cohen's d
	Pre-intervention	Post-intervention			Pre-intervention	Post-intervention			Pre-intervention	Post-intervention		
	Mean (*SD*)	Mean (*SD*)			Mean (*SD*)	Mean (*SD*)			Mean (*SD*)	Mean (*SD*)		
(a) . . .classmates you most like in PE. . .	0.117 ± 0.189	0.121 ± 0.056	0.893	−0.028*	0.131 ± 0.178	0.121 ± 0.160	0.726	0.059*	0.122 ± 0.071	0.121 ± 0.061	0.912	0.003
(b) . . .classmates you like least in PE. . .	0.118 ± 0.139	0.134 ± 0.182	0.497	−0.098	0.108 ± 0.161	0.117 ± 0.087	0.770	−0.069	0.114 ± 0.107	0.126 ± 0.145	0.470	−0.094
(c) . . .classmates who can help you learn in PE. . .	0.096 ± 0.133	0.141 ± 0.183	0.582	−0.238*	0.134 ± 0.226	0.061 ± 0.182	0.396	0.355*	0.113 ± 0.176	0.105 ± 0.149	0.895	0.049
(d) . . .classmates who can't help you learn in PE. . .	0.123 ± 0.132	0.143 ± 0.216	0.821	−0.111*	0.132 ± 0.195	0.086 ± 0.112	0.609	0.289*	0.126 ± 0.158	0.119 ± 0.175	0.900	0.041

**Opposing trends depending on gender.*

DISCUSSION OF QUALITATIVE AND QUANTITATIVE FINDINGS

The integrated mixed methods research strategy with a two-phase exploratory sequential design has been instrumental in improving our understanding of CLIL in the Physical Education field to examine the influence of this approach on the subject's basic purposes: (1) development of motor and sport-specific

TABLE 3 | ANOVA for students' physical activity level (SLPA/MVPA) by group of participants (CLIL/non-CLIL).

Physical activity level	Group	Mean (*SD*)	*F*	η^2
SLPA	Non-CLIL	72.79 (4.28)	25.664***	0.363
	CLIL	65.95 (4.95)		
MVPA	Non-CLIL	27.21 (4.28)	25.664***	0.363
	CLIL	34.04 (4.95)		

****p < 0.001. Mean refers to percentage per session. SLPA, sedentary-light physical activity; MVPA, moderate vigorous physical activity.*

skills, (2) promotion of health-related fitness and active lifestyles, and (3) personal, social and moral development (Hardman, 2011). While directly administered interviews in the first phase have been useful to narrow the study's aims, the use of a sociometric questionnaire and accelerometry in the second phase allowed us to analyze social relationships and physical activity levels objectively within Physical Education lessons.

Despite the fact that mixed approaches are increasingly being advocated as a means to better comprehend educational concepts and contexts (Johnson and Onwuegbuzie, 2004; Tolan and Deutsch, 2015), there are still limited examples of their combination in the literature. Combining qualitative and quantitative methods enhanced the validity of our findings because we could triangulate results that examine the same phenomenon across different methods, we could expand and better elaborate our findings, and we could unveil contradictory findings that resulted from the use of different methods (Greene et al., 1989; Tolan and Deutsch, 2015). Relevant findings emerged at each phase of the research process and are reported by the two foci into which phase II is divided.

Consistent with previous literature, participants described how Physical Education with CLIL provided students with more options to help one another, interact with other peers, be more attentive, increase teamwork and share similar weaknesses (Coyle et al., 2010; Coyle, 2015; Salvador-García et al., 2018; Lamb and King, 2019). These aspects are linked to the personal and social spheres of Physical Education (Dyson et al., 2004; Hardman, 2011). Their mention by the interviewees may be explained because CLIL entails a type of talking and interaction that is different from that of traditional lessons (Casal, 2016), resulting in the promotion of social skills and peer relations. On this account, CLIL programs go beyond the mere usage of the target language in content in order to include other essential lifelong skills such as social ones (Torres-Rincon and Cuesta-Medina, 2019).

The interviews illustrate that the Physical Education teachers interviewed feel the need to use collaborative activities when planning lessons through the CLIL approach. In this regard, the introduction of collaborative activities can also be useful to strengthen social dynamics within the group, enhancing prosocial behavior and empathy among students (Andueza and Lavega, 2017). In addition, this means that CLIL may entail a change in Physical Education methodology, making it more participative, inclusive and collaborative, which are ultimately some of the current trends in Physical Education because these features help to achieve a range of educationally beneficial objectives related to many different domains, such as the physical, lifestyle, affective, social and cognitive (Dyson et al., 2004; Kirk, 2010, 2013). All in all, the use of CLIL in the area of Physical Education may help align the subject with its current principles (Lamb and King, 2019).

Participants also stated that, according to their experiences, introducing CLIL contributed to the development of positive relationships between students (Casal, 2016; Bower, 2019). Similarly, a case study analyzing CLIL with Physical Education concluded that there was an improvement in social interaction and a sense of sharing among students (Christopher et al., 2012). Therefore, using CLIL could entail a change in the social dynamics of the group (Salvador-García et al., 2018). However, our quantitative findings do not totally align with the interview findings, since no significant differences were found when comparing pre- and post-test measures of the sociometric questionnaire. Despite these results, in general terms, there are some interesting outcomes when comparing the results obtained by gender. In this regard, three of the questions show opposing trends when the mean scores of males and females are compared. This might be related to the differences by gender that are often found regarding both interpersonal relations, for example, focusing on acceptance within the group (Andueza and Lavega, 2017), and CLIL (Doiz et al., 2014; Fernandez-Barrionuevo and Baena-Extremera, 2018). Therefore, it is necessary to carry out further research on this topic, because the effects on sociometric measures might need longer to appear (van der Wilt et al., 2019).

Regarding the first and second purposes of Physical Education (Hardman, 2011), that is to say, those closely linked to the physical sphere, interviewees also expressed their opinions on CLIL's possible effects and accelerometry allowed us to analyze it objectively. Contrary to the stereotypes of many critical voices who claim that physical activity levels decrease in Physical Education with CLIL (Coral et al., 2017; Martinez and Garcia, 2017), we did find evidence in both the interviews and accelerometry results that the quality of physical activity is not necessarily diminished. In addition, despite some teachers' concerns about their explanations being longer when applying CLIL (Lo and Macaro, 2015; Salvador-García and Chiva-Bartoll, 2017), the percentage of time that students were engaged in MVPA was also maintained.

We can explain such physical activity analytical results only by combining them with the findings from the qualitative study. In our case, the interviewed students were willing to help each other understand, maybe due to the high levels of motivation that are usually linked to Physical Education through CLIL (Baena-Extremera et al., 2017; Lamb and King, 2019). In addition, using CLIL may entail an increase in students' attentiveness (Zindler, 2013; Salvador-García and Chiva-Bartoll, 2017), or the use of teaching strategies that teachers employ to enhance students' understanding (Gomez and Jimenez-Silva, 2012; Salvador-García et al., 2019). In this regard, teachers who apply CLIL tend to be more concerned with the vocabulary and language structures they use to ensure effective communication (Ting, 2011; Zindler, 2013). However, this contrasts with other authors who claim that some teachers may overuse language learning materials such as

flashcards and, consequently, the teacher talking time is increased while students' activity time is diminished (Coral et al., 2017). More research is needed to further investigate these aspects and better understand how Physical Education sessions are carried out when the CLIL approach is used.

CONCLUSION

Addressing the stated research objective through the application of a unique mixed method strategy with exploratory sequential design has been useful in our study, as it puts students and teachers at the center of CLIL research in the field of Physical Education and focuses on the basic features of Physical Education. One of the main purposes of Physical Education refers to personal, social and moral development (Hardman, 2011). In this regard, the interviews undertaken revealed the potential role that CLIL may play in improving social relationships between students; however, the sociometric questionnaire findings only show some very slight trends in gender-based outcomes. In any case, the interpretation of these results yields some interesting inferences leading to the conclusion that the use of a CLIL approach might change the social interactions in class for the better. Thus, CLIL might strengthen one of the main purposes of Physical Education.

Regarding the aims of Physical Education related to development of motor and sport-specific skills and promotion of health-related fitness and active lifestyles (Hardman, 2011), some participants wondered whether physical activity levels would be altered due to the application of CLIL. Despite being recurrent in their responses, the interviewees did not reach any consensus about this concern, so in the second phase of the study a measurement of MVPA through accelerometry objectively showed that MVPA was not jeopardized, with the CLIL group obtaining higher levels of MVPA than the non-CLIL group. These results represent an outstanding finding, since they certainly shed new light on one of the most widespread concerns in this field. Therefore, according to our study, the CLIL approach does not necessarily hinder the basic purposes of Physical Education, which was a concern for many scholars (Merino, 2016; Coral et al., 2017; Pérez-Cañado, 2017). In fact, it might contribute to its development.

This study has some limitations. The quantitative part of the study relies on data collected with a limited sample. Also, given the fact that the study was carried out in Spain, the findings might not be transferable to all contexts. However, these are common issues that come with educational research that attempts to uncover intervention programs (Sandoval and Bell, 2004). We are convinced, instead, that by highlighting the views of these groups of participants and sharing the quantitative measures obtained, we have contributed to knowledge on how the CLIL approach can influence Physical Education. Furthermore, it should be noted that qualitative research does not attempt to generalize knowledge in a categorical way, but rather aspires to deepen our knowledge about contextualized phenomena. It does take advantage of the results obtained to relate them to existing literature and thus increase the conceptual framework of the field (Denzin and Lincoln, 2005). It is in this way that, from an interpretative paradigm, this study helps broaden knowledge in Physical Education research (Pérez-Samaniego et al., 2011).

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

This studies involving human participants were reviewed and approved by Deontological Commission of the University Jaume I:UJI-PREDOC/2016/03. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

OC-B and CS-G conceived the idea presented and designed the study. CS-G and CC-P organized the database. PR-M and CC-P performed the statistical analysis. CS-G wrote the first draft of the manuscript. OC-B, CS-G, and CC-P reviewed the methodological sections of the manuscript. All authors contributed to revision of the manuscript and read and approved the submitted version.

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The Effect of an Enriched Sport Program on Children's Executive Functions: The ESA Program

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Purpose: The effects of physical exercise on executive functions (EFs) are well-documented. EFs are involved in daily activities, and their development determines the quality of people's future life, both in terms of mental health and quality of life. The purpose of the current paper is to evaluate the effects of a physical education program, elaborated within the Enriched Sports Activity Program (ESA Program), an Erasmus + Project, on EFs, namely, visuospatial working memory, inhibitory control, cognitive flexibility, and task switching.

Method: Data were collected on November 2017 (t_1) and May 2018 (t_2). At t_1, a sample of 357 children from four European countries (Italy, Germany, Lithuania, and Turkey) performed a cognitive test battery made up of Digit Span Forward/Backward, Stroop Task, and Trail Making Test (TMT), whose order was randomized. From November until May, classrooms from the experimental group followed the ESA Program, while classrooms from the control continued with the ordinary physical education class. At t_2, children from both experimental and control groups performed again the cognitive battery.

Result: The repeated measures ANOVA showed a significant effect of the ESA Program on the TMT B and on Digit Span Backward, but no significant effects were found on Digit Span Forward and Stroop Task.

Conclusion: The introduction of a sport program enriched with cognitive stimuli has beneficial effects for children working memory and cognitive flexibility.

Keywords: training program, high-order cognitive abilities, cognitive flexibility, inhibitory control, physical education class, working memory

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INTRODUCTION

In the past decades, cognition and exercise have been considered as separate domains and, for this reason, were treated independently (Diamond, 2000). In recent years, a close link between physical exercise and cognitive abilities has been recognized (Colcombe and Kramer, 2003), specifically for what concerns the influence of physical exercise on executive functions (EFs).

Many hypotheses have been provided for explaining this improvement as the increase of the catecholamine levels (Chmura et al., 1994; Verburgh et al., 2014), which is linked to prefrontal cortex activity as well as executive functioning (Mehren et al., 2019), or the increase of cerebral blood flow (CBF) due to exercise (Verburgh et al., 2014). During childhood, prefrontal cortex activation should be more dynamic, and brain plasticity should encourage a permanent improvement in cognitive functioning (Khan and Hillman, 2014; Erickson et al., 2015.

EFs relate to a set of cognitive abilities that supervise the information processing for the implementation of goal-directed actions and that require a certain amount of memory, attention, inhibition, and self-control (Eslinger, 1996; Best, 2010; Davis et al., 2011). Especially for children, EFs are involved in the learning process (Alloway and Alloway, 2010); therefore, they are considered crucial for successful performances at school and the development of academic skills (Nayfeld et al., 2013). A study of Visu-Petra et al. (2011) revealed that EFs significantly predict children's academic achievements. More specifically, working memory tasks forecast their performance in math tests, while the inhibition task is positively associated with the general semester grade. Haapala (2013) undertook a systematic literature review from 1966 to 2011 on physical activity, academic performance, and cognition in children and adolescents, providing evidences which showed positive effects of 14- to 36-week physical exercise training on mathematical, reading, and language achievement scores.

However, studies hypothesizing a connection between EFs and specific academic skills (e.g., math skills) found mixed results ranging from a positive influence of physical exercise to none on academic performances. A meta-analysis by de Greeff et al. (2018) found positive moderating effects of inhibition in the relationship between acute exercise and academic achievement, while no moderating effects were found concerning working memory and cognitive flexibility. Moreover, for what concerns physical activity programs, the meta-analysis revealed a significant moderating effect of working memory and cognitive flexibility, while no effects were detected concerning inhibition and planning. These inconsistent results, probably, are due to methodological difficulties in the EFs measurement that are, in turn, related to the complex conceptualization of the construct (Van der Ven et al., 2012). Indeed, the conceptualization of EFs has changed throughout time. In the past, the EF system was considered a unitary structure, while today, researchers have recognized the existence of different, distinguished, but interrelated functions (Miyake et al., 2000).

Hence, a good development in EF is crucial for youth, since problems encountered in EFs during childhood are related to problems in terms of health, social status, and quality of life later on in adult life (Jacka et al., 2011; Diamond, 2012). For this reason, EFs have been related to children with several health issues, as attention deficit hyperactivity disorder (ADHD) (Kempton et al., 1999; Holmes et al., 2010; Ziereis and Jansen, 2015), autism (McEvoy et al., 1993; Gilotty et al., 2002; Rosenthal et al., 2013), and brain injuries (McCarthy et al., 2005; Kesler et al., 2011).

A significant improvement in children's cognitive abilities due to physical exercise has been found by Sibley and Etnier (2003). Specifically, physical activity seems to have positive effects on EF inhibitory function, planning and problem solving, cognitive flexibility, and visuospatial attention (Bidzan-Bluma and Lipowska, 2018). To what concerns the amount and frequency of physical exercise, a meta-analysis by Verburgh et al. (2014) has shown that acute physical exercise, which is a single bout exercise whose duration lasts from 10 to 40 min, has an overall effect on EFs, while no effects were detected concerning chronic exercise; that is, an exercise program lasting between 6 and 30 weeks. According to the authors, two main explanations may be provided: on the one side, chronic exercise has a smaller positive effect on cognitive functioning if compared to the acute exercise; on the other side, the studies included in the meta-analysis might not be suitable in terms of intensity, frequency, and duration. Moreover, while in acute exercise studies, the cognitive assessment took place immediately after the physical exercise, no information was provided concerning chronic exercise. Concerning the age, for children from 6 to 12 years, the authors found a moderate improvement of cognitive function after acute exercise. The importance of physical exercise for children EFs is crucial especially for low performer children who register a greater improvement compared to normal performer children (Diamond, 2012).

Considering that physical exercise has beneficial effects on children's cognition, increasing attempts have been done to implement physical activity programs enriched with cognitive challenges (Hillman et al., 2008). Tuckman and Hinkle (1986) compared children's physical and cognitive performance in a specific running program and an ordinary physical education class, finding that runners also became more creative than children in the ordinary class condition. Concerning this topic, Memmert (2006) confirmed that a sport enriched program can improve sport-related creative thinking, since children learn to perform successful behavior and to act it through creative motor functions. Davis et al. (2007) tested a physical activity program for obese children, analyzing the potential benefits of the program on EFs, and finding positive effects related to planning ability in high dose of exercise condition (40 min/day) compared to the no-exercise control condition.

The success of a sports program depends on its structure and its features. Diamond (2012) maintains that an effective aerobic training program can reduce disparities in EFs produced by differences in social status and predicts further academic success. Nevertheless, the improvement in one EF can be transferred to another, given the abovementioned multidimensional structure of the EF system.

The forecasted physical activity should also challenge children throughout the program. From a motivational point of view (Deci and Ryan, 2008), if kids are not pushed to do better, they stop improving, and, on the other side, if the activity does not become challenging, children get bored and abandon the program. Finally, single bouts of aerobic activity have produced the best results on EFs, but programs that last over time show smaller effects, thus Diamond (2012) suggests to

create combined programs of physical training and character development activities.

Considering these findings, the current paper analyzes the effect of Enriched Sports Activity Program (ESA Program) on children's EFs. The ESA Program is an enriched physical exercise protocol experimented within the Erasmus + Project *Enriched Sports Activity Program* (ESA Program; Agreement Nr.: Sport-579661-EPP-1-2016-2-IT-SPO-SCP). The project, which lasted 3 years, aimed at enhancing social inclusion, equal opportunity, and psychosocial well-being in children through an enriched protocol that introduced physical exercises able to stimulate cognitive growth (Alesi et al., 2017). The exercises were modified to stimulate the three core EFs, namely, inhibitory control, the ability to ignore one stimulus and concentrate on another; working memory, the goal-directed ability to monitor and manipulate mental representations stored in working memory; and task shifting, the ability to consciously switch from one task to another (Miyake et al., 2000; Diamond, 2013). The program was articulated into 27 units, divided into a 10-min baseline phase and a 15-min stimulation phase. The program is innovative since it standardized the warm-up session through the introduction of cognitive stimuli within exercises relating to several sports activities.

Considering the results retrieved from literature, the physical exercise protocol foreseen by the ESA Program should enhance EF performance in inhibitory control, working memory, and task shifting. Given the developmental phase of participants, ranging from 7 to 14 years, we expect a general improvement of all children's EFs, but a particular improvement in children who have followed the ESA protocol.

MATERIALS AND METHODS

Data collection took place in the first months of the school year in November (t_1) and in May (t_2), at the end of the same school year, within four different European countries (Italy, Lithuania, Turkey, and Germany) (**Table 1**). Four hundred twenty-two children were included in the sample, but 65 children did not complete the final evaluation. Thus, the research sample consisted of 357 children (48% males, 52% females) whose age was comprised between 7 and 14 years old (mean age = 9.55, SD = 1.77). The study was carried out according to the Helsinki Declaration (Hong Kong revision, September 1989). It also received permission from the Lithuanian Sports University's Research Ethics Committee in Social Sciences with approval No 579661-EPP-1-2016-2-IT-SPO-SCP (2018-02-05).

TABLE 1 | Selected participants per country.

Country	N	Intervention	Control
Italy	164	77	87
Lithuania	93	56	37
Turkey	80	40	40
Germany	85	38	36

Procedure

Cognitive data collection at t_1 took place within four European countries (Italy, Lithuania, Germany, and Turkey). After parents' signature of the consent form, children school classes were split in experimental and control groups. Children from both experimental group (ESA group) and control group completed a battery made up of three neuropsychological tasks derived by the Inquisit Lab platform: the Color Word Stroop Task (Stroop, 1935), the Trail Making Test (TMT) (Reitan, 1958), and the Digit Span Test (Lumley and Calhoon, 1934). One of the experimenters guided the children during the assessment, explaining the tasks they had to complete. Cognitive tasks were presented in a random order, and the data collection lasted about 30 min per respondent.

Children following the ESA Program completed 27 training units during physical education class, while children from the control group followed ordinary physical education class. At t_2, corresponding to the end of the school year, children repeated the same cognitive assessment in the same order presented at t_1.

Measures

Executive Functions

The following three EFs were measured: working memory, inhibitory control, cognitive flexibility and task-switching ability (Sánchez-Cubillo et al., 2009). For this purpose, Inquisit five by Millisecond© was employed, using the libraries available on the Millisecond© website. These scripts implemented the classic Stroop Task, TMT, and Digit Span Test with keyboard inputs.

Digit span forward/backward

Digit Span assesses working memory (Lumley and Calhoon, 1934; Woods et al., 2011). In the visual version, numeric sequences appear on the screen, and participants have to recall them (both in a forward and in a backward manner) by selecting with the mouse the digits from a circle of digits. Depending on performance, participants move up a level or down a level, and the assessment is over after 14 trials. The whole task lasts 15 min. The number of recalled digits before two consecutive errors was taken into consideration for data analysis. Scores are computed counting the number of recalled digits in the presented order and the number of recalled digits in the reversed order.

Stroop task

The Stroop Task is designed for assessing inhibitory control (Stroop, 1935). Participants are showed on the computer screen words written in four colors, such as red, green, blue, black. The task is made up of three conditions: in the congruent task (W), participants see some words on the screen and they have to indicate in which color the word is written that is congruent with its meaning, e.g., "red" word printed in red color. In the incongruent task (CW), participants have to indicate in which color the word is written and ignoring its meaning, e.g., "blue" word printed in red color. In the control condition (C), participants see some blocks on the screen, e.g., colored rectangles, and they have to indicate the color. Total trials are 84 derived by: 4 colors (red, green, blue, black) × 3 color-stimulus congruency (congruent, incongruent, control) × 7 repetitions. In the current study, the interference

score was calculated considering the logarithmic difference between inhibitory reaction time and control reaction time (MacLeod, 1991).

Trail making test

The TMT is a test developed for assessing cognitive flexibility and task switching (Reitan, 1958). In the A version, participants have to link numbers in increasing order, while in the B version, participants have to connect a number and a letter in an increasing way alternatively (i.e., 1-A-2-B-3-C). The trails were 4:1. Only numbers from 1 to 5; 2. only numbers from 1 to 25; 3. numbers and letters from 1A to 5; 4. numbers and letters from 1A to 13. For the calculation of the scores, only the B version completion time was used since it is more sensitive to cognitive flexibility skill (Kortte et al., 2002).

Enriched Sport Program

ESA Program. The implementation lasted 14 consecutive weeks in the school and the sports center context. It involved children from 7 to 14 years who already practiced sport. The protocol aimed to enrich the warm-up of regular sports activities with cognitive stimuli (inhibition, working memory, task shifting) for improving children's EF. The program consisted of 27 units lasting 25 min. The unit was made up of a baseline phase and stimulation phase, and it was obtained through a combination of two features: cognitive stimulus and movement domain. The construct validity was assessed only qualitatively: four experts from psychology and sport science rated the extent to which an exercise could stimulate a specific cognitive function. The discrepancies were solved through discussion.

The cognitive stimuli for the stimulation phase could involve inhibitory control, working memory, or task shifting. In the activity stimulating inhibitory control, the coach's verbal command for an exercise corresponded to the execution of another movement previously associated. For example, the verbal command "Skip-ahead" corresponded to "Kicked-ahead" movement, and the command "Fore-foot gait-ahead" corresponded to "Rear-foot gait-ahead." The stimulation of working memory occurred through the explanation of a series of exercises that children had to perform in a reverse order. For example, the oral command "Balance on the line-ahead/behind" corresponded to the performance "Balance on the line-behind/ahead." Concerning the task shifting stimulation, a circuit of exercises was created, and each child had to perform a specific exercise that was different from the others' one. When the instructor whistled, children had to switch to the exercise that the kid ahead was performing, until all of them had performed all the exercises in the circuit.

All the three domains started with a beginning level (B), followed by an intermediate level (I), and finishing with an advanced level (A). The design of the protocol was the following: the first nine units concerned the beginner level of exercise, whose domain was alternatively athletic drill, then sports ball, and finally smart circuits, and whose stimulation concerned alternatively working memory, inhibition, and task shifting. The same structure was kept for intermediate level and advanced level (**Figure 1**).

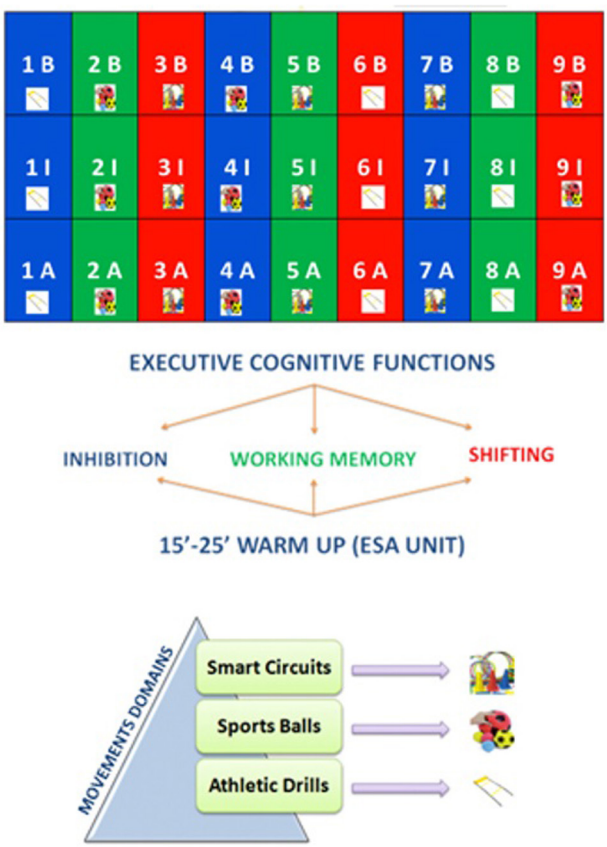

FIGURE 1 | The Enriched Sports Activity (ESA) Program Protocol.

A series of coaches' guidelines video tutorials were recorded to maximize the protocol standardization across the European administrators.

Data Analysis

Descriptive statistics was performed on the sample, including height and weight (**Tables 2**, **3**). Afterward, for evaluating the effects of the ESA Program on children's EFs, a repeated measures ANOVA model with Time × Group comparisons was performed. Specifically, the cognitive scores at the beginning and the end of the school year were compared, separating the general effect of improvement from the one induced by the ESA Program. The age of the participants was included as a covariate since the effects of physical exercise enhance executive function performance at different levels across ages (Ludyga et al., 2016).

RESULTS

For what concerns Digit Span Forward, repeated measures ANOVA showed a significant effect of Time between pre- and post-test conditions, while non-significant effects were found in the interaction between Time and Activity ($F_{1,355} = 2.26$, $p = 0.13$). No general performance improvement was observed in the Backward recall during time ($F_{1,351} = 0.21$, $p = 0.64$),

TABLE 2 | Distribution of height in different age ranges.

	Height (cm)	
Age	**Mean**	**SD**
7–8 years	131.0	6.19
9–10 years	140.0	8.62
11–12 years	154.0	9.58
13–14 years	165.0	5.42

TABLE 3 | Distribution of weight in different age ranges.

	Weight (kg)	
Age	**Mean**	**SD**
7–8 years	30.0	6.66
9–10 years	36.9	7.14
11–12 years	43.2	7.25
13–14 years	53.9	6.20

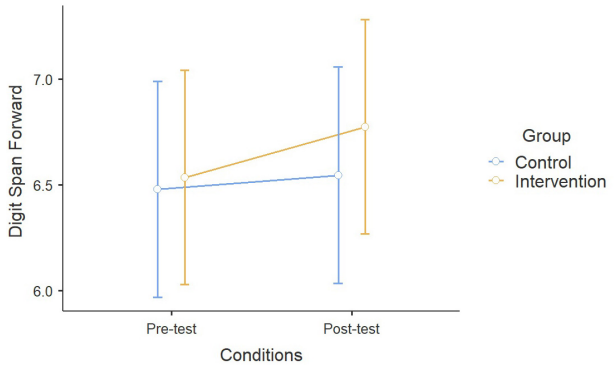

FIGURE 2 | Results on the Digit Span Forward.

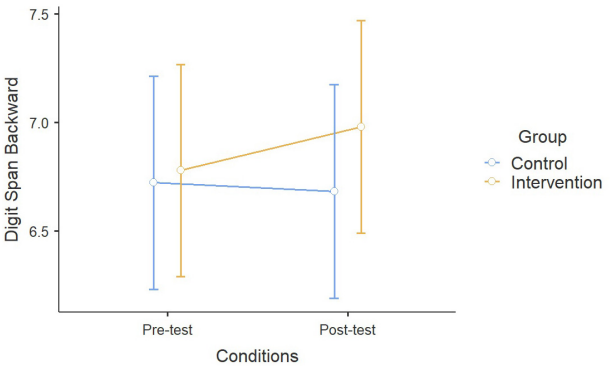

FIGURE 3 | Results on the Digit Span Backward.

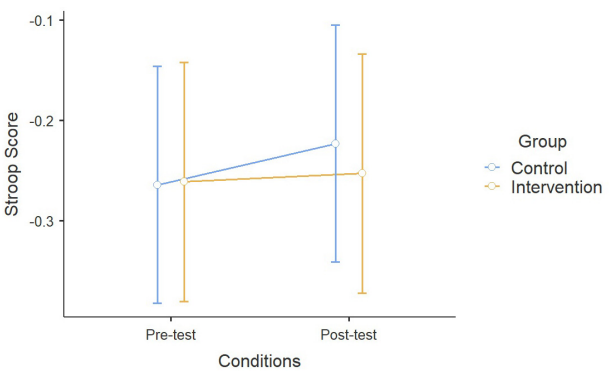

FIGURE 4 | Results on the Stroop Task.

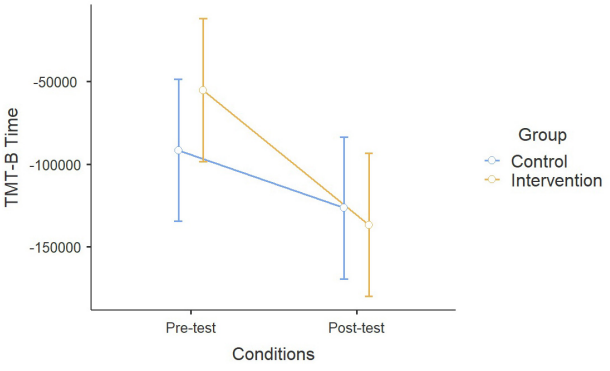

FIGURE 5 | Results on the Trail Making Test.

but children from the ESA Program significantly improved more their performance compared to the control group ($F_{1,351} = 4.58$, $p < 0.05$). No effects of Age were detected in both cases (Forward: $F_{1,355} = 1.04$, $p = 0.31$; Backward: $F_{1,351} = 0.05$, $p = 0.83$) (**Figures 2**, **3**).

A significant effect of Age has been found on the Stroop Task ($F_{1,338} = 6.98$, $p < 0.01$), but both the Time effect and the interaction between the treatment and the group were non-significant (Time: $F_{1,335} = 2.34$; $p = 0.12$; Time × Group: $F_{1,335} = 0.87$, $p = 0.35$) (**Figure 4**). Concerning the TMT, a significant effect of the ESA Program between pre-test and post-test conditions was found ($F_{1,348} = 26.3$, $p < 0.00$), as well as the interaction between Time and Group ($F_{1,348} = 13.7$, $p < 0.001$) and the influence of Age ($F_{1,348} = 12.4$, $p < 0.001$) (**Figure 5**).

DISCUSSION

The purpose of the current study was to test the effectiveness of the ESA Program on children's cognitive performances, in particular, their EFs. The ESA Program is an enriched sports program containing warm-up physical exercises that were modified to stimulate three core EFs (inhibitory control, working memory, and task shifting) (Diamond, 2013).

Some studies have already proven that the introduction of an ESA program enhances cognitive functioning (Beck et al., 2016; Gheysen et al., 2018). In this study, we specifically tested changes in working memory and short-term memory through Digit Span

Forward and Backward Task, inhibitory control through the Stroop Task, cognitive flexibility and task shifting through the TMT that are EFs involved in daily life and relating to school performances (Visu-Petra et al., 2011).

Moreover, the ESA Program has already shown its effect concerning children's physical fitness, where moderate effects were found in relation to throwing, jumping, sprinting, and agility (Duda et al., 1991). Our sample was made up of children coming from four European countries that implemented the ESA Program within the same period and following the same protocol, shared with all the partners through video tutorials. In this way, the standardization of the procedures was ensured.

For the evaluation of the program effectiveness, repeated measures ANOVA was run, revealing a significant effect of the ESA Program on Digit Span Backward and TMT B version. No significant effect of the ESA Program was found on Digit Span Forward nor on the Stroop Task. To summarize our results, the enriched sport program produced positive effects for working memory, task switching, and cognitive flexibility, while no beneficial effects were detected on inhibitory control and short-time memory. Concerning the age of the sample, a significant interaction with the ESA Program was found in the Stroop Task and TMT, indicating that older children significantly reduced the completion time of the task, but the same effect was not detected for Digit Span Forward and Backward.

The positive effect of an enriched sports program on working memory is in line with ample research. Both longitudinal and cross-sectional studies underlie a positive association among structured physical activity in childhood with higher working memory performance (López-Vicente et al., 2017). Koutsandreou et al. (2016) found that 10 weeks of interventions based on cardiovascular and motor afterschool exercise programs enhanced working memory skills on a sample of 9- to 10-year-old children with a larger degree due to the motor exercise intervention rather the cardiovascular program.

Moreover, a study by Beck et al. (2016) employed a sport-enriched math program made up of three conditions, namely, gross motor math group, fine motor math group, and control condition. The results showed that children from all the conditions improved their performance, but the ones from gross motor condition enhanced their performance significantly more than the other groups when tested immediately after the program. This enhancement was not found after 8 weeks.

The ESA Program's effects on TMT B reduction of time is coherent with findings of a previous study carried out by Schmidt et al. (2016). The authors compared four experimental conditions characterized by an increasing cognitive load, ranging from low cognitive demand to high cognitive demand, and increasing physical demand. They found that following a period of 10 min of cognitive challenging tasks, children showed better focused attention and decreased processing speed. The speed component of the attention was highly influenced. These findings focus on the issue concerning the quality of intervention. Cognitive challenging physical activities revealed to be more suitable to improve children's attention compared to ordinary physical activities.

No improvements of the ESA Program were found upon inhibitory control, a result that contradicts other data in literature (Tsai, 2009; Drollette et al., 2014). However, the studies that found a positive effect of physical exercise on inhibitory control used clinical samples including children with specific problems, like ADHD (Chang et al., 2014), while our sample was made up of children from ordinary school class. It seems that children with poorer performance on EF tasks may experience more positive effects following sports programs compared to children exhibiting baseline normal performance on EFs (Ludyga et al., 2016).

The review by van der Fels et al. (2015) pointed out the interplay between cognitive and motor skills in childhood. The authors emphasized how challenging tasks stimulate the co-activation of prefrontal cortex, cerebellum, and basal ganglia and trigger common processes as inhibition, planning, and monitoring. The current study introduces many advantages, as the combination of different sport movement domains and cognitive stimulation that provide to the coaches an innovative structured warm-up characterized by an increasing cognitive load. A higher cognitive load task requires higher attention and regular physiological condition and muscular fatigue may impair cognitive performance. For this reason, the warm-up phase has been selected as the most appropriate exercise unit section for a suitable cognitive stimulation. Moreover, the physical assessment provided through the first phase of the Program has demonstrated its effectiveness also from a physical point of view (Thomas et al., 2020).

Some limitations of the present study should be noted. First of all, follow-up measurements were not implemented; thus, we do not have information about the stability of our results during time. Secondly, performances in EFs were detected, but an important limitation is that they were not linked to children's academic achievement or their reading, writing, and calculating skills. Finally, construct validity was only assessed qualitatively. Given these limitations, future research should investigate the effects of enriched sport programs with accurate construct validity measures on children's academic achievement with a follow-up period after the conclusion of the program.

Providing enriched programs, as the one suggested by the ESA Program, at school may significantly improve children's cognitive functioning that in turn should have beneficial effects on their academic performances.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Lithuanian Sports University's Research Ethics Committee in Social Sciences. Written informed consent to

participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AG, AB, and MA contributed to the conceptualization. FŞ, ÖG, SP, VI, YD, DS, AB, and MA contributed to the data curation. AG, SB, and MG-L contributed to the formal analysis. AB and MA contributed to the funding acquisition and contributed to the project administration. FŞ, ÖG, SP, VI, YD, DS, and MG-L contributed to the investigation. AG, MA, YD, DS, and MG-L contributed to the methodology. SP, VI, and MG-L contributed to the resources. FŞ and ÖG contributed to the software. SP, VI, and AB contributed to the supervision. YD and DS contributed to the validation. AG and MA contributed to the visualization. AG, SB, AB, MA, and MG-L contributed to the roles/writing of the original draft. FŞ, ÖG, SP, VI, YD, and DS contributed to the writing, reviewing, and editing.

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Effects on Personal Factors Through Flipped Learning and Gamification as Combined Methodologies in Secondary Education

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Purpose: This study aims to analyze the effects of a flipped and gamified program on the autonomy, competence, relation with others, satisfaction/enjoyment, intrinsic and extrinsic motivation, and boredom of students of Physical Education.

Method: The study used a control group and an experimental group to compare pretest and posttest data in both of them. Instruments used were the Basic Psychological Needs in Exercise Scale, Sport Motivation Scale, and Sport Satisfaction Instrument, all of them validated in academic literature.

Results: On one hand, data indicated that autonomy has been increased with the application of these teaching methodologies. On the other hand, students' satisfaction, enjoyment, and intrinsic motivation have improved based on the interaction with gamification and flipped learning. Finally, with all dimensions, it seems that academic performance has been improved, although not in a significative way.

Discussion/Conclusion: Results of the study provide to educational researchers valuable information for a better understanding of how flipped learning and gamification influence personal performance of Physical Education students.

Keywords: autonomy, motivation, Physical Education, flipped learning, gamification

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INTRODUCTION

The intrinsic technological nature of the current era is promoting continuous changes in people's daily actions (Maldonado et al., 2019). Especially, in the field of education, technology is reaching a leading role (Area et al., 2016). This has led to the emergence of new ways of teaching and learning content from an innovative perspective, in which students assume a greater role (Li et al., 2019). Educational innovation in the new millennium has driven the emergence and constant development of training activities focused on student participation (Pereira et al., 2019). All this derives in the promulgation of the concept of active methodology as a new way of transmitting and generating a knowledge shared and elaborated by the students themselves, guided by the teacher for an optimal achievement of the objectives and consolidation of the contents (Kerrigan, 2018).

This new direction taken by the teaching practice has meant an increase in the motivation and attitude of the students (Álvarez-Rodríguez et al., 2019) due to the new opportunities and means of learning that the students have within their reach (Mat et al., 2019), bringing today's education

closer to the singularities of a digital society (Nikolopoulou et al., 2019). This has encouraged not only the deployment of new ways of imparting the contents but also the appearance of new spaces and times for the instructional process (Nogueira et al., 2018), what is known as ubiquity (Cabero and Barroso, 2018).

To adapt today's education to the new demands of students developed in a time of great technological stimulation, the innovative actions of teachers, to improve the quality of training and student satisfaction, have resulted in the projection of methodological approaches. Among them are gamification and its variants such as escape room, and flipped learning, as a combination between the face-to-face and virtuality of learning moments (Parra-González et al., 2020). Specifically, in the subject of Physical Education, innovative practices are proliferating to impart the contents from a new approach in order to encourage the attitude of students on their way to effective and motivating learning (Quintero et al., 2018; Kang and Kang, 2019; Rodríguez et al., 2019; Wyant and Baek, 2019).

Gamification is one of the active methodologies that has reached a great penetration in the learning spaces of our day (Sánchez et al., 2020). This formative approach is based on the game and the transformation of formal contexts into playful learning spaces (Hanus and Fox, 2015; González et al., 2016). Despite its expansion in current teaching practice, the use of games for content delivery has been developing since the 1960s (Malone and Lepper, 1987). This game-centered approach aims to facilitate the student's effort to achieve the learning objectives and adapt to the demands, needs, and interests of the collective (Oliva, 2017; Parra-González et al., 2019). The games used have evolved over time, from the most classic of childhood to those with a large digital load that generate immersion in a virtual reality (Contreras-Espinosa, 2016). And its potential has been verified in different educational stages, positioning it as a suitable methodology for any age range (Giannakos, 2013; Dib and Adamo-Villani, 2014; Su and Cheng, 2015).

With gamification, students prepare their own knowledge structures supported by academic indicators benefited such as motivation (Pisabarro and Vivaracho, 2018; Groening and Binnewies, 2019), attitude (Lee et al., 2013; Pérez-Manzano and Almela-Baeza, 2018), interest, autonomy (Xi and Hamari, 2019), commitment (Chu and Hung, 2015), dedication (Simões et al., 2013; Wang, 2015), attraction (Area and González, 2015), collaboration (Perrotta et al., 2013), interactions between agents (teacher-students and content) (Parra-González and Segura-Robles, 2019), and problem-solving capacity (Kapp, 2012) in activities to develop.

An essential aspect of gamification is the incentive that the student receives in any progress or step that is being achieved, which has a positive impact on the psychosocial indicators, previously exposed and that are directly connected with the performance obtained by the students (Mekler et al., 2017). The recent literature on gamified practices in Physical Education reflects the potential of this teaching and learning methodology, contributing to the improvement of various academic indicators, such as motivation, involvement, and student satisfaction (Mora-González et al., 2020). The escape room is conceived as a training modality based on the gamification of the student's learning environment. This didactic approach is based on the resolution of challenges and problems raised that give rise to various instructional situations where students have to put their knowledge into practice (Agreda et al., 2019).

This methodological innovation is based on a game, challenge, or problem that students have to solve both autonomously (self-management of knowledge) and collaboratively (shared knowledge management), encouraging the participation of students in a problematic situation of a real nature or invented by the teacher (Wynn and Okie, 2017). In every escape room, students are locked in classrooms or different spaces where they have to perform different tasks, activities, challenges, tests, and riddles, among others, to obtain the "key" in a certain time that will allow them to leave the place (López-Pernas et al., 2019).

The expert literature on the state of the matter reflects that the development of training practices through escape room promotes the improvement of various academic indicators already mentioned previously by gamification. Specifically, this gamified practice improves motivation (Borrego et al., 2017), activation, participation (Sierra and Fernández Sánchez, 2019), satisfaction, attitude, and attraction of students for the learning actions to be carried out (Pérez et al., 2019) to assimilate and reinforce the contents (Eukel et al., 2017).

All these improvements produced have a direct and positive impact on student grades and, consequently, student performance (Hursen and Bass, 2019). The latter is enhanced as a result of this innovative practice of transmitting, reinforcing, and consolidating knowledge developed by the student himself in a collaborative learning experience experienced and experienced in the first person (Kinio et al., 2019).

In the field of Physical Education, these innovative practices of a gamified nature are already being carried out. Recent research reveals proposals and recommendations to efficiently perform an escape room in the classrooms to impart the contents of that subject. Also, experts in this line of study offer guidance, resources, and ideas for optimal development by teachers less experienced in the use of this training methodology (Flores, 2019; Segura and Parra, 2019).

Due to the high rate of sedentary lifestyle and obesity in the youngest population (Talarico and Janssen, 2018), it is necessary to increase the time of physical activity during the class time of the Physical Education subject. Students are in as long as possible on the move One solution to reduce the time of explanations of the contents, activities, tasks, and games to be performed is flipped learning. This innovative methodology is presented as a mix between face-to-face and digital training (Mengual et al., 2020).

This innovation of a hybrid nature implies a greater use of class time and greater activity of students because the explanations have been made prior to the face-to-face session and digitally in other contexts (Bergmann and Sams, 2012). The teacher's role is focused on generating audiovisual content so that students can view them on any mobile device with an Internet connection (López et al., 2019a). In this way, class time is devoted to deepening the didactic content and solving the students' doubts since the phase of explanation and assimilation of contents has been carried out outside the classroom (Bognar et al., 2019). This promotes an alteration and inversion of learning moments. First,

the student visualizes the content at home or in any place suitable for learning and in the classroom, the assimilated in the digital environment is reinforced and implemented (Long et al., 2017).

Flipped learning is presented in impact literature as a didactic approach that has achieved relevant popularity and effectiveness at different levels, stages, and educational contexts (He et al., 2016; López et al., 2019b; Zainuddin et al., 2019). All this is reflected in various studies that demonstrate how the application of this mixed approach to learning improves motivation (Tse et al., 2019), teamwork (Kwon and Woo, 2017), attitude (Lee et al., 2018), participation and activation (Chyr et al., 2017), autonomy (González and Carrillo, 2016), commitment (Huang et al., 2018), and interactions between the agents involved and with the contents (Hwang et al., 2015). All this has a positive impact on students' grades and performance (Karabulut et al., 2018; Nortvig et al., 2018; Sola et al., 2019).

In particular, the application of flipped learning in Physical Education has shown encouraging results as reflected in the reported studies (Hinojo et al., 2018, 2020), placing this innovative approach as a methodological alternative to impart the own contents of Physical Education and, in the same way, increase intrinsic factors of the learning process such as motivation, autonomy, problem solving, the use of class time, the interaction between teacher–student, student–student, and student–content, and the deepening of content and ratings.

In short, different recent high-impact researches show the potentialities of the instructional approaches previously presented (Luong, 2019; Østerlie and Kjelaas, 2019; Quintas et al., 2020; Sargent and Casey, 2020). The novelty that this study presents concerning the existing literature focuses on the simultaneous integration of both training methodologies for the approach of contents linked to the subject of Physical Education. Despite the scientific volume that covers these teaching and learning methodologies separately in the field of education in general, the interest aroused in this work focuses on the combination of both methodological innovations in the field of physical activity and sport. Therefore, research is required to promote a change in the point of view of professionals in this educational sector, as well as the development of new training experiences adapted to the new times (Cañabate et al., 2019).

MATERIALS AND METHODS

Research Design and Data Analysis

This research has been carried out through experimental and pre–post design based on the quantitative design as indicated by experts (Hernández et al., 2014; Pérez-Escoda, 2018). This type of design has already demonstrated its effectiveness as a tool to know the effects of different tools or methodologies in the educational field (Juliá-Hurtado and Baena-Extremera, 2018; Epelde-Larrañaga et al., 2020). The objective of pre–post studies is to observe over time and to check the influence of different variables on the study population. In traditional pre–post studies, differences are only observed in one study group (Gravetter and Forzano, 2009). In order to give the results more robustness, a control group is added to the study to which no methodologies are applied. The objective is to provide the results with greater validity.

The students were divided into two groups, which we named experimental and control groups. There was a pretest and a posttest analysis in each group. The intervention on the experimental group consisted of teaching through the methodology and technique of flipped learning and escape room. In contrast, the control group follows a traditional methodology, without the use of any specific methodology.

All statistics have been carried out with the Statistical Package for the Social Sciences (SPSS) v25 program. Before carrying out the different analysis, the normality of the sample is checked, using the Kolmogorov–Smirnov test, and obtaining significant results, so that non-parametric statistics is used to perform inferential analysis. To test effect size, we use Cohen d. Effect size is a quantitative measure of the magnitude of the experimenter effect. The larger the effect size, the stronger the relationship between two variables (Harlow et al., 2016; Lenhard and Lenhard, 2016).

Participants

The participants who took part in this research were 64 students enrolled at third grade of secondary school. Other studies of a certain impact show that the size of the sample in this kind of researches does not condition the performance of these experiments (Rodríguez, 2011).

The selection of the sample was carried out through an intentional sampling due to the ease of access to the students. They are enrolled in an educational secondary school in the Autonomous City of Ceuta (Spain). This research came out as a need that one of the researchers, who also work there as a teacher, detected that something needed to be done to improve a situation.

Specifically, the students were selected from the third year of Secondary Education (n = 64; mean age = 15 years; SD = 1.62). The configuration of the two groups on which the experimentation was carried out is specified in **Table 1**.

Instruments

The instruments used to carry out this research were four scales. The first one was the Basic Psychological Needs in Exercise Scale; the version used in this research was the one validated and translated into Spanish (Moreno et al., 2008). The dimensions used and to be analyzed were autonomy, competence, and relation with others (for example, I feel like I can communicate openly with my classmates). It had a Likert-type scale from 1 (totally disagree) to 5 (totally agree).

The second scale, which was used, was Sport Motivation Scale, which was adapted to Physical Education as well (Granero-Gallegos et al., 2014), used to analyze extrinsic and intrinsic

TABLE 1 | Study groups by sex.

Groups	Boys *n* (%)	Girls *n* (%)	Total *n* (%)
Experimental group	17 (53.12)	15 (46.87)	32 (50)
Control group	11 (34.75)	21 (65.62)	32 (50)
Subtotal	28 (43.75)	36 (56.25)	64 (100)

motivation (for example, for the pleasure of living stimulating experiences), also with a Likert-type scale from 1 (totally disagree) to 5 (totally agree).

The third scale used was the Sport Satisfaction Instrument. The one used was the Spanish version also adapted to Physical Education (Baena-Extremera et al., 2012) to measure the satisfaction/enjoyment and boredom (for example, I usually find Physical Education in English interesting), also with a Likert-type scale from 1 (totally disagree) to 5 (totally agree). In addition, the last scale was used only at the posttest moment to measure the academic achievement. The decision about which factors were going to be analyzed was taken due to the dimensions of the questionnaire, the factors that can be influenced by the implementation of active methodologies on teaching and learning process, and both of these aspects were followed up after the scientific literature revision which was done.

Procedure

In relation to the procedure, pretests were administered to both control and experimental groups. Then, a teaching methodology based on flipped classroom and escape room was used with the experimental group. Afterward, posttests were applied on both groups to analyze the outcomes (**Figure 1**). Time between pretests and posttests was 5 weeks.

Intervention

A didactic unit consisting of eight sessions on contents related to physical condition and health was carried out to work the physical qualities such as strength, endurance, and speed. With the control group, the sessions were carried out in a traditional way. The teacher was in charge of designing the physical tasks and activities to be carried out by the student. The role assumed by the teacher in this group was purely expository and face-to-face. The teacher focused on explaining the activities of each session in the corresponding installation, always in person, and the student limited himself to carrying out the tasks without taking the lead or choosing the actions to be carried out. The training actions focused on general fitness circuits using training materials, as well as cooperative motor games. On the contrary, in the experimental group, the teacher presented audiovisual materials on a content management platform so that the students could visualize them before going to the face-to-face session. Once the students went to the class, they already had a knowledge base and information about the activities and challenges to carry out. In this group, the teacher's role is more passive. The student acquires all the prominence since he is the main agent who has to carry out each of the tests, challenges, and enigmas of the designed escape room. The tests, challenges performed by the students in the escape room had a physical component with the purpose of working on the physical qualities mentioned above. In addition, students could dress up and characterize based on the theme of the escape room. Therefore, the teacher grants the students of the experimental group autonomy and freedom to investigate, explore, and collaborate to pass all the tests and solve the final puzzle, thus including all the elements used during the experimentation.

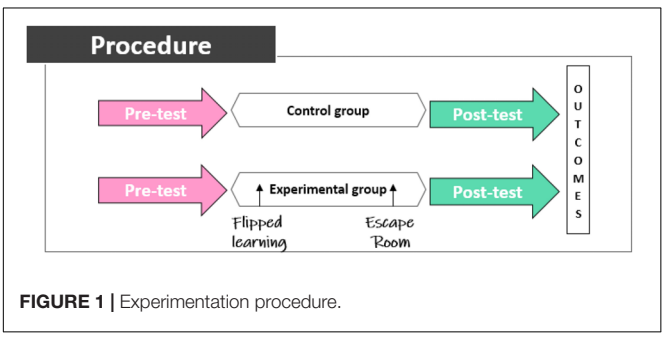

FIGURE 1 | Experimentation procedure.

RESULTS

Before carrying out the different descriptive and inferential analyses, the reliability of the instruments used through Cronbach's alpha is checked. All the results obtained show satisfactory results for each of the dimensions (Bonett and Wright, 2015).

In addition, the omega index (ω) is calculated, which, unlike the alpha coefficient, works with the factor loads, being a test less biased than the classical alpha (Salazar Vargas and Serpa Barrientos, 2017). In the same way, the results show acceptable values, between 0.70 and 0.90 (**Table 2**; Campo-Arias and Oviedo, 2008).

Table 3 shows the values obtained in the pre–post tests performed for the control group and the experimental group being similar. The highest values in the control group were obtained for competition (4.61 ± 0.13) and the lowest for extrinsic motivation (2.21 ± 0.83). Similarly, the highest values in the pretest control group were obtained for satisfaction (3.29 ± 1.02). It is in the values of the subsequent test of the experimental group that the data seem to change significantly, so that, following the main objective of the study, inferential analyses are performed on pre–post values in the control group and the experimental group to prove it.

Table 4 shows the results obtained after the analysis of the values obtained in the posttest in learning achievement dimension. This dimension is calculated using the evaluation obtained by the students at the end of classes, so it is only considered as a posttest result. Values do not show significant differences ($Z = -1.125$; $p = 0.071$). These differences, despite being unique, do not show great strength ($d = 0.11$). In this case,

TABLE 2 | Reliability and validity indices.

	Alpha (α)	Omega (ω)
Autonomy	0.87	0.89
Competence	0.90	0.88
Relation with others	0.81	0.83
Satisfaction/enjoyment	0.89	0.85
Extrinsic motivation	0.82	0.83
Intrinsic motivation	0.80	0.78
Boredom	0.84	0.81

TABLE 3 | Mean (M) and standard deviation (SD) of the results for the pretest and posttest.

Traditional Learning (Control group)		
	Pretest	**Posttest**
	Mean (SD)	**Mean (SD)**
Autonomy	4.09 (0.25)	4.15 (0.11)
Competence	4.10 (0.27)	4.61 (0.13)
Relation with others	3.53 (0.12)	3.49 (0.32)
Satisfaction/enjoyment	3.29 (1.02)	3.12 (0.32)
Extrinsic motivation	2.50 (0.73)	2.21 (0.83)
Intrinsic motivation	2.41 (0.51)	2.51 (0.60)
Boredom	3.31 (0.25)	3.50 (0.42)
Learning achievement		4.71 (1.91)
Gamified–Flipped Learning (Experimental group)		
	Pretest	**Posttest**
	Mean (SD)	**Mean (SD)**
Autonomy	3.99 (0.14)	4.81 (0.21)
Competence	3.82 (0.37)	4.50 (0.33)
Relation with others	4.01 (0.24)	4.91 (0.12)
Satisfaction/enjoyment	3.62 (0.71)	4.71 (0.47)
Extrinsic motivation	2.51 (0.51)	2.91 (0.61)
Intrinsic motivation	2.11 (0.42)	3.60 (0.51)
Boredom	3.20 (0.15)	1.10 (0.52)
Learning achievement		4.90 (1.01)

TABLE 4 | Mann–Whitney *U* test for learning achievement.

		Mean Rank	**U**	**Z**	***p***	***d****
Posttest	**Traditional**	51.13	112.000	−1.125	0.071	–
	Gamified–Flipped Learning	55.12				

**The effect size of the statistical analyses was determined using Cohen's d (d_{cohen}) (Cohen, 1988).*

TABLE 5 | Wilcoxon test for dimensions in pre–post in traditional learning.

Dimensions	**Groups**	**Mean Rank**	***Z***	***P***	***d***
Autonomy	Pretest	40.11	1,181	0.052	–
	Posttest	42.55			
Competence	Pretest	27.17	2,224	0.055	–
	Posttest	29.09			
Relation with others	Pretest	53.35	1,347	0.261	–
	Posttest	56.19			
Satisfaction/enjoyment	Pretest	33.12	2,389	0.055	–
	Posttest	27.11			
Extrinsic motivation	Pretest	65.17	−1,288	0.071	–
	Posttest	61.35			
Intrinsic motivation	Pretest	21.13	3,436	0.002*	0.42
	Posttest	32.17			
Boredom	Pretest	38.12	−2,017	0.264*	–
	Posttest	33.94			

**Significant difference.*

TABLE 6 | Wilcoxon test for dimensions in pre–post in flipped and gamified learning.

Dimensions	**Groups**	**Mean Rank**	***Z***	***p***	***d***
Autonomy	Pretest	41.10	1,781	0.003*	0.22
	Posttest	53.60			
Competence	Pretest	31.07	2,224	0.060	–
	Posttest	33.10			
Relation with others	Pretest	61.32	1,047	0.002*	0.13
	Posttest	69.27			
Satisfaction/enjoyment	Pretest	23.12	2,389	0.005*	0.29
	Posttest	42.98			
Extrinsic motivation	Pretest	73.97	−2,288	0.055	–
	Posttest	60.10			
Intrinsic motivation	Pretest	21.13	2,288	0.003*	0.31
	Posttest	41.87			
Boredom	Pretest	49.01	−3,017	0.002*	0.33
	Posttest	32.10			

**Significant difference.*

flipped learning obtained a higher mean rank ($MR = 60.82$) value than traditional learning ($MR = 40.23$).

Similarly, results are analyzed in the control group (pre–post) in each of the dimensions analyzed. **Table 5** does not show significant differences between pre and post values in most dimensions. It is only Intrinsic motivation ($Z = -2{,}288$, $p = 0.55$, $d = 0.42$), in this case, effect size can be considered medium.

In **Table 6**, Wilcoxon signed-rank test shows that flipped and gamified intervention in the experimental group had a statistically significant change in five of seven dimensions analyzed. Autonomy has improved positively, obtaining results of $Z = 1{,}781$, $p = 0.03$. Although these differences are significant, they show a small effect size ($d = 0.22$). In the same way, Relation with others ($Z = 1{,}047$, $p = 0.02$, $d = 0.13$), Satisfaction/enjoyment ($Z = 2{,}389$, $p = 0.05$, $d = 0.29$), intrinsic motivation ($Z = 2{,}288$, $p = 0.03$, $d = 0.31$), and Boredom ($Z = -3{,}017$, $p = 0.02$, $d = 0.33$) show significant differences too. Effects sizes to all of them can be considered small. Only Competence ($Z = 2{,}224$, $p = 0.60$) and Extrinsic motivation ($Z = -2{,}288$, $p = 0.55$) do not show significant differences.

DISCUSSION

The present study shows the influence of techniques related to new teaching models, in learning outcomes, and in different variables related to it. Current teaching must at some time be a process of constant change in teaching practice and in the daily memory of students, with constant transformations (Maldonado et al., 2019). For this, the use of active methodologies that lead to the achievement of objectives is essential (Kerrigan, 2018), as well as the use of new ways to impart in terms of spaces and time they are related (Nogueira et al., 2018).

In this experimentation, progress in learning has been compared, referring to different variables, of two groups, which have served as control and experimental groups.

The values studied in both groups have been measured before the experiment. Subsequently, a measurement of these values has been made, obtaining interesting and specific results with the application of the new methodologies.

From the study, it can be extracted that values such as autonomy have been increased with the application of these teaching models coinciding with Parra-González et al. (2020), which is to be expected especially in the application of inverted learning as a tool for the acquisition of knowledge. In addition, social relations have been increased as a result of the implementation of new methods, as indicated by other studies (Rodríguez et al., 2019).

It should be noted that the increase in satisfaction and enjoyment that students have obtained based on the interaction with gamification and flipped learning, which corroborate the results and coincide with what has been indicated in other investigations (Area and González, 2015) and in other studies related to psychosocial factors (Mekler et al., 2017). Of course, and in accordance with what has been indicated in previous research (Pisabarro and Vivaracho, 2018), there is also an increase in the intrinsic motivation of students, which implies a better acceptance of teaching and a greater predisposition to learning, eliminating glimpses of boredom in students, which entails and connects, directly, with a better performance obtained by students, as in other cases of implementation of these methodologies (Groening and Binnewies, 2019).

However, in the experimentation, there are no significant changes in variables such as student competence, as well as in extrinsic motivation, which is not consistent with that reported by other studies and authors (Mora-González et al., 2020), without influencing the future of the student (Hinojo et al., 2020) and without having an important significance for the final result.

The prospect of this study focuses on making the scientific community aware of the potential of the combination of active methodologies, both face-to-face and digital, in the teaching and learning process in the field of Physical Education, with the purpose to raise awareness among the teaching group of the benefits reported after its application.

The main limitation of this research focuses on the nature of the sample, which is situated in a single context with certain peculiarities at a social and geographical level. This projects that the results achieved here are taken with caution as the replication of this research in other contexts may vary the findings presented here.

Therefore, as a future line of study, this study is intended to be carried out in different contexts in order to verify and consolidate the potential and advantages of this methodological combination. It can be concluded that both flipped learning for content teaching and gamification to achieve the objectives are methodologies that improve student learning, as well as multiple factors associated with the education of students in current classrooms and autonomy, relationship with others, enjoyment, intrinsic motivation, and boredom. The appearance of these teaching methods should not be renounced in a changing world that has its greatest challenge in teaching.

DATA AVAILABILITY STATEMENT

The datasets generated for this study are available on request to the corresponding author.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' tutors.

AUTHOR CONTRIBUTIONS

AS-R and MP-G conceived the hypothesis of this study, analyzed the data, and performed the data interpretation of statistical analysis. AF-C and JL-B participated in data collection and wrote the manuscript with the most significant input. All authors contributed, read, and approved the final manuscript.

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"Cooperative Learning Does Not Work for Me": Analysis of Its Implementation in Future Physical Education Teachers

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Cooperative learning (CL) is one of the pedagogical models that has had more application in the area of Physical Education (PE), being highly worked in the initial training of teachers. The aim of the study is to check to what extent future PE teachers are able to apply in the classroom the PE training they have received at university, deepening their fears, insecurities and problems when carrying it out. Thirteen future PE teachers (7 girls and 6 boys) aged 20.87 ± 1.43 participated and, after having been trained in CL in various subjects, applied it in the classroom during their internship. They were selected through purposeful non-probability sampling. A qualitative methodology was used, being the interviews, the teaching diaries and the seminars with the tutor the instruments of data collection used. Three categories of analysis were used: (a) initial expectations in the application of the CL; (b) problems encountered in its implementation; (c) reflection about its application in the future. The results showed how the future teachers did not see their expectations of success fulfilled, encountering resistance from both students and teachers in PE. Furthermore, they reflect the need to continue training in a model that has infinite nuances so that it can be implemented satisfactorily. It is necessary to continue researching a pedagogical model with so many possibilities in the area of PE and with so much transversality on a social level.

Keywords: physical education, cooperative learning, pedagogical model, models-based practice, initial teacher training

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INTRODUCTION

Society is constantly evolving, transforming different implicit realities under concrete socio-cultural factors (Sudakova and Astafyeva, 2019). In the face of this, the school cannot remain in the background, and concrete mechanisms of permanent formation must be established that are in line with the current situation. This connection between society and school must be closely linked to the role played by the university, intentionally addressing research-action processes that favor and promote true educational innovation (Roffeei et al., 2018). If continuing education is especially relevant to educational advancement, initial training takes on special significance, due to its great impact on the creation of the professional identity of teachers (Androusou and Tsafos, 2018). In this sense, without a doubt, one of the greatest challenges lies in seeing how this university training can be successfully replicated by future teachers in schools. It is also necessary to focus on other

factors that may be important in the development of a teacher's identity, such as the transferability of learning, academic motivation or the teacher's perception of competence.

This relevance of initial teacher training takes on an even greater dimension when it comes to PE, where the use of corporeality is present. The body is an indissoluble element of the individual, and for this reason, from the PE it must be worked on with clear pedagogical purposes that go beyond biomedical and physiological parameters (Kennedy et al., 2019). The acquisition of values in the practice of physical activity is not achieved by the mere fact of doing it, but rather there must be an ethical base built under very clear and defined social purposes (Schenker, 2019). This is where pedagogical models of teaching come into play, especially that of CL, which has already demonstrated benefits in the relational, motivational and learning environments of students (Casey and MacPhail, 2018). Applying the CL model in PE with guarantees ensures a climate of respect, empathy and initial solidarity on which to base motor practice, something that favors the self-concept and autonomy of students when carrying out their daily activities in the classroom. This relates to the theory of self-determination, demonstrating how a good social climate in the group affects the intrinsic motivation of students, the identified regulation and task orientation (Sevil et al., 2016). Starting from a climate of equality in the PE classroom is essential, since corporal exposure to others is constant, which on many occasions generates fears and insecurities in the face of failure and the consequent mockery of one's classmates (Duncan and Bellar, 2015). This has a direct consequence in society, where on many occasions the criteria of honesty and nobility have been lost, with the ego taking precedence and the search for individual benefit over the common good.

However, applying the CL model in PE effectively is not easy, since it requires a high level of mastery in the knowledge of its implementation phases and the elements that constitute it. In certain cases, faculty believe that they are applying it adequately, when in reality what they are doing are only isolated activities of a cooperative nature that are not integrated into a specific methodology (Morgan, 2019). And if it is not easy to apply it consistently, it is even more complex to teach it with guarantees of replicability in the classroom. On various occasions, the initial training of teachers, due to the idyllic context in which the teaching takes place, can lead to a feeling of control over the learning acquired by the student, something that is not always corroborated when he or she tries to apply it in the classroom (Jones, 2019). Studies carried out with future PE teachers, with a pre-test design, showed that the CL is fundamental to apply it as a scaffolding in the teaching process. Specifically, this scaffolding favors variables such as practical knowledge, teaching skills and self-efficacy (Legrain et al., 2019). However, it was shown that when this scaffolding is not structured and applied in a transversal way in the training, problems related to teaching skills appear. Research has shown the difficulties PE teachers have in introducing new technologies into cooperative learning (CL) when they do not intentionally use them throughout the course (Bodsworth and Goodyear, 2017). Sometimes PE teachers confuse the implementation of CL with the implementation of specific activities and games, which causes problems for the class to act truly as a group (Casey et al., 2015). Another of the main problems of teachers in the application of the CL is found in the difficulties that students have in solving their problems, so it is necessary to establish longitudinal programs of intervention (Gorucu, 2016). On some occasions, in the teacher's eagerness to apply the CL in the classroom, they forget what the didactic purposes of the proposed interventions are (Wallhead and Dyson, 2017). Another major problem is generated around the power relationships established in the classroom. The qualitative research of Barker and Quennerstedt (2017), through the work of dance in PE, showed how CL can favor the group climate over the students' motor skills. Another of the most common reticence among PE teachers to apply CL is the reduction of motor commitment it entails in the classroom. However, research such as that of Altinkok (2017), applied with 6–7 year-old students, in 12 weeks and with a pre-test, showed a greater development of motor skills in the experimental group.

Therefore, and considering the different social benefits that the implementation of the CL in the school PE has demonstrated, it is necessary to verify the effects of replicability that its teaching has on the future PE teachers. Therefore, the objective of the study is to analyze to what extent future PE teachers are able to apply in the classroom the training on CL that they have received at the university, deepening in their fears, insecurities and problems when carrying it out. This is a significant contribution to the existing literature on the subject, since, in addition to generating new evidence on the applicability of this model, it uses a contrast of qualitative instruments that allow for reflection and redirection of the practices of teachers throughout their process of implementation in the classroom.

Cooperative Learning as an Essential Element in the Initial Training of Physical Education Teachers

In the initial training of PE teachers, in addition to the specific contents of the discipline, it is necessary to intentionally address a diversity of methodological aspects that are transferable to the classroom in which they carry out their professional activity (Capel et al., 2018). These are related to the design of classes, the organization of groupings, time management or the application of assessment. All of them are clearly immersed in the development of pedagogical models, within which the CL is essential for several reasons. It starts from an important social base, which makes dialogue and consensus building a priority in its implementation. In addition, and starting from the empowerment of the capacities of the group members, the achievement of challenges is sought jointly, which favors the feeling of affiliation (Hortigüela-Alcalá et al., 2019). This process must be articulated under the promotion of the generation of positive motor experiences, proposing activities where the level of achievement is perceived as affordable and motivating by the students (Koka, 2013). All the typology of contents that includes the subject of PE has a place in the CL, always being implicit the values of solidarity, empathy and respect for others. These fundamental premises of action in the classroom have a clear connection with the behavioral patterns of today's society, which

allows the establishment of a binomial with the school and with the connection of its learning. Furthermore, it can be applied in a transversal way to other curricular areas, establishing common action protocols regarding student responsibility and autonomy.

Another of the fundamental aspects that justify the teaching of the CL in the initial training of teachers is the increase of the motor possibilities that it entails in the student, since it does not reduce the learning objectives to the achievement of a determined motor performance in an isolated test. Its vision and application is carried out in its widest spectrum, being applicable in diversity of contents, tasks and contexts (Casey and Goodyear, 2015). In addition, it allows the development of emotional bonds between the members of the class, putting themselves in the place of others when it comes to making decisions. This causes that as future PE teachers they rethink how to promote social interactions in the classroom in a positive way, improving the group climate, self-esteem and self-concept of the students. Under this prism of pedagogical action, one of the main purposes of school PE is achieved, which is the generation of positive learning experiences around motor skills. This is connected to what has been called transcontextual analysis, defined as the impact that PE classes have on students so that they later decide to practice physical activity autonomously in their free time (Hagger and Chatzisarantis, 2016). The CL model is also very interesting to be applied from the sports teaching, since it teaches that everyone has to play with everyone in different conditions and situations, going far beyond the mere competition where someone is always defeated (Kolovelonis, 2019). It establishes procedures for playful performance in which everyone has the right and opportunity to win, and the fact of not winning does not mean that someone is eliminated. For this purpose, techniques such as 1-2-4, numbered heads together, Aronson's puzzle or the collective score are applied.

It is necessary to emphasize from the initial training of the teaching staff that the CL is not only applied in a punctual way through isolated activities, since the key to the success of its implementation is found in delimiting temporary phases in the medium term that allow the class to act in a cohesive way around motor skills (Lafont et al., 2016). This pedagogical awareness leads the future PE teacher to create a professional identity of a cooperative nature, generating an idiosyncrasy and a behavior that defines him/her as a teacher. This has repercussions on such relevant aspects as the selection of content to be developed in the classroom, time management in tasks, the way of carrying out groupings or the proposal and typology of the approach to objectives. Therefore, the transversality that characterizes the CL is usually well accepted among future PE teachers, since their previous experiences do not limit or bias their applicability in the classroom (Yuksel et al., 2019). The design, preparation and evaluation of activities are essential for PE teacher to gain confidence in their professional practice. To this end, it is essential that, in addition to knowing about the diversity of activities, they are able to structure them within a methodology that can be adapted in a variety of contexts (Lafont et al., 2016). However, a novice teacher's professional beginnings are not easy. Considering the level of teaching experience, it can be seen that new teachers are excessively dependent on the curriculum. Therefore, it is necessary that initial training of PE teachers include more support from experienced teachers in the subject (Viciana and Mayorga-Vega, 2017). While teachers say they are confident in aspects related to health and fitness, they are more hesitant in those related to assessment and classroom control (Randall, 2020). Another of the training deficiencies that future PE teachers admit to have is that related to Special Educational Needs. This subsequently generates problems in the actual treatment of inclusion in the classroom (Maher and Fitzgerald, 2020). It is necessary to work from the initial training of teachers to question the hegemonic practices associated with PE, establishing pedagogical lines that can respond to the needs of a new type of physical education (PE) teacher (Wrench and Garrett, 2015).

All of the above-mentioned benefits are key to the initial training of teachers, thus increasing the guarantees of implementing it in their professional future and thus achieving educational and social transformation. And this is precisely what this study aims to prove, analyzing the effectiveness of its application in the specific school context by new teachers.

MATERIALS AND METHODS

Participants

Thirteen future PE teachers (7 girls and 6 boys) aged 20.87 ± 1.43 participated. This number of participants is ideal in relation to the type of study, instruments and analysis used. All of them had received CL training throughout their university career. This qualification is the Degree in Primary Education, with the speciality in CL, given at the University of Burgos (Spain). There are 5 subjects (30 ECTS or 750–900 h the student spends on the study activity) that make up the specialty, taken in the third and fourth years. Specifically, in the third year there is a subject called pedagogical models in PE, whose main objectives revolve around the teaching of the school PE, with the teaching of the CL model having great weight. It is in this subject that future PE teachers were specifically trained in the application of the CL in the classroom. The model was approached in a theoretical-practical way, analyzing each of its elements and phases and applying them later in the classroom through a diversity of contents. A model of formative assessment and feedback was established in each of the classes, influencing in a reflexive way their learning possibilities. However, in previous subjects, different methodological approaches had been dealt with in PE in a transversal way. These subjects are called "Educational Game in PE" "Inclusive PE" and "Sports Initiation." The main idea is that future teachers acquire the necessary knowledge to be able to apply the model with guarantees within the classroom in the near future. This was verified in their school practice phase carried out in the third and fourth grades. These practices were developed in 8 public schools in the city of Burgos (Spain). The choice of these 13 participants was intended to meet a double criterion: (a) the participants' voluntariness; (b) the best academic record in the subject of pedagogical models in PE. These criteria guarantee the correct acquisition of the CL by the participants, which ensures greater reliability of the results. The students with the best grades proved to have a better understanding of the essence of the CL, which ensured better replicability of the model

in schools. Three schools where the internships took place were subsidized, while the rest were publicly owned. Two schools were in municipalities near the capital, while the others were in the city itself. None of them had more than 600 students. There was no substantial difference in the characteristics of the student in all of the schools, except for two schools located in a neighborhood with a lower socio-economic level. This did not decisively influence the application of the CL by the future teachers. In none of the schools was the CL being applied as a PE methodology, which eliminated the possible bias of the interventions. These interventions were carried out with students from all grades of the primary stage.

The training given on CL was carried out by a 34 years old teacher, doctor, with 10 years of experience in the university field in the same degree and university, and specialist in the teaching of school PE.

Instruments

Three different instruments were used for the collection of information: interviews, teaching diaries and the seminars with the teacher. The questions in each instrument are clearly connected to the objectives of the study and to the categories that structure the results, thus giving reliability to the study (Swaminathan and Mulvihill, 2018). These tools make it possible to gather in a detailed and in-depth way all the information concerning the experiences of future EP teachers on the implementation of the CL. In addition, the use of Teachers' Diaries and Seminars with the professor allowed for reflection throughout the intervention, redirecting professional practice according to the problems encountered. Teachers' Diaries have proven to be an ideal qualitative tool for building the professional identity of novice teachers (Gut et al., 2016).

Interviews: These were carried out individually with the participants at the end of the intervention and were of a semi-structured nature (**Table 1**). Issues related to the initial expectations generated, to the results obtained after the implementation of the CL in the classroom and to the main benefits and problems found for its future replicability were addressed.

Teachers' diaries: each participant made his or her own. They had a structured character based on the categories of analysis of the results: (a) initial expectations in the application of the CL; (b) problems encountered in its implementation; (c) reflection on its application in the future. The participants were writing in the same weekly throughout the 12 weeks that the intervention lasted. It is a tool that allows the teacher to take a perspective on the development of his/her own practice, and that, applied over time, favors a greater understanding of the context in which one acts (Safronov et al., 2020).

Seminars with the professor: were carried out throughout the intervention. Before the beginning of the application in the classroom, the professor who taught them about C established with the participants four seminars, spaced approximately every three weeks. They were conducted together, in order to exchange opinions and experiences about the results that were being found in each of the contexts. It is a clearly reflective instrument of great utility within the educational action-research process (Liu and Wang, 2018).

TABLE 1 | Basic script used for semi-structured interviews with participants.

- What were your initial intentions before you carried out the process?
- How did you organize the work in the classroom based on cooperative learning?
- What has the application of the CL in the classroom brought you?
- What have been the main problems you have encountered?
- What would you change if you had to make a new intervention with the CL?
- Will you continue applying the CL in your professional future? Why?

Design and Procedure

The research has been structured in four distinct phases throughout the 2018–2019 school year:

Phase 1. Structuring of the study and establishment of the schedule: the study arose from the need to verify to what extent the initial training received by PE teachers on CL was subsequently replicated in the classroom. The usefulness and contribution of the research was confirmed since, through a qualitative approach, the aim was to check the experiences of future teachers in their practice contexts.

Phase 2. Contact with the participants and delimitation of the CL intervention in the classroom: having taught about CL to all the participants, it was easy to contact them to carry out the research. They were summoned before the start of their 12-week internship in order to record data from the schools they were going to work in. In addition, the intervention to be carried out was specified to be homogeneous in all cases. The intervention of all participants was based on three basic principles: (a) to respect the five elements that make up the CL; (b) to eliminate competitive proposals within the classroom; (c) to carry out the same didactic units in the intervention. The choice of these criteria was made in view of the importance of respecting the structure that gives the CL its essence, thus giving it sufficient rigor in its application (Fernández-Río et al., 2018). In this way, it was guaranteed that any possibility of competition would be eliminated. It was agreed to carry out the pedagogical interventions through the same contents, in order to maintain the fidelity in the totality of the interventions. These units were three. The first one was about games and cooperative activities, where a series of group challenges were posed to be solved in a motor way. These activities were related to transporting objects, overcoming obstacles, passing and receiving mobile elements and trusting one's peers. The second unit of work was body expression, specifically shadow theater, where groups worked with a light bulb and a white cloth to make different shadows and create a narrative story. The third didactic unit focused on the work of motor skills and physical condition, where the four basic physical capacities were worked on through cooperative team challenges, thus obtaining rewards to overcome different levels. The aim of this program was to implement CL through a diversity of contents, demonstrating in a practical way how the phases and elements that structure the model were applied. This training was related to the previous learning that the students had in relation to other models, deriving in the possibility of its hybridization. The characteristics of the intervention are based on reflection, action research and the replicability of learning. The theory was clearly linked to practice, establishing constant reflections on what happened in each of the

activities. This would allow them to act with greater rigor when they were in the schools.

Before carrying out the field work, the teacher prepared a script with the timing of the sessions to be carried out by the participants. This made it possible to guarantee a reliable and homogeneous intervention. Throughout the intervention in the schools it was corroborated that this script was respected.

Phase 3. Carrying out of the seminars with the participants: these seminars were carried out throughout the 12 weeks of intervention. A total of four were held. A seminar was established every three weeks. This was considered to be an adequate time, maintaining the balance between autonomous classroom practice of future teachers and the need for advice. All the participants were summoned to a seminar at the university in order to dialogue, share, advise and guide their interventions. The teacher used a script, divided into four parts, to maintain the monitoring structure: (a) compliance with the established plan; (b) type of problems encountered in the classroom; (c) how to solve these problems; (d) comments, questions and suggestions. In these seminars, in rotational order, each participant presented the main problems they had encountered in the classroom, in order to find common patterns of action that could be useful to all. Subsequently, decisions were made to try to reverse these problems found in the classroom. Each seminar lasted approximately 2 h. All were recorded on audio, for later listening when recapitulating the data.

Phase 4. Conducting the interviews and data analysis: at the end of the intervention, individual interviews were conducted with each of the participants. These interviews were carried out in the teacher's office. Each one had a duration of 45 min and they were recorded in audio. In this last phase the teacher also received the teachers' diary. From here, all the data obtained was transcribed and dumped into the text analysis computer program and the data was analyzed. In addition, the researchers reflected deeply on the purpose of the study, the procedure carried out and its adequacy to the objective set.

Data Analysis

A qualitative approach was used to gain an in-depth understanding of how future teachers were able to apply the CL learned at university in the classroom. To do so, it was essential to know in first person the perception of the participants throughout the process, verifying how they were gradually transforming their school contexts and creating their professional identity. The fact that the main source of data was the assessments and experiences of those involved in the process allowed us to approach the study phenomenon in a real and interpretative way (Rubel and Okech, 2017). A triangulation was carried out between the information obtained in the data collection instruments with the aim of guaranteeing the reliability, transferability and credibility of the results. In addition, the most significant text extracts were coded in each of the instruments, using cross matching patterns (Saldaña, 2009). The researchers took an active part in the field work, reflecting throughout the process on the linearity of the results with the objectives of the study. The information was articulated, grouping it by thematic axes in the categories generated by means of a selective, open and axial codification (Strauss and Corbin, 2002).

Generation of Categories and Their Categorization

Once the data from each instrument used was transcribed, it was dumped into the WEFT QDA computer and analysis program. Through the saturation of coinciding texts and ideas and the treatment of thematic axes, the information was grouped into the three initial categories of the study: (a) initial expectations in the application of the CL; (b) problems encountered in its implementation; (c) reflection on its application in the future. These categories are common to all the data collection instruments used, and are used to structure the analysis of the results. They are related to the object of study and the design of research, thus respecting the criteria of specificity and coherence that all qualitative research must have (Le Roux, 2017).

Initial expectations in the application of the CL: aspects related to the way of understanding and applying CL in the classroom, its educational purposes and the factors that directly influence its school treatment are addressed.

Problems encountered in its implementation: information regarding the problems encountered when applying the CL in the classroom and the guidelines and orientations established to successfully redirect the process are analyzed.

Reflection about its application in the future: the data linked to which are the positions and attitudes that future FE teachers have in relation to the application of the CL in the future are integrated, taking into account what happened after their first experience.

Coding of Data Collection Instruments

Different acronyms are used to identify the text extracts with the data collection instrument from which they come. In relation to the interviews, it is used (EP1, EP2, EP3...) depending on the participant interviewed. Likewise, with regard to the teaching diaries, it is used (DD1, DD2, DD3...). For the seminars with the teacher, the acronym (SP1, SP2, SP3, and SP4) is used, taking into account the four seminars held throughout the intervention.

RESULTS

With regard to data coding, the following primary and secondary issues were obtained:

Initial expectations in the application of the CA: The primary issues were the understanding and application of the CL, while the secondary issues were the expectations, fears and uncertainty generated about the functioning of the model.

Problems encountered in its implementation: The primary issues were the excessive competitiveness of the students and their lack of experience, while the secondary issues were the lack of motor commitment, and the use of adequate space and materials.

Reflection on its future application: The primary was the need for further training in the model, while the secondary was the importance of reflection throughout the process and confidence in the model's potential. All the information extracted from the three data collection instruments is grouped into the three

categories of the study. Through the analysis of crossed patterns, the number of resulting literal text extracts is presented, showing the most significant and coinciding ones. Presenting the most consistent text extracts in each of the categories, in relation to the objectives of the study, favors the elimination of possible biases on the part of the researchers and guarantees the reliability of qualitative studies (Peterson, 2019). The qualitative methodology must have its main strength in the analysis of the participants' experiences through the text, being not at all less rigorous than the quantitative one (Wallace and Kuo, 2020). In this case, the results follow a research structure linked to four of the five qualitative approaches (Creswell, 2007; Creswell et al., 2007): case study, narrative, phenomenology and action research.

Initial Expectations in the Application of the CA (302 Text Extracts)

It can be seen how the expectations that the future teachers had at the beginning were not completely satisfied, finding problems in practice such as student boredom and lack of control over the classroom:

> *"I honestly thought that the students would respond very well to cooperative learning activities, however, many of them said that they were bored and wanted to do something else" (EP5). "I go home frustrated, because I had prepared the session very well, I thought it would be fun for them, but I spent the whole class trying to motivate them towards the activities [...] (DD9)." "It was a direct hit with reality. From the beginning I lost control of the class, and I was more concerned about being attended and listened to than actually doing the activities. The students disconnected as soon as the explanations were a little long" (SP1).*

It also reflects how future teachers thought they knew the CL model, although later in the classroom many doubts and uncertainties were generated when applying it in terms of aspects such as group management, application of content and time management:

> *"I thought I was clear about the principles of the CL, and how through them the class was going to cooperate. However, from the first day I realized that it was not going to be easy, as I found it difficult to adapt the activities to the characteristics of the groups" (EP10). "In principle I thought that the application of the CL could be carried out through any content, but for example in those of a sporting nature I find it difficult to eliminate competition" (DD5). "One of the main ones for me is managing class time. I think that in one class I will be able to do three or four activities, when at most I have time for two" (SP2).*

Participants highlight how the reality of the classroom with children differs greatly from what was learned and experienced at the university:

> *"When they tell you about the benefits of CL in the university you only see advantages, everything seems very nice and you think it will be easy to apply" (EP1). "They show you videos of the kids doing activities and you are shocked [...]. You can't wait to get to the classroom to try them out" (EP6). "When you get to class everything changes, you realize that everything in college was too idyllic" (DD9). "Among us adults, there was silence, more autonomy and when something was proposed everyone did it without a problem [...] When you put it to the children it is a totally different reality, more complex" (SP3).*

Problems Encountered in Their Implementation (318 Text Extracts)

One of the main problems perceived by future teachers was the excessive competition among students:

> *"Children are very used to competing in PE, and this is noticeable from day one" (EP7). "They always want to win above all else and this makes it very difficult for them to enter into the logic of cooperation" (EP12). "Whenever I propose a cooperative activity there are always a couple of students in class who want to solve it by themselves as soon as possible, and they also tend to make fun of those who are not capable" (DD13). "They are so used to winning and losing that when they have to think as a team there are some who tend to get bored [...] There is also a group of students who do not talk for fear of being laughed at" (DD6). "Some class members are not able to respect each other's waiting times and different learning rhythms... they think more individually than collectively and this is hard to change" (SP4).*

It was also observed how future teachers perceived greater ease in applying the model to those contents more linked to cooperative activities than to those related to physical condition:

> *"When you are doing team activities it is much easier to apply the model, as the guidelines are much clearer" (EP9). "I realized how in physical fitness activities we act more competitively and it becomes more difficult." (DD10). "In some content related to games I usually go to win individually, so implementing the model sometimes becomes more complicated" (DD5). "The main challenge is to be able to apply the cooperative learning model above any content" (SP2).*

Another problem expressed by the future teachers was the lack of motor commitment involved in the implementation of the CL:

> *"I am aware that the CL involves reflection and dialogue among participants [...]. The problem is when this time is too long, which causes the time of motor practice to be reduced" (EP4). "You can see how some children disconnect when the explanation is too long" (EP8). "On the one hand I know that the methodology has these characteristics, but on the other hand I think that from the PE we should encourage movement and the practice of physical activity, so I am faced with an eternal dilemma" (DD12). "It is the students themselves who often say that they are bored, commenting that when we practice a sport [...] Many times you think that what you are doing makes no sense and does not motivate them. This makes me very angry, since I prepare my classes a lot" (SP3).*

Reflection on Its Future Application (324 Text Extracts)

The results of this variable indicate how future teachers express the need for further training in the model:

> *"This classroom experience has helped me realize what I still need to learn from cooperative learning" (EP10) "I thought I already knew a lot about cooperative learning, but reality has shown me that I still have to justify the tasks much better, their adaptation to the students, to the space [...]" (EE8) "Some things are not going well for me, but the most important thing is that I am aware of why, so I*

will be able to change it the next times I develop these tasks in class." (DD7) "This is to be taken as an apprenticeship in our training [...]. We must not despair, it is our first experience in the classroom, and we still have a long way to go in our formation" (SP2).

They also highlighted the satisfaction and importance of the seminars held with the professor throughout the intervention:

"The seminars have helped me to know that I was not the only person who had problems, and that things were happening to the rest of my classmates in class that were very similar to mine" (EE2). "We have always been told at the university about the importance of teaching reflection on practice, and the seminars we have done have helped me to realize this" (DD13) "I was looking forward to this seminar to share with you everything that is happening to me and see how the intervention is going [...]. It is an ideal way to share and look for common strategies" (SS3).

Although the participants have reflected a diversity of problems in the implementation of the model in the classroom, they remain confident in their potential and in continuing to apply it in their professional future:

"Having had certain problems at the beginning is normal, but I still believe that this model is fundamental in contributing to the type of physical education that we want" (EE1) "Problems in the classroom are normal with this methodology and with any other [...] Mistakes serve to continue learning" (EE4) "Although I have had problems, there have been more positive than negative things, and I honestly want to continue applying this methodology in my future" (DD8) "If you believe in participatory physical education, you must use models such as the cooperative model, otherwise the principles behind the subject are totally different" (SS4).

DISCUSSION

The aim of the study was to analyze to what extent future PE teachers were able to apply the CL training they have received at university in the classroom, by exploring their fears, insecurities and problems in doing so. The results show how the initial expectations that future PE teachers had are not matched in reality, finding a variety of problems when applying the C model in the classroom. However, they show that they understand the difficulty involved and intend to continue applying it in their professional future. The results obtained connect perfectly with the theory of occupational socialization (Richards et al., 2014), which tries to connect the initial training of teachers with the professional reality they will find in the classroom. To do so, it is essential to pay attention to the pedagogy of dialogue, actively following up on the future teachers in their first contacts with the classroom. This will allow them to achieve confidence and competence in themselves to create their own professional identity (Eather et al., 2019).

In relation to the first category of the study, related to the initial expectations, the reality in the school showed them the complexity that has to apply the CL with the children, manifesting how different everything is in relation to what was experienced in the university. This is one of the main problems that exist today in the initial training of teachers, where they are trained more on theoretical aspects than on the acquisition of practical resources for application in the classroom (Richards et al., 2013). From the perspective of pedagogical coherence, university teachers must maintain a close relationship with what is happening in the schools, showing scientific evidence of which methods, strategies and protocols are the best to follow in each context. As indicated by Greaves et al. (2019), the university must provide channels so that future teachers can apply what they have learned in their subjects, with the possibility of experimentation and above all with guarantees of redirecting teaching processes. The data from the study have reflected the perceived shortcomings in managing groups and class time well according to the content selected. It is common for new teachers to fall into the error of "more is better," considering that many activities are necessary in order to generate more learning. In fact, the CL is characterized by a high component of group reflection, which means that in many cases the number of activities is not the most relevant element in the teacher's planning (Walker and Johnson, 2018). On the other hand, the participants in the study have reflected the frustration they felt when students were sometimes bored in class. This is common when students first receive the CL in PE, as they are usually more accustomed to traditional PE models in which physiological activation takes precedence over social and learning aspects. Dyson et al. (2016) indicate that despite the initial resistance that we may encounter in schools, students and even families when applying the CL, we must be consistent in its application until the student acts under the logic of cooperation. This full conviction can serve as a stimulus for the professional development of teachers, thus increasing the possibilities of applying the pedagogical model correctly.

With regard to the second category of the study concerning the problems encountered, two were the main axes found. On the one hand, the excessive competitiveness of students, and on the other, the perceived lack of motor commitment. It is usual that the activities applied in the PE are based on the immediacy of the objective to be achieved from an individual approach (throwing faster, arriving running before the colleagues, making more jumps than the others...). This type of conception of the subject, applied year after year, creates in the student a driving culture, where what matters is individuality above any collective, creative and social criteria (Pill and SueSee, 2017). When this logic of acting is imposed, the students with more individual success reject any kind of change in the subject, since the protagonism to which they were accustomed is reduced. This is why new teachers must be guided and accompanied throughout these training processes, since they produce great contrasts with respect to their initial pretensions (Richards and Templin, 2011). In this sense, even today the "wet T-shirt syndrome" still prevails within the PE classes, understanding that if the student does not sweat in the PE classes is not generating real learning. However, several studies (Hortigüela-Alcalá et al., 2017, 2018) indicate that the motivation and predisposition of PE teachers to teach one content or another is not linked to the intensity of the level of physical practice required by the content. Therefore, teaching programs must be aimed at reducing the competitiveness of students, designing protocols to monitor each of the strategies implemented (Johnson and Johnson, 2009). Connecting with the

ideas addressed in the theoretical framework, the results have shown the various problems encountered by future PE teachers. This is why CL must be taught in universities as an in-depth pedagogical model, and not in isolation at specific moments. Its possibilities are infinite, but if it is not properly focused, it can have the opposite effect to that intended at the beginning, for example in the dialogue that it requires among students for learning sports (Darnis and Lafont, 2015). It is essential to have clear teaching structures that can be applied transversely to any content, with the objective of fostering social relations through motor skills (O'Leary et al., 2015).

The last category of the study has been about the reflection of the future PE teachers to apply the CL in their professional future. Firstly, the future teachers express the need to continue being trained in the model, assuming its complexity and considering the experience a key factor to be able to continue evolving as professionals. In this sense, Bores-García et al. (2020) highlight the importance of the activities carried out in the classroom being governed by the principles that give meaning to the CL model, and for this, teachers must ensure that these activities can be extrapolated to a variety of contexts. In this sense, the participants of the study highlighted as very relevant and necessary the seminars that were held with the teacher throughout the intervention, since they allowed them to reconstruct their steps in the school and to reflect on the problems that were encountered throughout the process. Lynch and Curtner-Smith (2019) criticize the poor connection that in many cases exists between education faculties and schools, explaining how an education system is broken if the predominant socio-cultural influences in each context are not intentionally addressed. There is still a large gap between initial teacher training and the reality of schools, which creates a tension between theory and practice. In order to reduce this tension, it is essential that teacher trainers develop auto-ethnographic processes in order to understand the applicability of learning (Yung, 2020). Some authors advocate the need for an intense reformulation of initial teacher training, establishing innovative training plans that adapt to an increasingly changing educational reality (Yeigh and Lynch, 2017). Finally, the results show how future teachers, after the experience, continue to trust in the potential derived from the CL, hoping to continue applying it in their professional future. This is why, from the initial teacher training, the development of practices in real contexts must be guaranteed, thus contributing to the generation of the construction of a clear professional identity that can be transferred to their daily life at school (Androusou and Tsafos, 2018). In the present investigation, a 12-week intervention has been carried out, addressing the entire duration of the course. It is ideal to be able to establish interventions of the longest possible duration, thus guaranteeing the establishment of significant learning (Watts et al., 2019).

CONCLUSION

In relation to the objective of the study, it has been verified how the future teachers of PE have not seen their initial expectations fulfilled in the application of the CL in the school, finding diverse problems like the management of the time, the motivation of the student or the scarce motor commitment of the activities. However, they consider the experience to be very positive, hoping to continue applying the model in their professional future. The main contribution of this research, besides generating new evidences about the applicability of the CL, has been the use of a contrast of qualitative instruments that allow to reflect and redirect the practices of the future PE teachers. In addition, seminars were carried out with the participants throughout the intervention process, thus contributing to the pedagogy of dialogue and the theory of occupational socialization. This is a contribution to the previous literature, since it allows for the establishment of connections between the initial training of PE teachers and schools, through designs based on reflection and the construction of professional identity.

However, the article has some limitations. On the one hand, only one intervention is measured. On the other hand, only the assessments experienced by future PE teachers are taken into account. Therefore, it would be interesting to contrast these results with future interventions of a longitudinal nature, thus verifying the level of evolution of the participants with respect to the application of the CL. In this sense, it would also be possible to attend to the students' assessments. In addition, it would be interesting to make interventions by increasing the number of participants, as well as the establishment of teaching programs based on a diversity of research.

We consider this research of special interest for all those PE teachers who work the CL in the school. Also for all those responsible for the elaboration of school curricula or for the management of physical activity programs, understanding that the cooperation has to be closely linked to the sport field. It is necessary to continue investigating in this line and throwing light on the bonanzas and guarantees of the application of the CL in PE.

DATA AVAILABILITY STATEMENT

All datasets generated for this study are included in the article/supplementary material.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Bioethics Committee of the University of Burgos. The participants provided written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DH-A: conceptualization, validation, and investigation. AH-G: investigation and visualization. SG-V: investigation and formal analysis. JP-V: investigation and resources. AB-E: review and editing. All authors contributed to the article and approved the submitted version.

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Complementing the Self-Determination Theory With the Need for Novelty: Motivation and Intention to Be Physically Active in Physical Education Students

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The theoretical framework of the self-determination theory establishes that the satisfaction of basic psychological needs and more self-determined motivational forms are related to positive behavioral consequences and, therefore, may increase the intention to be physically active in Physical Education students. In this sense, the need for novelty has been proposed as a psychological need by recent scientific evidence, so it is necessary to prove its possible contribution to the prediction of young people's behavior. Therefore, the main objective of the study was to test a model that analyzed the power of prediction of the satisfaction of the needs for autonomy, competence, relatedness, and novelty as well as the motivation experienced in Physical Education on the intention to be physically active. A questionnaire was administered to 1665 Physical Education students with an average age of 12.43 years (SD = 1.87), of which 835 were boys and 830 were girls. An adaptation of the Spanish educational context of the Basic Psychological Needs in Exercise Scale (BPNES) that includes the need for novelty, the Perceived Locus of Causality Scale (PLOC), and the Intention to be Physically Active Scale (IPAS) was used. Path analysis results showed that the satisfaction of the psychological needs for autonomy, competence, relatedness, and novelty predicted autonomous motivation. On the other hand, the need for autonomy positively predicted controlled motivation, while the satisfaction of relatedness did so negatively. The need for competence and autonomous motivation positively predicted the intention to be physically active in Physical Education students, obtaining an explained variance of 33%. However, controlled motivation was not related in a statistically significant way to the intention to be physically active. In conclusion, the results of the hypothesized model highlight the importance of satisfying all the basic psychological needs (including novelty) and give special emphasis to the need for competence, since it predicts autonomous motivation and the intention to be physically active outside of the educational context.

Keywords: self-determination theory, psychological needs, school education, secondary education, physically active

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INTRODUCTION

Despite the multiple benefits that regular physical activity provides in children and adolescents (e.g., Janssen and LeBlanc, 2010), increasing adherence to it and reducing sedentariness among this demographic continues to be a major global health issue (WHO, 2019). In recent years, the study of motivation has been widely applied to the field of physical activity by being considered as that which energizes and gives direction to human behavior (Ryan and Deci, 2017) and, therefore, is very useful as a concept to analyze aspects related to adherence to activity (e.g., Ryan et al., 1997; Teixeira et al., 2012).

As such, one of the principal theories that focuses on the workings of motivational processes in human beings is the self-determination theory (SDT; Deci and Ryan, 1985, 2000; Ryan and Deci, 2017). SDT identifies the existence of three basic psychological needs which are universal and inherent in all individuals. These are autonomy, competence, and relatedness. "Autonomy" refers to a person's need to see themselves as the origin of their own actions and to experience actions of their own choosing; "competence" refers to the need to control the result and achieve efficiency; and "relatedness" refers to the need to be connected to others (Ryan and Deci, 2017). These three needs explain the regulation of people's behavior, established on a motivational continuum, which fluctuates between autonomous motivation (i.e., intrinsic regulation, integrated regulation, and identified regulation), passes through more controlled forms of motivation (i.e., introjected regulation and external regulation), and ends with the absence of regulation or amotivation (Deci and Ryan, 2000; Ryan and Deci, 2000, 2017; Vansteenkiste et al., 2010). Intrinsic motivation concerns activities carried out to generate pleasant sensations or for enjoyment and inherent interest. In identified regulation, the person consciously valors an activity and experiences a high degree of volition to act. In integrated regulation, the person valors the activity and finds it to be consistent with other interests. Introjected regulation refers to behaviors performed by avoidance of negative feelings (like shame or anxiety) for failure and by rewards of self-esteem for success. External regulation comprises behaviors which are imposed by a system of rewards and punishments. Finally, amotivation concerns to lacking intentionality (Ryan and Deci, 2020). SDT suggests that the satisfaction of these basic psychological needs is associated with autonomous motivation, while frustration of the same is related to controlled motivation and amotivation (Ryan and Deci, 2017).

As a complement to SDT, Vallerand (1997, 2001) developed the hierarchical model of intrinsic and extrinsic motivation (HMIEM), identifying the existence of three distinct levels of motivation: global (general motivation of the subject), contextual (motivation within a specific context, such as Physical Education classes), and situational (motivation experienced during the course of a Physical Education session or a particular activity). This model established that motivation at any of these levels is influenced by social factors (e.g., the interpersonal style of the teacher); that the perception of the three basic psychological needs mediates the effect between these social factors and motivation; and that motivation brings a series of consequences across a wide variety of contexts (Ryan and Deci, 2017), including in Physical Education (e.g., Van den Berghe et al., 2014). In this way, the scientific literature has shown how satisfaction of the needs for competence, autonomy and relatedness increases the most self-determined types of motivation (Ntoumanis, 2001; Standage et al., 2006; Fin et al., 2019), and this leads to positive behavioral consequences in students, some of which are associated with the practice of physical activity outside of the school context (e.g., the intention to be physically active; Hein et al., 2004; Mouratidis et al., 2008; Lim and Wang, 2009).

Within this context, González-Cutre et al. (2016) recently opened a new line of investigation concerning the functioning of motivational processes. These authors proposed that the need for novelty, understood as the need to experience something that has not been experienced previously or that diverges from the daily routine, could be considered as a new basic psychological need within SDT. In fact, several studies have proposed more new candidate-needs in the last few years (Vansteenkiste et al., 2020).

The fourth mini-theory of SDT, or in other words, the basic psychological needs theory (BPNT), analyze the relations between the basic psychological need satisfactions and frustrations on well-being and the ill-being (Ryan and Deci, 2017). Within BPNT, Ryan and Deci (2017) established six criteria that a candidate need should meet to be including as a basic psychological need: (1) the satisfaction of this candidate must be strongly associated with well-being, health and psychological integrity, while its frustration must be negatively associated with these consequences and positively related with ill-being; (2) it must specify the experiences and contents that lead to well-being; (3) candidate need should be a significant and constant mediator of the relationships between personal and social factors and the motivational and psychological functioning of the individual; (4) any new candidate should act as a growth need and not as a deficit need, meaning that the new basic psychological need must act in accordance with the three existing needs and not as a substitute for one of them when they become frustrated or threatened; (5) it should be a precursor and not a consequence within the motivational process of self-determination theory; and (6) it must work universally for all ages and cultures.

In this sense, Bagheri and Milyavskaya (2020) have proposed and analyzed a similar key-concept to novelty as candidate new. These authors showed how the novelty-variety (personal perception of doing or experimenting something new and the possibility of different combinations) fulfilled some criteria; since novelty-variety was a factor separated from the other needs, the findings did not depend on the age of the participants or novelty-seeking preferences, and when novelty-variety was thwarted, there was a reduction on well-being.

In this line, novelty (excluding the variety-feature) has also fulfilled some criteria. González-Cutre et al. (2016) showed through a confirmatory factor analysis that the need for novelty is a distinct construct to those of autonomy, competence, and relatedness. These results have coincided with recent findings by Trigueros et al. (2019) in a study to validate the Spanish version of the Basic Psychological Needs Satisfaction Scale for Physical Education classes. The confirmatory factor analysis also showed

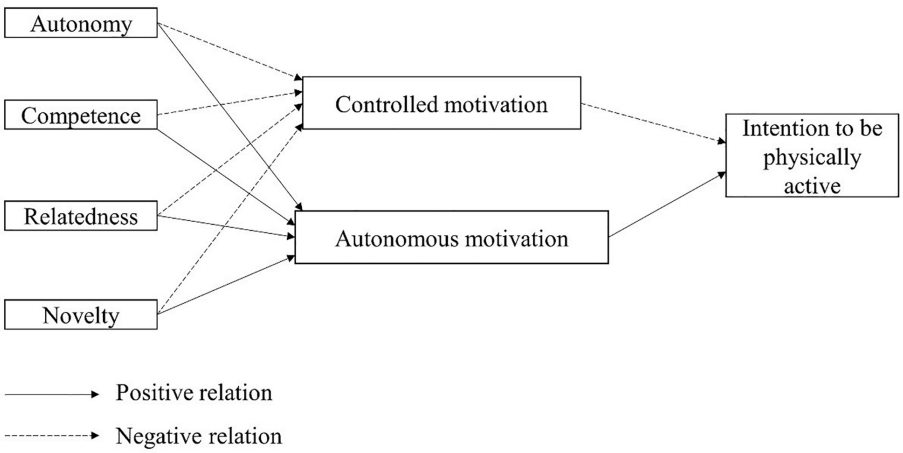

FIGURE 1 | Hypothesized model of the basic psychological needs, with autonomous and controlled motivation and the intention to be physically active.

the need for novelty as an independent factor. Likewise, the studies by González-Cutre et al. (2016, 2020) and González-Cutre and Sicilia (2019) have demonstrated how the aforementioned construct is positively associated with the most self-determined types of motivation and with positive consequences, such as life satisfaction, enjoyment, and vitality in Physical Education. González-Cutre et al. (2020) also showed the moderating role of openness to experience in the association between the novelty need satisfaction and well-being.

This existing relationship between the need for novelty and positive consequences has now become the object of study in other contexts. In particular, Birdsell (2018) has recently shown a positive correlation between the satisfaction of the need for novelty and the commitment to and satisfaction of learning English for a group of Japanese students. To this extent, the recent scientific evidence indicates that novelty could be a basic need within BPNT. However, it is still necessary to analyze whether similar benefits emerge at the cognitive, behavioral and physiological level, and in various contexts (Vansteenkiste et al., 2020).

In terms of the role played by the need for novelty with respect to physical activity, little is currently known. In fact, the study by Fernández-Espínola et al. (2020) is the only published investigation on the satisfaction of the need for novelty and its behavioral consequences in relation to the practice of physical activity (the intention to be physically active in the future). The results of this investigation showed that the need for novelty was associated with the intrinsic motivation of Physical Education students and the growth of their intention to be physically active in the future. However, the traditional basic psychological needs were not included in this study. Therefore, further study is required of the role of the need for novelty when combined with the other three psychological needs in a sequence that includes some variable related to the practice of physical activity as a consequence.

Thus, taking into account the importance that knowing young people's intention to be physically active could have for global health, just like the lack of studies that relate the need for novelty with behavioral consequences within SDT, the objective of the present study was to test the interrelations between the need for novelty and the basic psychological needs, autonomous motivation, controlled motivation and the intention to be physically active in the future. Using a model which hypothesizes that the three existing basic psychological needs, as well as novelty, would act as positive predictors of autonomous motivation and as negative predictors of controlled motivation. In turn, autonomous motivation would act as a positive predictor of the intention to be physically active, while controlled motivation would act as a negative predictor of the same (see **Figure 1**).

MATERIALS AND METHODS

Participants

The sample of this investigation was composed of 1665 students of Physical Education, who were studying between the 5th year of primary school up to the first year of the high school diploma (equivalent to first year of A-level study) and belonged to 15 educational institutions (12 public schools and three private schools) in the province of Huelva (Spain). Specifically, the sample constituted 835 boys and 830 girls, of ages ranging from 10 to 18 years old (M = 12.43, SD = 1.87). Convenience sampling was used to select the all the participants. Students received two physical education sessions per week.

Measures

Basic Psychological Needs

The most recent version of the Measurement of Psychological Needs Scale was employed (González-Cutre and Sicilia, 2019), which was adapted from the *Basic Psychological Needs in Exercise Scale* (BPNES; Vlachopoulos and Michailidou, 2006) for the Spanish educational setting, to which the authors added the need for novelty. The scale consisted of a total of 17 items

grouped into four aspects (four items per aspect, except for the novelty aspect, which consisted of five items): autonomy (e.g., "I have the opportunity to choose how to exercise"), competence (e.g., "I exercise efficiently"), relatedness to others (e.g., "I feel very comfortable when I exercise with friends") and novelty (e.g., "I think that I often discover new things"). The preceding phrase was "In my Physical Education classes...". The responses were scored using a Likert scale with five options, from 1 (corresponding to *Totally agree)* to 5 (corresponding to *Totally disagree)*. The internal consistency of this scale was 0.83 for the need for novelty, 0.74 for the need for relatedness, 0.73 for the need for autonomy, and 0.70 for the need for competence. Factorial validity of the Psychological Needs Scale was examined using confirmatory factor analysis (CFA), which offered acceptable fit indices ($\chi^2 = 417.21$, $p = 0.00$, χ^2/g.l. = 3.69, CFI = 0.92, IFI = 0.92, TLI = 0.91, SRMR = 0.05, RMSEA = 0.06).

Autonomous and Controlled Motivation

The factors of intrinsic regulation, identified regulation, introjected regulation and external regulation were used from the Perceived Locus of Causality Scale in Physical Education, tested in the Spanish context by Moreno-Murcia et al. (2009) from the *Perceived Locus of Causality Scale* (PLOC; Goudas et al., 1994). Each factor is composed of 4 items: intrinsic regulation (e.g., "Because physical education is fun"), identified regulation (e.g., "Because I want to learn sporting skills"), introjected regulation ("Because I would feel bad about myself if I didn't do it") and external regulation (e.g., "Because I'll have problems if I don't do it"). The responses were scored using a Likert scale, with a scoring system range from 1 (*Totally disagree)* to 7 (*Totally agree)*. The phrase preceding the items was "I participate in Physical Education classes...". The internal consistency was 0.78 for intrinsic regulation, 0.78 for identified regulation, 0.69 for introjected regulation, and 0.70 for external regulation. The data from this study revealed adequate psychometric properties of the PLOC in PE using CFA ($\chi^2 = 520.60$, $p = 0.00$, χ^2 / g.l. = 3.25, CFI = 0.92, IFI = 0.92, TLI = 0.91, SRMR = 0.06, RMSEA = 0.06). In order to calculate autonomous motivation, the sum of intrinsic regulation subscale weighted by two and of identified regulation subscale was used. Similarly, in order to calculate controlled motivation, the sum of external regulation scale multiplied weighted by two and of introjected regulation scale was used (Hagger et al., 2014).

Intentionality to Be Physically Active

The adapted and translated (into Spanish) version (Moreno-Murcia et al., 2007) of *Intention to be Physically Active Scale* (IPAS) by Hein et al. (2004). The scale was introduced with the phrase "With respect to your intention to practice some form of physical activity...". The scale was composed of five items in order to measure the intention to be physically active (e.g., "I regularly practice sport in my free time"). The responses were scored using a Likert scale, ranging from 1 (*Totally disagree)* to 5 (*Totally agree*). Cronbach's alpha was 0.77. The CFA showed acceptable fit indices ($\chi^2 = 24.45$, $p = 0.00$, χ^2 / g.l. = 4.89, CFI = 0.99, IFI = 0.99, TLI = 0.98, SRMR = 0.02, RMSEA = 0.08).

Procedure

The present study was developed in accordance with current legislation in Spain concerning investigative studies of people and in line with the ethical principles of the American Psychological Association (2020). Firstly, the permission of the Ethics Committee of Biomedical Investigation of Andalusia (Spain) was obtained. The next measure completed to enable data collection was to establish contact with the management team of each of the educational institutions, with the intention of informing them about the aims of our investigation and to request their cooperation. Subsequently, given that the sample consisted of subjects who were minors, authorization in the form of a written signature was requested from their legal guardians so that they could participate in the study. Once authorization was granted, the questionnaires were distributed in the presence of the principal researcher, who gave a brief explanation of the objectives of the study, set out a series of guidelines on how to complete the questionnaires and addressed any issues that arose from the reading and comprehension of some of the items, emphasizing anonymity and the importance of providing honest answers. In general, the time required to complete the questionnaire was 15 minutes.

Data Analysis

Firstly, the data matrix was filtered, followed by an analysis of the reliability of the data and calculation of the variables. Then, descriptive statistics of said variables and bivariate correlations were calculated. Moreover, a path analysis was completed with the aim of analyzing the hypothesized predictive relationships between the study variables using the method of estimation of maximum authenticity. Regarding indirect effects, Preacher and Hayes' (2008) methods of multiple mediation were used, generating the limits of confidence for the indirect effects through bootstrapping. In order to verify the validity of the model, the following goodness-of-fit indices were taken into account: the CFI (*Comparative Fit Index*), the IFI (*Incremental Fit Index*), the TLI (*Tucker Lewis Index*), the ratio between chi-squared and degrees of freedom (χ^2 /g.l.), the SRMR (*Standardized Root Mean Square Residual*), and RMSEA (*Root Mean Square Error of Approximation*) combined with its confidence interval (CI) of 90%. The aforementioned goodness-of-fit indices are considered acceptable when the values of CFI, IFI, and TLI are greater than 0.90 (Hu and Bentler, 1995), 0.08 or lower for RMSEA (Browne and Cudeck, 1993) and SRMR (Hu and Bentler, 1999), and between 2 and 3 for χ^2 /g.l. (Schermelleh-Engel et al., 2003). This analysis was completed with the statistical programs SPSS 23.0 and Amos 23.0.

RESULTS

Descriptive Analysis and Bivariate Correlations

In **Table 1**, the descriptive statistics (mean, standard deviation, skewness and kurtosis) and bivariate correlations are shown. In terms of the mean scores of the motivational regulations,

TABLE 1 | Descriptive statistics and bivariate correlations of the study variables.

Variables	RG	*M*	SD	S	C	1	2	3	4	5	6	7	8	9	10	11
1. Autonomy	1–5	3.40	0.86	−0.27	−0.30	–	0.53**	0.34**	0.64**	0.47**	0.47**	0.33**	0.08**	0.50**	0.18**	0.33**
2. Competence	1–5	3.96	0.76	−0.67	0.01	–	–	0.46**	0.54**	0.59**	0.60**	0.27**	−0.03	0.63**	0.08**	0.52**
3. Relatedness	1–5	4.18	0.79	−0.91	0.16	–	–	–	0.46**	0.43**	0.41**	0.11**	−0.07**	0.45**	−0.17	0.34**
4. Novelty	1–5	3.83	0.89	−0.76	0.19	–	–	–	–	0.54**	0.55**	0.27**	0.01	0.58**	0.11**	0.37**
5. Intrinsic R	1–7	5.83	1.15	−1.21	1.36	–	–	–	–	–	0.76**	0.26**	−12**	0.98**	0.00	0.48**
6. Identified R	1–7	5.84	1.13	−1.33	1.86	–	–	–	–	–	–	0.36**	−0.02	0.89**	0.11**	0.53**
7. Introjected R	1–7	4.39	1.43	−0.21	−0.54	–	–	–	–	–	–	–	0.51**	0.31**	0.75**	0.24*
8. External R	1–7	3.87	1.54	−0.06	−0.79	–	–	–	–	–	–	–	–	−0.09**	0.95**	−0.04
9. Autonomous M	3–21	17.50	3.26	−1.30	1.73	–	–	–	–	–	–	–	–	–	0.04	0.53**
10. Controlled M	3–21	12.12	4.00	− 0.04	0.74	–	–	–	–	–	–	–	–	–	–	0.05*
11. Intention	1–5	4.22	0.80	−1.18	0.96	–	–	–	–	–	–	–	–	–	–	–

** $p < 0.05$ ** $p < 0.01$; M, mean; SD, standard deviation; S, skewness; C, kurtosis; R, regulation; RG, range; M, motivation.*

identified regulation, followed by intrinsic motivation, showed the highest value. Autonomous motivation showed higher mean score than controlled motivation. With respect to the mean scores of the basic psychological needs, the need for relatedness, followed by the need for competence, displayed the highest score.

In turn, in the correlation analysis it was observed that all the basic psychological needs correlated positively and significantly with the intention to be physically active and with all types of motivation, except for external regulation, where the need for autonomy correlated positively and significantly, whilst the need for relatedness correlated negatively and significantly. Regarding the correlation of motivational regulations and the intention to be physically active, all types of motivation correlated positively and significantly, except for external regulation.

Path Analysis

The results of the hypothesized model, where autonomous motivation and controlled motivation, respectively interceded positively and negatively between the satisfaction of the basic psychological needs and the intention to be physically active, showed that the need for novelty and the three basic psychological needs were positive and significant predictors of autonomous motivation, and that the latter also behaved as a positive predictor of intention. In turn, controlled motivation was only predicted significantly by the needs for relatedness (negatively) and autonomy (positively), and contrary to what was expected, behaved as a positive but insignificant predictor of intention. However, this model did not show adequate goodness-of-fit indices, $\chi^2 = 144.99$, $p < 0.05$, χ^2 /g.l. = 28.99, CFI = 0.97, IFI = 0.97, TLI = 0.85, SRMR = 0.043, RMSEA = 0.13, 90% CI [0.11, 0.14].

In this regard, with the aim of obtaining an improved fit of the model, the three relationships that showed an insignificant weight of regression (between the needs for competence and novelty with controlled motivation, and between the latter and the intention to be physically active) were eliminated, and the modified indices of the model were then observed. These suggested that the model could be improved, adding a direct relationship between the need for competence and the intention to be physically active. Thus, considerable improvements were achieved for the goodness-of-fit indices: $\chi^2 = 14.59$, $p < 0.05$, χ^2/g.l. = 2.09, CFI = 0.99, IFI = 0.99, TLI = 0.99, SRMR = 0.011, RMSEA = 0.026, 90% CI [0.005, 0.044].

The results of this model (see **Figure 2**) showed that satisfaction of the needs for autonomy (β = 0.08, $p < 0.001$), competence (β = 0.39, $p < 0.001$), relatedness to others (β = 0.12, $p = 0.001$) and novelty (β = 0.26, $p < 0.001$) were positive and significant predictors of autonomous motivation. In turn, with regard to controlled motivation, the need for autonomy acted as a positive predictor (β = 0.21, $p < 0.001$), and the need for relatedness as a negative predictor (β = −0.09, $p < 0.001$).

With respect to the intention to be physically active, this was predicted by autonomous motivation (β = 0.34, $p < 0.001$) and the need for competence (direct effect: β = 0.30, $p < 0.001$; indirect effect: β = 0.13, $p < 0.001$). Likewise, other indirect effects of intention to be physically active were found with respect to the need for autonomy (β = 0.03, $p < 0.001$), novelty (β = 0.09, $p < 0.001$) and relatedness to others (β = 0.04, $p < 0.001$). The explained variances were 49% for autonomous motivation, 4% for controlled motivation, and 33% for the intention to be physically active.

DISCUSSION

The objective of this study was to test the interrelationships between the need for novelty and the basic psychological needs, as well as motivation and the intention to be physically active in the future, through the use of a model which hypothesized that all the needs would act as positive predictors of autonomous motivation, and as negative predictors of controlled motivation. Equally, autonomous motivation would act as a positive predictor of the intention to be physically active, while controlled motivation would act as a negative predictor of the same. The results obtained have demonstrated partial support for the hypothesized model.

Firstly, the need for novelty and the three existing basic psychological needs predicted autonomous motivation both positively and significantly. These results were consistent with our model and the findings of González-Cutre and Sicilia (2019),

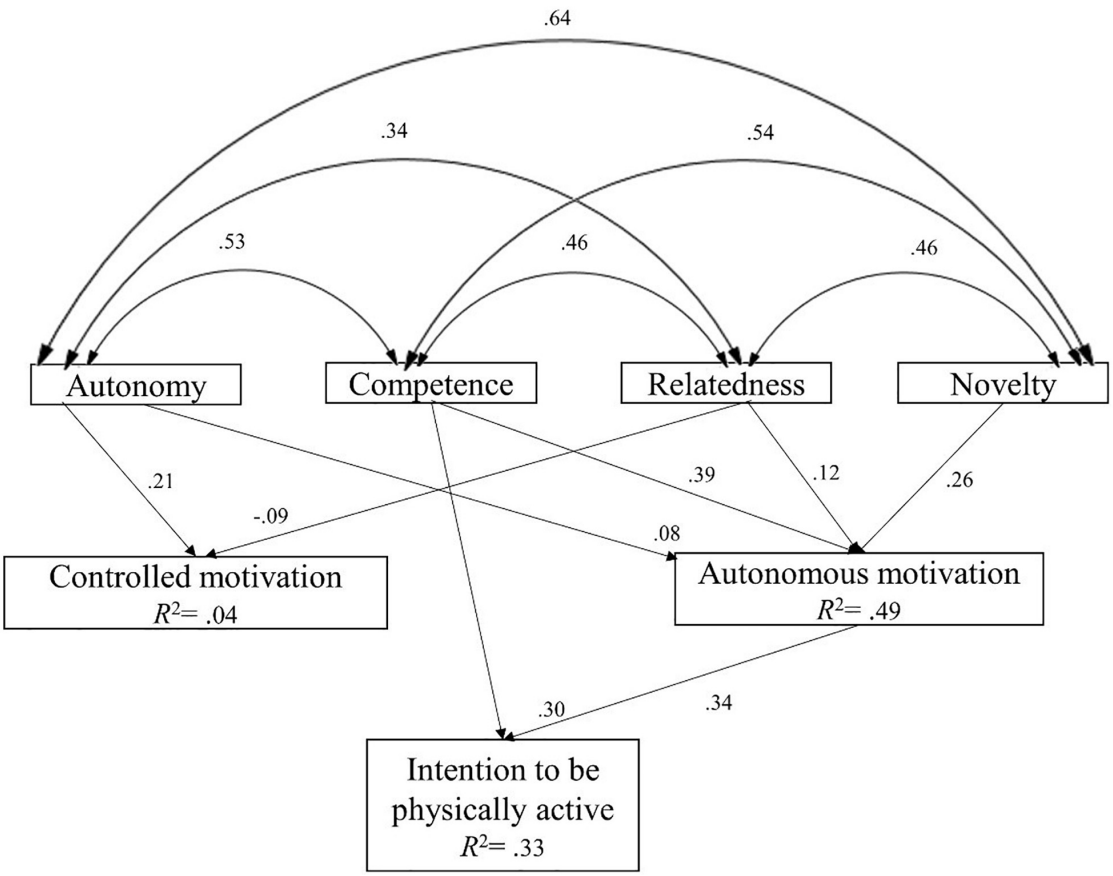

FIGURE 2 | Final path model of existing relationships between the four basic psychological needs, autonomous motivation, controlled motivation, and the intention to be physically active in the future. R^2 = explained variances.

Trigueros et al. (2019), and González-Cutre et al. (2020), where the types of autonomous motivation were positively predicted by the satisfaction of the four needs. This supports the idea that the need for novelty acts in synergy with the other three basic psychological needs, thus fulfilling one of the criteria established by Ryan and Deci (2017). For these authors, the fourth criterion that a proposed need must fulfill in order to be included in BPNT is that it acts as a growth need and not as a deficit need, meaning that the new basic psychological need must act in accordance with the three existing needs and not as a substitute for one of them when they become frustrated or threatened.

On the other hand, with respect to controlled motivation, the results obtained were not the same as those hypothesized. Only the needs for autonomy and relatedness were associated with it. The need for relatedness predicted controlled motivation negatively, while, contrary to what was expected, autonomy behaved as a positive predictor of the same. Currently, it is possible to compare these results only with the findings of González-Cutre et al. (2020), because this is the only study to have included controlled motivation within a similar motivational sequence. The results of the investigation by González-Cutre et al. (2020) showed that the need for competence acted as a negative predictor of controlled motivation, in accordance with the hypothesis of the proposed model. The satisfaction of a basic psychological need as a predictor of controlling motivation may be due to the fact that supporting autonomy, competence, and relatedness is positively correlated with introjected regulation and negatively and weakly correlated with external regulation (Vasconcellos et al., 2019).

Finally, with regard to the intention to be physically active, the results partially supported those proposed in the hypothesized model. In this regard, intention was predicted positively and directly by autonomous motivation, while no significant relationship was found with controlled motivation. These results agree with previous investigations (Hein et al., 2004; Taylor et al., 2010), where the most self-determined types of motivation behaved as positive predictors of the intention to be physically active in the future, providing evidence which supports the idea that what happens in Physical Education classes can affect students' behavior in their free time (Hagger et al., 2003; Hagger and Chatzisarantis, 2012; Ferriz et al., 2016). Moreover, it was found that satisfaction of the need for competence was the only one that directly affected this variable. In the study by González-Cutre et al. (2020), the need for competence was also the only one to present direct effects on the two consequences concerned (enjoyment and vitality). In this line, the recent

systematic review and meta-analysis by Vasconcellos et al. (2019) has showed that the need for competence presents higher direct effects on adaptive outcomes than the need for autonomy or need for relatedness. As a result, it seems that the need to control and succeed in tasks by themselves could be a key factor in determining whether the practice of physical activity during childhood and adolescence is continued into adult life.

Likewise, the intention to be physically active was also indirectly predicted by the needs for autonomy, relatedness and novelty, the last of which presented the largest indirect effect. These results support the mediating role played by motivation in the existing relationship between the satisfaction of basic psychological needs, including the need for novelty, and its consequences, thus partially fulfilling another of the criteria established by Ryan and Deci (2017) to be able to include a new need in their theory. For these authors, any new need should behave as a constant and significant mediator of relationships between personal and social factors and the motivational functioning and psychology of the individual.

On the other hand, the principal limitations found in the study must be addressed, as well as future lines of investigation. Firstly, being of cross-sectional design, this study has not been able to analyze whether the satisfaction of the need for novelty is associated with positive consequences over a long period of time. It would be interesting for future studies to utilize a longitudinal design in order to explore this. Secondly, no social factors (e.g., interpersonal style of the teacher) have been measured in this study, and so it has not been able to assess the effect of measuring satisfaction of the need for novelty against social factors, motivation and their consequences. Future studies should analyze the role played by the need for novelty together with the three basic psychological needs in the complete sequence proposed by the theory of self-determination. Thirdly, neither integrated regulation nor amotivation was measured in this study. Finally only the relations of the satisfaction of the basic psychological needs have been analyzed in this study. It would be interesting for future investigations to explore the importance that the frustration of these needs has upon the intention to be physically active in the future.

CONCLUSION

In conclusion, the results of the hypothesized model have shown the importance of satisfying the need for novelty together with the other basic psychological needs (with special emphasis on the need for competence) in Physical Education classes, because this predicts the autonomous motivation and intention to be physically active of students in the future, outside of the school context.

As the results of the present study indicate, if teachers of Physical Education wish to increase the intention of their students to be physically active in the future, they must consciously try to generate a learning atmosphere in their classes that satisfies both the traditional basic psychological needs and the need for novelty (setting novel tasks and challenges that go beyond the daily routine), because said satisfaction predicts autonomous motivation and, consequently, grows the intention to practice physical activity in the future, outside of the educational context. In line with what is proposed by González-Cutre and Sicilia (2019), we suggest that, in order to introduce novel themes in Physical Education classes, teachers could apply methodologies unrelated to traditional approaches (e.g., gamification), use different materials, introduce the use of TIC, take students away from the school in order to practice physical activity (e.g., climbing and hiking), or call in experts so that students can take part in activities that are different to those typically taught in the educational center (e.g., parkour and zumba). Furthermore, the results of the study highlight the satisfaction of the need for competence above the other needs, because this directly predicts intention. Therefore, it is necessary for teachers to put special emphasis on proposing motor tasks and challenges that are achievable for the students, in order to help them to establish personal improvement as a principal objective, to allow them sufficient time to practice, to offer fundamentally positive encouragement, etc.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Portal de Ética de la Investigación Biomédica de Andalucía (Spain) (https://www.juntadeandalucia.es/salud/portaldeetica/). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

CF-E was responsible for conducting the study process, collaborating in the design of the study, collecting the data, conducting a preliminary analysis, and writing part of the manuscript. BA collaborated in the design of the study, was responsible for carrying out the analysis of the data and writing the results, collaborated in writing various sections of the manuscript, and has reviewed the final version. JT-F collaborated in the writing of the article and reviewed the final version. PS-L had primary responsibility for the design of the study, collaborated in the writing of the article, and reviewed the final version. All the authors collaborated significantly in the preparation of the manuscript and have given their approval to the final version of the article.

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Relationship Between the Practice of Physical Activity and Physical Fitness in Physical Education Students: The Integrated Regulation As a Mediating Variable

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The practice of physical activity (PA) contributes to the prevention of chronic diseases such as obesity, metabolic syndrome or cardiovascular diseases, being also directly related to the individual's physical fitness. Therefore, it is necessary to measure and monitoring the levels of PA in childhood and adolescence, since it may be useful to describe their current health status and the association with physical fitness, as well as to reveal putative consequences in the future. Within the educational field, it has been shown that physical education (PE) classes are a favorable context for the creation of healthy physical-sports habits and self-determined motivation could be a key for explaining the level of PA practice. For this reason, the purpose of this research was to study the mediating role of integrated regulation (IR) on the relationship between PA and physical fitness in children and adolescents. A total of 325 students between 11 and 14 years old participated in the study. The level of PA was estimated through the specific *Physical Activity Questionnaire for Children* (PAQ-C), while motivation and IR were measured by using the *Perceived Locus of Causality scale* (PLOC-2). In addition, physical fitness was measured through the *Eurofit fitness battery of tests*, composed of three body composition measures and seven tests of different physical capacities. The physical fitness score showed no differences when genders were compared. After regression analysis, the resulting models revealed a good adjustment and correlation between PA practice and physical fitness ($\beta = 0.173$; $p < 0.001$), being established through the macro *Process* that this relationship is partially conditioned by the IR ($\beta = 0.122$; $p = 0.03$). ROC curve analysis estimated the score of 5.88 as a cut-off point to discriminate between levels of IR for students, classified as physically active or not (AUC = 0.67; $p < 0.001$). The conclusions from these main and other

complementary analyses reporting complete mediations, suggest that the IR could be decisive in predicting and explaining the relationship between the practice of PA and physical fitness at these ages, highlighting its importance for a greater adherence to the practice.

Keywords: physical activity, physical fitness, integrated regulation, IPAQ, PLOC-2, schoolchildren

INTRODUCTION

Physical activity (PA) can be defined as any body movement produced by the action of skeletal muscles that causes an increase in energy expenditure (Rauner et al., 2013; Voss et al., 2017; Chacón-Cuberos et al., 2018a). Its practice is considered a key factor in the development, promotion and maintenance of healthier lifestyle habits at any age (Møller et al., 2009; Dumith et al., 2011; Chacón-Cuberos et al., 2018a; Castro-Sánchez et al., 2019; Zurita-Ortega et al., 2019). The physiological and psychological benefits of PA have been widely studied, highlighting the physiological ones, through the prevention and treatment of various chronic diseases such as obesity, cardiovascular disease, and metabolic syndrome (Cole et al., 2000; Webber et al., 2008; Møller et al., 2009; Ahn et al., 2011; Welk et al., 2011; Benítez-Porres et al., 2016a,b; Fang et al., 2017; Chacón-Cuberos et al., 2018a; Zurita-Ortega et al., 2019). Despite these benefits, the current scientific literature seems to have found sufficient evidence to affirm that there is a decreasing trend in PA practice worldwide (Adams, 2006; Webber et al., 2008; Owen et al., 2009; Dumith et al., 2011; Wang et al., 2016; Fang et al., 2017; Palou et al., 2019; Sierra-Díaz et al., 2019). More specifically, the World Health Organization (WHO) has identified such physical inactivity as a major global problem and has ranked it as the fourth largest risk factor for mortality worldwide (Dumith et al., 2011; Wang et al., 2016; Sierra-Díaz et al., 2019). This physical inactivity is the cause of the increase and prevalence of higher levels of obesity and overweight in the population, with sectors being particularly affected in the last decade, identified as children and adolescents (Adams, 2006; Ness et al., 2007; Webber et al., 2008; Dumith et al., 2011; Henriksson et al., 2016; Wang et al., 2016; Fang et al., 2017; Chacón-Cuberos et al., 2018b; Palou et al., 2019; Sierra-Díaz et al., 2019). In this line, the current data show worrying statistics, since a high percentage of this population are below the minimum PA practice levels pre-established by the WHO. This institution recommends at least 60 min per day of moderate physical activity (MPA) and vigorous physical activity (VPA) for the maintenance of adequate levels in order to provide health benefits at these ages (Riddoch et al., 2007; Nader et al., 2008; Webber et al., 2008; Steele et al., 2009; Dumith et al., 2011; Ekelund et al., 2011; Griffiths et al., 2013; Benítez-Porres et al., 2016a; Fang et al., 2017; Onetti-Onetti et al., 2019; Riso et al., 2019). Furthermore, scientific research in recent years has supported a focused reduction in these levels of PA practice at early ages, highlighting the fact that, as in primary education, there is a decreasing tendency for PA practice levels year by year, with an increasing inactivity trend continuing through adolescence and even adulthood (Nader et al., 2008). These tendencies put the situation in the spotlight due to the implications on the current and future health of the population (Webber et al., 2008; Collings et al., 2013; Henriksson et al., 2016; Fang et al., 2017). Therefore, the study and monitoring of PA practice levels in childhood and adolescence should be a priority, since their maintenance at these ages is considered a strong predictor of adequate PA practice levels in adult life (Møller et al., 2009; Riddoch et al., 2009; Rauner et al., 2013; Henriksson et al., 2016; Chacón-Cuberos et al., 2018b; Sierra-Díaz et al., 2019).

As a complement to the concern and importance of PA practice, current research focuses on combined studies with fitness levels (PF) (Ruiz et al., 2011; Rauner et al., 2013; Henriksson et al., 2016; Schutte et al., 2016; Wang et al., 2016; Palou et al., 2019; Riso et al., 2019; Tomkinson et al., 2019; López-Gil et al., 2020), and also including other variables such as obesity (Ness et al., 2007; Steele et al., 2009; Ekelund et al., 2011; Collings et al., 2013; Rauner et al., 2013; Benítez-Porres et al., 2016b; Henriksson et al., 2016; Fang et al., 2017; Palou et al., 2019), eating habits (Agostinis-Sobrinho et al., 2018; Ramírez-Vélez et al., 2018; López-Gil et al., 2020), physical self-concept or body image (Fernández-Bustos et al., 2019; Onetti-Onetti et al., 2019), and the motivational climate (Chacón-Cuberos et al., 2018a,b, 2019; Castro-Sánchez et al., 2019; Zurita-Ortega et al., 2019), among others.

Physical fitness is defined as the set of attributes that are achieved or possessed in relation to the ability to perform PA (Pate, 1988; López-Gil et al., 2020) or exercise with a certain skill influencing the sports performance (Schutte et al., 2016). It is considered an essential prerequisite for both, the development of daily activities without fatigue and the participation and performance of activities in free-time and leisure (Cvejic et al., 2013; Rauner et al., 2013; Schutte et al., 2016). The PF components within the health area, are cardio-respiratory, muscular and motor fitness, flexibility and body composition (Rauner et al., 2013; Kolimechkov, 2017; López-Gil et al., 2020).

Physical fitness along with PA play a key role in the health status, with the study of their interaction being a major research topic (Dollman et al., 2005; Ardoy et al., 2011; Rauner et al., 2013; Henriksson et al., 2016; Wang et al., 2016; Palou et al., 2019; Riso et al., 2019; López-Gil et al., 2020). However, this interaction can result in two different situations. For instance, a greater or lesser participation or PA practice is observed as a consequence of PF levels or the capacity to perform PA and exercise. In other words, a high level of PF could lead to a positive impulse that would generate a higher level of participation and practice of PA (Dollman et al., 2005; Schutte et al., 2016). On the other hand, scientific evidence also points out the level of PA practice as a predictor of the PF level (Dumith et al., 2011; Rauner et al., 2013;

Fang et al., 2017; Palou et al., 2019), being its relationship similar to the one described above. Given higher levels of PA practice, an increase in PF levels is expected. Conversely, lower levels of PF will also be observed in situations where the levels of PA practice are low. Despite the fact that the directionality of the relationship between PF and PA does not seem to be completely clear, PA appears to be significantly conditioned by the levels of PF present in schoolchildren at this age, with aspects such as aerobic and motor fitness playing a predominant role. Therefore, low PA could be an underlying cause of the observed decrease in PF in schoolchildren (Barnett et al., 2009; Aggio et al., 2012; Fang et al., 2017). In any case, the combined association and study of PA and PF is considered a determining factor for both, follow-up and the improvement of health at all ages, especially in the children and adolescent population (Ardoy et al., 2011; Rauner et al., 2013; Henriksson et al., 2016; Fang et al., 2017; Palou et al., 2019; Riso et al., 2019).

Moreover, the habits acquired at this age will be often reproduced in adulthood, and these factors could influence and explain the acquisition of occasional healthy life-style (Chacón-Cuberos et al., 2018b; Fernández-Bustos et al., 2019; Sierra-Díaz et al., 2019). Consequently, it is necessary to gain insight studying not only the level and relationship between PA and PF, but also the reasons why the balance leans in one direction or another toward the acquisition of whether active and healthy or harmful and inactive physical sports habits. Considering that at these ages most of the day is spent in the classrooms (Ahn et al., 2011), the educational centres become the ideal location where to investigate, with the physical education (PE) playing a preponderant role (Ahn et al., 2011; Trigueros et al., 2017; Chacón-Cuberos et al., 2019; Fernández-Bustos et al., 2019) as a consequence of the environment and contents developed within this subject (Sierra-Díaz et al., 2019). PE classes are an ideal context for the creation of adherence and healthy living habits promotion associated with PA practice beyond the classroom itself (Moreno et al., 2008, 2009; Ahn et al., 2011; Dudley et al., 2011; Gillison et al., 2013; Sierra-Díaz et al., 2019). However, in order to be sure of the impact and influence of the PA, it is necessary to consider its study under the perspective of the Self-Determination Theory (SDT) (Deci and Ryan, 1985; Chacón-Cuberos et al., 2018a,b; Sierra-Díaz et al., 2019; Zurita-Ortega et al., 2019). The SDT allows to explain the reasons leading an individual to start, continue or abandon the practice of PA within the study context (Deci and Ryan, 1985; Ryan and Deci, 2000; Dudley et al., 2011; Gillison et al., 2013). The SDT is regulated by the differentiation of three types of motivation depending on the self-determination degree: intrinsic motivation (IM), extrinsic motivation (EM), and de-motivation (DE) (Deci and Ryan, 1985; Ryan and Deci, 2000; Gillison et al., 2013; Sierra-Díaz et al., 2019). IM justifies the participation and performance of activities by personal and inherent issues as a result of the enjoyment, novelty, or satisfaction involved in performing PA itself within the PE classroom. IM is the most self-determined motivation. The EM is based on the premise that external or environmental factors exist as conditioning elements in the students' behavior and participation at this age within PE classes. Four types can be differentiated: integrated, identified, introjected, and external regulation, from highest to lowest self-determination level, respectively. Each of them is identified with different reasons and/or incentives to perform PA within the PE classroom. For integrated regulation (IR), the manifestation of a behavior would allow the integration of PA practice as another routine within those considered as mandatory for the school's daily life (Ferriz et al., 2015; Trigueros et al., 2017). This type of regulation is identified with the last previous step of recognizing the personal value that PA practice would have in this case, and is the most self-determined within EM (Deci and Ryan, 1985; Ryan and Deci, 2000; Gillison et al., 2013). On the other hand, within the educational field for PE, the most self-determined expressions of motivation are associated with greater PA practice outside the classroom, with the scientific literature pointing directly to IR as the most determining motivation when explaining the involvement or not of schoolchildren in extracurricular PA (Wilson et al., 2006; Ferriz et al., 2015; Trigueros et al., 2017).

Finally, DE is identified as the absence of any type of interest toward the realization of physical-sporting activity at these ages, within the context of the educational environment for the PE (Ryan and Deci, 2000; Moreno et al., 2009; Dudley et al., 2011; Gillison et al., 2013; Sierra-Díaz et al., 2019). Thanks to this precept, it is possible to identify the causes originating some preferential behaviors toward the practice of PE at these ages, as well as the possible influence and relationship on the active and healthy life habits acquired for this population outside the classroom (Deci and Ryan, 1985; Moreno et al., 2008, 2009; Dudley et al., 2011; Gillison et al., 2013; Castro-Sánchez et al., 2019; Sierra-Díaz et al., 2019; Zurita-Ortega et al., 2019).

In spite of the relationships that may exist between PA, PF and motivation, few studies have analyzed these factors simultaneously outside of the university educational context. Therefore, the main objectives of this study were to analyze: (a) the relationship between the level of PA practice and the level of physical fitness in PE students, and (b) the mediating role of IR on the relationship between PA and physical fitness in schoolchildren.

MATERIALS AND METHODS

Design and Participants

A descriptive and cross-sectional study design with non-probability-based sampling was used. The sample was selected using a sampling for convenience. A total of 325 healthy schoolchildren aged between 11 and 14 years old from five primary schools in the Region of Murcia (Spain) participated in the study. A balanced percentage distribution by gender was provided with a sample composed by male [n = 164 (50.5%)] and female [n = 161 (49.5%)] students. Age and anthropometric characteristics data, including BMI classification (Cole et al., 2000) are shown in **Table 1**.

Sample Size

The calculations to establish the sample size were performed using G*Power 3.1.9.4 software. The significance level was set at $\alpha = 0.05$. Accordingly, the sample size (power analysis) revealed

TABLE 1 | Sample descriptive data according to the gender.

	Total (n = 325) M ± SD	Boys (n = 164; % = 50.46) M ± SD	Girls (n = 161; % = 49.54) M ± SD	p	d
Age (years)	12.39 ± 1.03	12.51 ± 1.02	12.27 ± 1.03	0.063	0.112
Height (cm)	1.50 ± 0.08	1.49 ± 0.08	1.50 ± 0.08	0.131	−0.149
3rd percentile [%(n)]	16 (52)	32 (19.6)	20 (12.4)		
15th percentile [%(n)]	26.7 (87)	48 (29.4)	38 (23.6)		
Median [%(n)]	50 (162)	72 (43.6)	91 (56.5)		
85th percentile [%(n)]	6.1 (20)	10 (6.1)	10 (6.2)		
97th percentile [%(n)]	1.2 (4)	2 (1.2)	2 (1.2)		
Weight (Kg)	45.19 ± 14.27	43.56 ± 13.29	46.86 ± 15.06	0.021*	−0.168
Span (m)	1.51 ± 0.10	1.51 ± 0.10	1.52 ± 0.10	0.298	−0.116
BMI (kg/m^2)	19.92 ± 4.82	19.39 ± 4.43	20.45 ± 5.15	0.068	−0.117
Normal weight [%(n)]	71.69 (233)	73.17 (120)	70.19 (113)		
Over weight [%(n)]	18.77 (61)	18.29 (30)	19.25 (31)		
Obese [%(n)]	9.54 (31)	8.54 (14)	10.56 (17)		
Physical fitness					
CRF (mL/kg/min)	39.98 ± 5.38	40.94 ± 5.65	39.00 ± 4.92	<0.001**	0.232
Handgrip strength (kg)†	19.65 ± 19.24	20.24 ± 26.58	19.04 ± 5.43	0.113	−0.102
Relative Handgrip strength (kg/mass kg)†	0.43 ± 0.11	0.43 ± 0.11	0.42 ± 0.11	0.234	0.133
Standing Broad Jump (m)	1.28 ± 0.24	1.34 ± .24	1.23 ± 0.22	<0.001**	0.492
Standing Broad Jump (cm)	128.25 ± 23.69	133.85 ± 23.80	122.55 ± 22.11	<0.001**	0.492
Sit-ups (n total)	19.54 ± 5.55	20.20 ± 5.54	18.88 ± 5.51	0.032*	0.239
Shuttle run 5 × 10 m (s)	16.30 ± 1.64	15.92 ± 1.66	16.69 ± 1.52	<0.001**	−0.305
Sit and reach (cm)	14.89 ± 10.70	11.55 ± 9.70	18.28 ± 10.63	<0.001**	−0.350
PFGS	0.00 ± 2.35	−0.062 ± 2.37	0.063 ± 2.34	0.631	−0.053
Physical activity total score	2.97 ± 0.73	3.03 ± 0.77	2.91 ± 0.68	0.119	0.182
Integrated regulation	5.90 ± 1.11	5.90 ± 1.17	5.91 ± 1.06	0.756	0.019

*kg, kilograms; cm, centimeters; m, meters; BMI, body mass index; mL, milliliters; min, minute; CRF, cardiorespiratory fitness; PFGS, physical fitness global score; †, mean handgrip right and left; n, number; s, seconds; p = significance level; d = effect size (d Cohen); n, number; % percentage; **p < 0.01; *p < 0.05.*

that 306 participants would obtain a 95% power to significantly detect a correlation of $r = 0.30$ in the population (Østerås et al., 2017). In order to prevent possible dropouts or elimination of recorded data by detection of abnormal response, we decided to recruit a higher number of participants.

Measurements and Materials

Physical Activity and Perceived Locus of Causality

In order to provide an estimate of the MPA to VPA levels, all students completed the international *Physical Activity Questionnaire for Children* (PAQ-C) (Crocker et al., 1997; Voss et al., 2013) validated for children aged 8–14; using the validated Spanish version by Manchola-González et al. (2017). PAQ-C is a 7-day recall composed of nine items about the frequency of physical activities at school, at home, and during leisure time (Kowalski et al., 1997). It contains nine items rated on a five-point Likert scale, where each item is rated between 1 (low PA) and 5 (high PA). Once the values were obtained for each of the items that compose the questionnaire, a final score was computed (total PA) by calculating the average value obtained in the 9 items. The PA total score allows differentiating and classifying the schoolchildren as sedentary or active according to the data obtained with the PAQ-C tool. There are several possibilities within this classification, such as the one given by Chen et al. (2008), who assigned PAQ scores $\leq$2 as "low activity," >2 and $\leq$3 as "moderate activity" and >3 as "high activity." There are also several studies that subdivide the sample into "active" and "low active/non-active" youth, such as Ogunleye et al. (2012), who divided youth into "active" and "low active" based on the median distribution of PAQ scores by age and sex. Along the same lines, Cervantes et al. (2017) differentiated between active schoolchildren when scores were above 3, and sedentary schoolchildren with scores below 3. Finally, Benítez-Porres et al. (2016a) established a ranking and differentiation between active and non-active schoolchildren based on a cut-off point of PAQ-C > 2.75. As a consequence, in this study the consideration and classification of the schoolchildren as active or non-active was established according to a mean score of 3 (Cervantes et al., 2017). The questionnaire shows an internal consistency value with a Cronbach's alpha coefficient (α) of 0.83 and a good or excellent reliability value with an inter-class correlation coefficient (ICC) of >0.73 and a 95% confidence interval.

Similarly, students performed the *Perceived Locus of Causality Scale* (PLOC-2) (Ferriz et al., 2015). Through this questionnaire, the scores obtained by the schoolchildren for the different types of motivation established by the SDT within the PE

classes were recorded. The questionnaire arises as a consequence of the fusion of the Perceived Locus Causality Scale (PLOC) (Moreno et al., 2009) and the four items elaborated by Wilson et al. (2006) to measure IR. The scale is headed at the beginning by the phrase "I participate in PE classes...." It is composed of 6 factors and a total of 24 items distributed by four for each factor. The components of the scale are: IM (e.g., "because PE is fun"), IR (e.g., "because it's in line with my way of life"), identified regulation (e.g., "because I want to learn sports skills"), introjected regulation (e.g., "because I would feel bad about myself if I didn't"), external regulation (e.g., "because that's what I'm supposed to do"), and demotivation (e.g., "I really feel like I'm wasting my time in PE classes"). The instrument uses a Likert scale ranging from 1 to 7 where 1 is identified as disagreeing strongly and 7 as agreeing strongly. The reliability of the scale measured through Cronbach's alpha (α), obtained the following results by factors: α = 0.84 (IM); α = 0.93 (IR); α = 0.84 (identified regulation); α = 0.69 (introjected regulation); α = 0.69 (for external regulation) and α = 0.82 (demotivation). Confirmatory factor analysis showed the following adjustment rates: $\chi 2$ (235, N = 858) = 1147.31, $p < 0.001$, $\chi 2/gl$ = 4.88, CFI = 0.92; IFI = 0.92, TLI = 0.91, RMSEA = 0.065 (IC 90% = 0.063–0.071) and SRMR = 0.065. Finally, factorial weights ranged from 0.47 to 0.90.

Physical Fitness Assessment

Several studies analyzing the PF as predictor of PA (Jaakkola et al., 2015) or the use of muscle strength field-based test to identify risk in several diseases among adolescents (Castro-Piñero et al., 2019) used a battery of PF assessment in order to obtain scientific support and strong correlations between key factors related to the health status in young population. The level of physical fitness and the different components (core strength, lower and upper body strength, agility, balance, flexibility, and endurance) were assessed using the *Eurofit Physical Fitness Test Battery* (Gulías-González et al., 2014; Purohit et al., 2016). The protocols established by the guidelines for this test battery and the American College of Sports Medicine [ACSM], 2010 were followed to guarantee the safety of the participants. In addition, to ensure the successful performance in the Test Battery, all students were informed about the protocol to perform in the experimental sessions. A usual warm-up (mostly running and dynamic stretching exercises) during 7–8 min was carried out before physical testing. The better result of two attempts per hand (*handgrip test* and *5 × 10 m shuttle run*) and three attempts for *standing broad jump* and *sit and reach test* were recorded, while only one successful attempt was allowed for the *sit-ups test* and *20 m Shuttle Run*. All tests were conducted indoors (school gym) wearing comfortable sporting attire. Jumping and running tests were carried out on wooden non-slippery floor. The recovery time between attempts was set at 2 min, except for the 5 × 10 m shuttle run test, with a complete recovery between attempts. The raw scores obtained in each physical fitness test were transformed into standardized scores (z-scores) for the entire sample. Then, an overall physical fitness general score (PFGS) was calculated. The overall PFGS score was obtained by calculating the average of the z-scores obtained in each of the PF tests (Jaakkola et al., 2015; Østerås et al., 2017; Castro-Piñero et al., 2019).

Body composition characteristics measurement

The anthropometric measurements made for the determination of weight, height and span followed the standards established by the International Society for the Advancement of Kinanthropometry (ISAK) (Esparza-Ros et al., 2019). Body weight (kg), body mass index (BMI) and % body-fat were measured without shoes using a Bioelectrical impedance analysis device (BIA) (Tanita BC-545N–Body composition monitor to measure per segment) to the nearest 0.1 kg. The Height (cm) was measured using a stadiometer (Tanita HR001 Leicester portable height rod) to the nearest 0.1 cm. The span was measured (in meters) using an anthropometric wall tape (Lufkin L1025B) and metal standoffs. The requirements and clothing for these measures were established beforehand through the information provided in the dossier given to the PE teacher, as well as in the information letter provided to parents or legal tutors and the students themselves. It was established that students should come with comfortable sportswear (short-sleeved shirt and shorts), and their height and weight must be taken barefoot. The established protocol was performed in order to ensure an adequate data collecting process during all the tests.

Cardiorespiratory fitness (CRF)

A maximum incremental field test *(20-m endurance shuttle run test)* was performed in order to estimate the maximum volume of oxygen (MOC) consumed. The test involves running between two lines separated by 20 m while following the rhythm of acoustic signals. The initial speed was set at 8.5 km/h increasing by 0.5 km/h per minute (maximum of 18.0 km/h at 20th min). Subjects were instructed to run maintaining the pace, follow the straight running line and turn properly after completing each lap. Verbal encourage was provided to ensure a full-effort test. When the subject did not reach the end line twice following the acoustic signal or stopped completely due to the fatigue, the test was finished. Léger's et al. (1988) equations were used in order to transform the states to relative MOC values (López-Gil et al., 2020).

Upper and lower body strength

Upper body muscular strength was assessed using the *handgrip strength* by a hand dynamometer with adjustable grip (TKK 5101 Grip-D, Takei®, Tokyo EH101) recording the scores in kilograms (Kg). The reported precision of the dynamometer was 0.1 kg. A short demonstration and verbal signal were provided during the test and the grip was adjusted to the hand size. The hand span was measured in both hands from the tip of the thumb to the tip of the small finger with the hand wide opened as much as possible. Therefore, the optimal grip span was selected (boys and girls) following the recommendations by España-Romero et al. (2008). The minimum time required was set at 2 s (maximum at 5 s) and two attempts per hand were allowed. The analysis was performed using the averaged best scores reached by each hand. A normalization was calculated and expressed as kg/mass kg (Ruiz et al., 2011). The *sit-up test* measures abdominal muscles function as number of

sit-ups completed from lying position (knees bent at a 90°) in 30 s. The test was performed on floor mate and Casio handheld stopwatches (HS-80TW-1EF) were used for recording the time. Moreover, the *standing broad jump test* has been successfully used for measuring the lower limb explosive strength. Participants jumped horizontally from the starting line to achieve maximum distance (in cm). The test was performed three times and the best score was kept for further analysis. The test was performed in an indoor school gym in order to avoid falls caused by slipping and a classic anthropometric tape (Lufkin L1025B) of 5 m length and 3.4 cm wide was used for distance measuring.

Motor fitness and flexibility

Speed and agility were evaluated by the *5 × 10 m Shuttle test*. The participants were required to complete five repetitions of 10 m distance at the maximum possible speed between two lines placed at 5 m each other. The results were measured in seconds using Casio handheld stopwatches (HS-3V-1). Measuring tape and marker cones were used to perform the test. The best score of two attempts was used for further analysis (López-Gil et al., 2020). The *sit and reach* test was performed following specific instructions. Lower body flexibility was assessed while attempting to reach forward as far as possible keeping knees straight in a sitting position. Sit and reach box was used to record the distance reached by the hand in cm.

Procedures

Informed Consent and Previous Information

The following protocol was established to ensure similar data collection in all centres and throughout the whole process. Firstly, the schools were contacted, and a meeting with the directors was requested to inform them about the research purpose and to request their participation. After the acceptance, a meeting with the PE teachers was held. At this meeting, they were provided with all the necessary documentation and all doubts regarding the measurement protocol to be followed, instruments and tests to be carried out, were explained. In addition, the facilities and spaces available within the educational centre were visited and organized. Secondly, an adequate and similar schedule about the days and time slots was agreed. Prior to the intervention, all students and their parents or legal tutors were informed about the study characteristics as well as the possible benefits and potential risks. Subsequently, a consent form to voluntarily participate in the study was fulfilled and signed.

The study was conducted in accordance with the ethical principles of the Helsinki declaration for human research (World Medical and Association, 2013) and was approved by the institutional review board of the Catholic University San Antonio of Murcia (Code: CE031802).

Researchers visited the school in two different days (first and second phase), always at the same time of the day (10:30 am–02:30 pm), separate by at least 48 h and no more than 72 h and controlling the environmental conditions (space, temperature, and humidity). Thus, all tests were performed at the same location and time as well as with similar humidity (30–40%) and temperature (20–24°C) conditions.

Measures

Physical Activity Questionnaire for Children and PLOC-2 (approximately 30 min) were performed during the first phase (First session) by the participants. An investigator provided the questionnaires to the participants and informed them how to fill them in. In order to carry out the different questionnaires effectively, several research assistants explained the questionnaires and test protocols solving possible questions during the process. Once the questionnaires were completed, the body composition measurements and *handgrip strength test* were registered following the protocols detailed previously. In order to carry out the different tests, the participants were divided into two equal groups, making rotation (station 1: weight, height and span; and station 2: *handgrip strength test* – dynamometry). Each group was guided by a researcher who was responsible for explaining and controlling the performance of each test. The first phase was completed in 1 h.

In the second phase (second session), students performed the *5 × 10 m shuttle test*, *20 m shuttle run* (first post), *the sit-and-reach test, standing broad jump* and *sit-up test* (second post). The participants kept the division in equal groups, making rotations to conduct the tests correctly. The **Figure 1** shows the complete data collection process during all the tests in both phases.

Statistical Analysis

Means (M), standard deviations (SD), percentages (%) and frequencies were calculated using descriptive statistics. Data normality and homogeneity (Kolmogorov–Smirnov and Levene tests) were conducted prior further analysis. Data variables with different units and arithmetic scales were transformed on standardized scores (Z score). Subsequently, when differences between groups were observed, an independent sample *t*-test, Mann Whitney *U* test or Pearson's chi-squared test (χ^2) were used, depending on the assumption of normality. A *post-hoc* comparison for the 2xn tables was applied (statistic contingency coefficient); including statistic value and *p*-value. The maximum expected value was 0.703; showing a small association $r < 0.3$; the *r*-value of the moderate association was between 0.3 and 0.5 and the high association $r > 0.5$. Effect size was calculated by Cohen's *d* [0.2 (small); 0.5 (medium) and >0.8 (large) effect]. In addition, multiple regression analysis was performed to determinate relationship between variables. In all cases, data independence, absence of collinearity, normality and homoscedasticity were verified. The existence of relationship between these variables was measured by Rho (ρ) of Spearman and Pearson correlation coefficients, accordingly.

In order to assess whether the association between main variables, a multiple moderated mediation analysis was performed. The mediation analysis was performed using the PROCESS macro from SPSS (SPSS Inc., Chicago, IL, United States). The resampling procedure of 10,000 bootstrap samples was used for the non-parametric sample (Preacher and Hayes, 2008), while the classical method of stepwise regression by Baron and Kenny (1986) was used for the parametric sample.

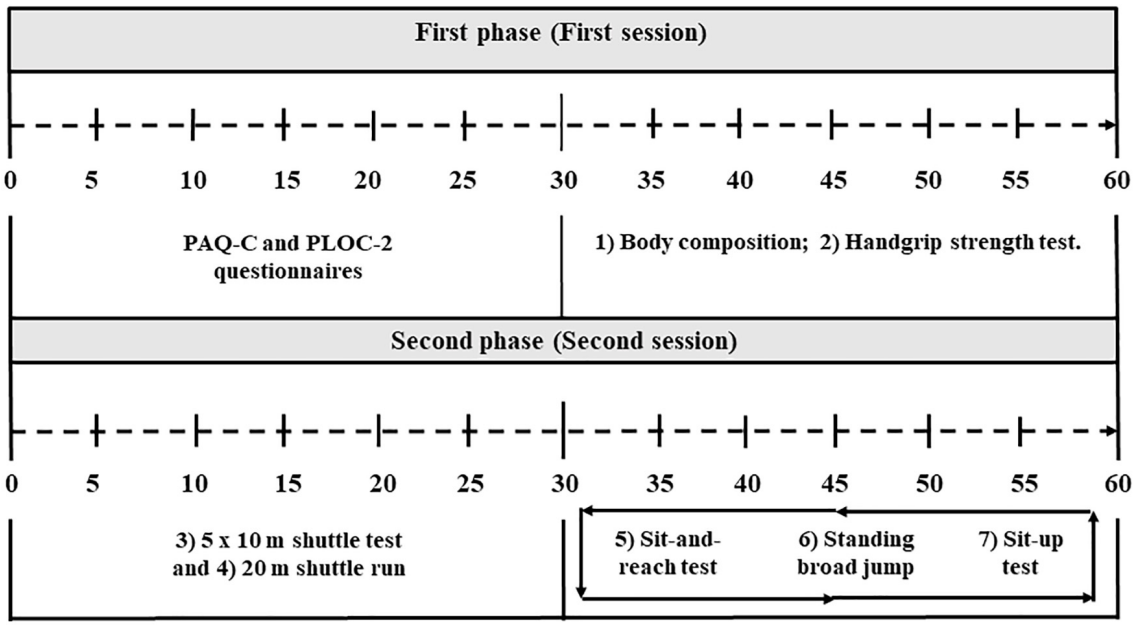

FIGURE 1 | Schematic representation of first phase (see text for full description).

Statistical significance of mediation effect was examined by test of Sobel (1982). When the z value was higher than 1.96 and p value was lower than 0.05 a mediating effect is admitted (Sobel, 1982; Preacher and Hayes, 2008).

Finally, a ROC (Receiver Operating Characteristics) curve analysis was performed to determinate the precise cut-off points of IR variable in the determination and classification of the study participants according to their classification (physically active or not). The classification accuracy for each set of cut-off points was evaluated by calculating weighted statistics, sensitivity, specificity and area under the receiver operating characteristic curve (AUC). An area of one represents a perfect rating, while an area of 0.5 represents an absence of rating accuracy. ROC-AUC values of >0.90 are considered excellent, 0.80–0.89 good, 0.70–0.79 fair, and <0.70 poor (Metz, 1978). Data analysis was performed using the software SPSS (IBM Corp., Armonk, NY, United States) for Windows, Version 24.0, as well as MedCalc 14.12.0 (Mariakerke, Belgium). The statistical significance level was set at 0.05 for all statistical comparisons.

RESULTS

The general and individual scores for each PFGS tests, as well as the PA level for both, overall level and according to gender are reported in **Table 1**. Concerning to the anthropometric characteristics, significant gender differences were only observed for the weight variable ($p = 0.021$, $d = -0.168$). Regarding the scores in the different PF tests according to gender, statistically significant differences were found for CRF ($p < 0.001$, $d = -0.232$), sit-ups ($p = 0.032$, $d = 0.239$), length jump ($p < 0.001$, $d = 0.492$), 5 × 10 m shuttle run test ($p < 0.001$, $d = -0.305$) and flexibility ($p < 0.001$, $d = -0.348$), finding higher values in girls compared to boys only for the last test.

Likewise, the anthropometric characteristics, as well as the individual scores for each PF tests according to the PA total score are shown in **Table 2**. For anthropometric characteristics, only differences in weight or BMI were obtained. In addition, we observed significant differences for the standing broad jump, sit-ups and shuttle run 5 × 10 m tests in the individual tests of the PF battery. According to the classification as sedentary or active schoolchildren, these differences were significant in the PFGS. Finally, there were also differences in the score for the IR. Specifically, the differences in individual PF tests and in the PFGS are displayed in **Figure 2**.

The different bivariate correlations according to the obtained score for the PF score index in relation to the IR and PA variables are presented in **Table 3**. Positive and statistically significant correlation was found between the PF score index and the PA level ($R = 0.174$, $p = 0.001$), the PF score index and IR ($R = 0.138$, $p = 0.003$) and between the predictor variables of PA level and IR ($R = 0.324$, $p < 0.001$).

The results (**Figure 3**) revealed that the PFGS was associated with the practice of PA ($R^2 = 0.03$, $F = 9.85$, $\beta = 0.173$, SE = 0.03, $t = 3.13$, $p = 0.001$, 95% CI = 0.035 to 0.150) and with IR ($R^2 = 0.051$, $F = 8.55$, $\beta = 0.15$, SE = 0.021, $t = 2.656$, $p < 0.008$, 95% CI = 0.014 to 0.095). In addition, the IR was associated with the practice of PA ($R^2 = 0.109$, $F = 39.13$, $\beta = 0.33$, SE = 0.081, $t = 6.25$, $p < 0.001$, 95% CI = 0.347 to 0.665).

The mediating effect of IR on the association between PA practice and PFGS was also analyzed. After including IR in the equation, the association between PA practice and PFGS remained significant, but its effect was reduced ($R^2 = 0.051$, $F = 8.55$, $\beta = 0.122$, SE = 0.128, $t = 2.11$, $p = 0.03$, 95%

TABLE 2 | Sample descriptive data according to the Physical Activity Total Score.

	Physical Activity Total Score (PAQ-C)					
	Sedentary		Active		*p*	*d*
	M	SD	M	SD		
Height (cm)	1.50	0.09	1.49	0.08	0.178	0.151
Weight (Kg)	46.56	14.62	43.39	12.88	0.043*	0.136
Span (m)	1.52	0.10	1.51	0.09	0.174	0.1000
BMI (kg/m^2)	20.31	4.74	19.36	4.55	0.048*	0.1333
Physical fitness						
CRF (mL/kg/min)	39.42	5.58	40.60	5.13	0.061	−0.121
Handgrip strength (kg)†	18.57	4.74	18.28	3.96	0.807	0.03
Relative Handgrip strength (kg/mass kg)†	0.45	4.74	0.44	3.96	0.641	0.03
Standing Long Jump (m)	1.25	0.24	1.32	0.23	0.007**	−0.301
Sit-ups (n total)	18.55	5.55	20.62	5.35	0.001**	−0.379
Shuttel run 5 × 10 m (s)	16.52	1.62	16.06	1.63	0.021*	0.149
Sit and reach (cm)	14.32	10.80	0.53	15.54	0.370	−0.059
PFGS	−0.31	2.45	0.34	2.20	0.013*	−0.280
Integrated regulation	5.59	1.23	6.27	0.82	<0.001**	0.336

kg, kilograms; cm, centimeters; m, meters; BMI, body mass index; mL, milliliters; min, minute; CRF, cardiorespiratory fitness; PFGS, physical fitness global score; †*, mean handgrip right and left; n, number; s, seconds, p = significance level; d = effect size (d Cohen); **p < 0.01; *p < 0.05.*

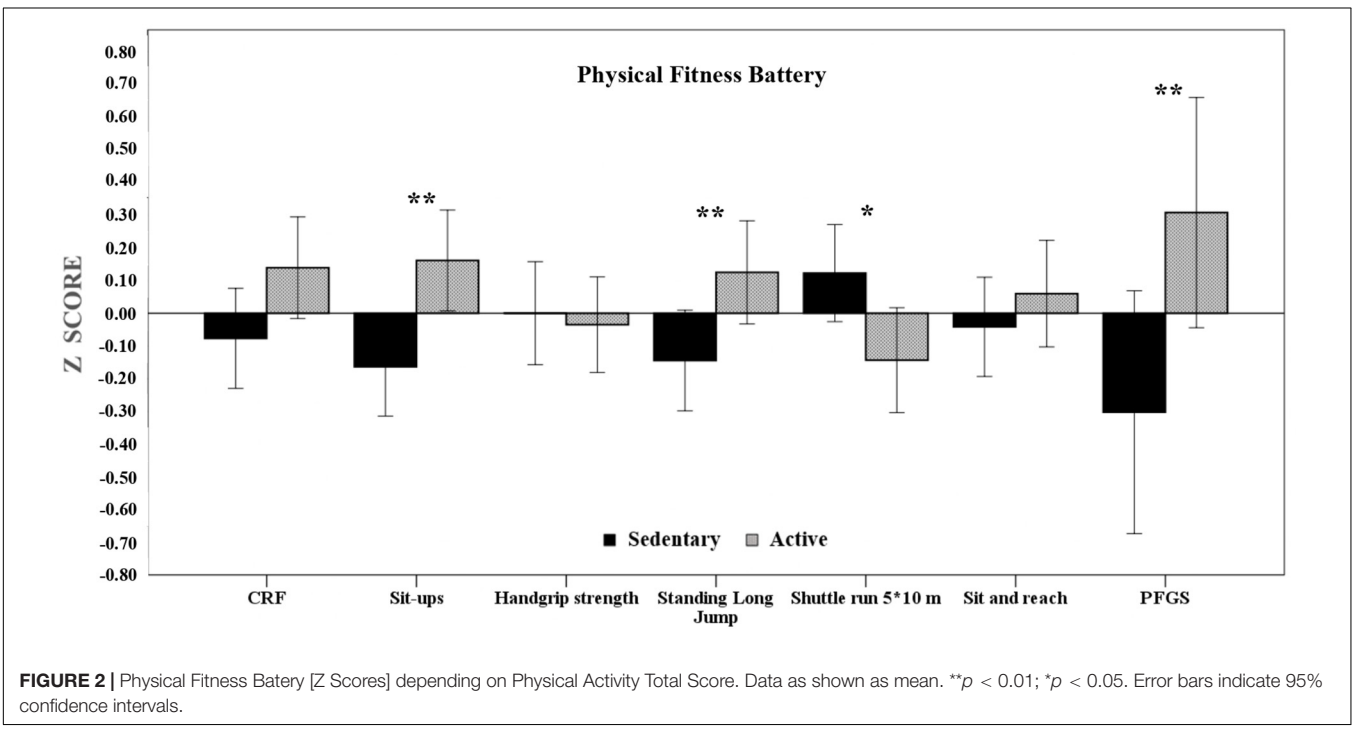

FIGURE 2 | Physical Fitness Batery [Z Scores] depending on Physical Activity Total Score. Data as shown as mean. **$p < 0.01$; *$p < 0.05$. Error bars indicate 95% confidence intervals.

CI = 0.004 to 0.128), suggesting that IR is a mediating variable with a partial effect. The analysis of mediation revealed both, a significant direct and indirect effect with a significant Sobel test value ($z = 2.44 \pm 0.01$, $p = 0.01$).

Area under the curve and the scores for the PAQ-C equivalent to the coordinates with the highest sum of sensitivity and specificity are shown in **Tables 4**, **5**. The AUC of the PAQ-C score for all cases, including male and female, was significant ($p < 0.05$) and moderate discriminator was observed only for male gender (AUC > 0.7) when comparing active and non-active children, while for all case studies and female gender alone it was a weak discriminator (AUC < 0.7).

The IR score cut-off from the ROC analysis was 5.88 for the whole group and one subgroup (girls), while for boys the cut-off point was 6.37 when discriminating between active and non-active children.

TABLE 3 | Bivariate correlations between Physical Fitness Index Score and the related variables of the study.

	1	2	3
1. Physical Fitness Index Score	1		
2. Physical Activity Total Score	0.174**	1	
3. Integrated Regulation	0.138**	0.324**	1

$^{**}p < 0.01$.

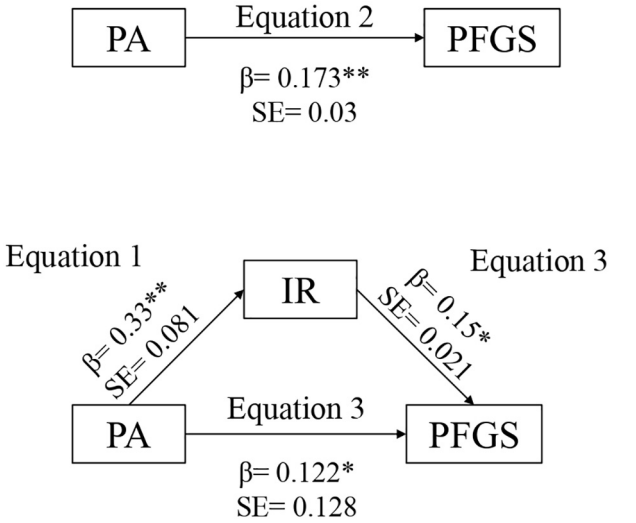

FIGURE 3 | Mediation of Physical Activity (PA) and Physical Fitness Global Score (PFGS) by Integrated Regulation (IR).

TABLE 4 | Area under the ROC curve of PAQ-C score based on integrated regulation (IR).

IR	PAQ-C score		
	Total (*n* = 325) Active	**Boys (*n* = 164) Active**	**Girls (*n* = 161) Active**
AUC	0.668	0.714	0.611
SE	0.030	0.041	0.045
95% CI	0.614 to 0.719	0.638 to 0.738	0.530 to 0.687
p	<0.001**	<0.001**	0.014*
Youden index	0.281	0.371	0.219

AUC, area under the curve; SE, standard error; CI, confidence interval; p, significance level; $^{**}p < 0.01$; $^{*}p < 0.05$.

Sensitivity was moderate for the different groups when considering a complete group (75.15%), or separated by gender (64.63% and 67.74% for boys and girls, respectively). However, for specificity, only one factor (boys) had a moderate-high score (75.5%), while for the whole group or girls alone showed moderate values (52.91% and 53.33%, respectively). Finally, the ability of the male gender to determine the differentiation between active or non-active was higher than the ability of the IR score for female gender and overall, as evidenced by the scores for positive and negative probability ratios on this factor compared to the others (girls alone and entire group). The same applies to positive and negative predictive values. ROC curves are shown in **Figure 4**.

DISCUSSION

In the present study we describe, compare and analyze the mediating role of IR on the relationship between the PA and PF level in school children between 11 and 14 years old. The results confirmed a positive association between PA and PF variables. In addition, the data allowed us to corroborate the IR role as a partial mediator of the established relationship between both variables. In addition, we established a cut-off point to discriminate between IR levels according to the classification (physically active or not) based on the PAQ-C scores by ROC curves analysis.

Firstly, concerning the anthropometric measures, significant differences when compared the schoolchildren gender and weight were observed (slightly higher +7.04% in girls). However, there were no significant differences in the BMI or any of the other anthropometric measures. These results are consistent with those previously reported by other studies (Jaakkola et al., 2015; Fang et al., 2017; Fernández-Bustos et al., 2019; López-Gil et al., 2020). Conversely, no significant differences were observed between genders when comparing PA levels, which is not in accordance with previous research studies where evidences of higher PA practice levels for boys were reported (Owen et al., 2009; Riddoch et al., 2009; Collings et al., 2013; Griffiths et al., 2013; Voss et al., 2017). However, several studies pointed out that such differences in the PA level could be due to significant differences in BMIs, as well as the results in measures of adiposity allowing for the identification and classification of schoolchildren with or without problems of hypertension or obesity (Riddoch et al., 2007, 2009; Owen et al., 2009; Ekelund et al., 2011; Niederer et al., 2012; Collings et al., 2013; Rauner et al., 2013; Jaakkola et al., 2015; Raistenskis et al., 2016; Wang et al., 2016; Fang et al., 2017; Fernández-Bustos et al., 2019). More precisely, those studies state that children who are obese or overweighted have a higher tendency to be physically less active (Ness et al., 2007; Rauner et al., 2013; Wang et al., 2016).

Our findings did not reveal any significant difference in the BMI by gender, which could justify the lack of differences in the PA levels in our sample. Furthermore, even if it seems evident that lower BMI levels could be associated with higher PA, the desire to lose weight in female students could be the trigger for inducing a more active behavior and, therefore, increased PA practice levels (Fernández-Bustos et al., 2019), explaining the lack of differences found in this study. The obtained scores in our research for PA practice levels are very similar to those found in previous research [e.g., PA total score = 2.97, PA score girls = 2.91, PA score boys = 3.03 in our study versus PA score total = 3.09, PA score girls = 3.11, PA score boys = 3.07 (Benítez-Porres et al., 2016b) or PA score total = 2.6 (Voss et al., 2017) or PA score girls = 2.7 and PA score boys = 2.9 (Voss et al., 2013)].

TABLE 5 | PAQ-C score cut-off points and sensitivity, specificity, likelihood ratios, and predictive values, based on integrated regulation (IR).

	Cut point	Sensitivity	95% CI	Specificity	95% CI	+LR	95% CI	−LR	95% CI	+PV	95% CI	−PV	95% CI
Total	>5.75	75.17	67.4–81.9	52.91	45.2–60.5	1.6	1.3–1.9	0.47	0.3–0.6	58	53.5–62.4	71.1	64.3–77.1
Boys	>6.25	64.63	53.3–74.9	72.5	61.4–81.9	2.35	1.6–3.5	0.49	0.4–0.7	70.7	62.0–78.1	66.7	59.2–73.4
Girls	>5.75	67.74	54.7–79.1	53.33	42.5–63.9	1.45	1.1–1.9	0.6	0.4–0.9	50	38.9–61.1	70.6	58.3–81.0

CI, confidence interval; LR, positive (+) and negative (–) likelihood ratios; PV, positive (+) and negative (–) predictive values.

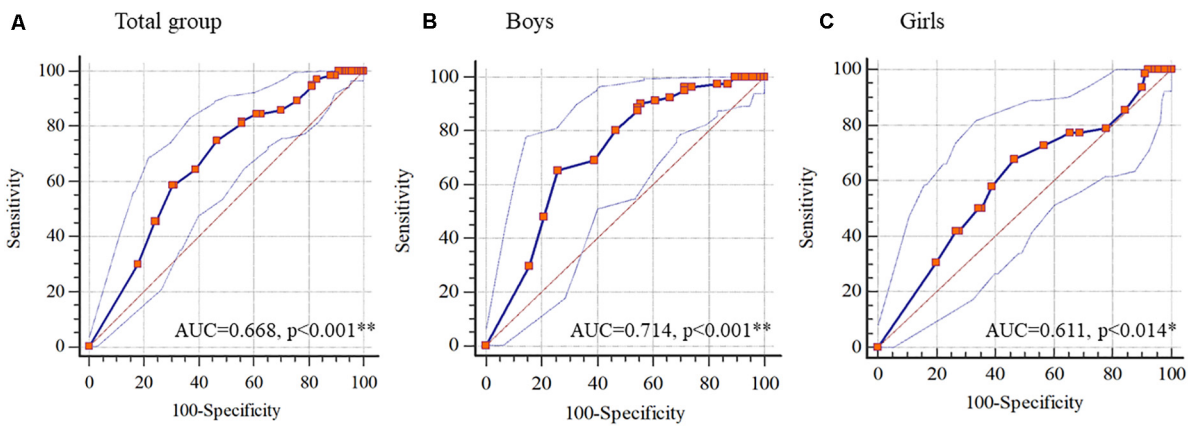

FIGURE 4 | Receiver-operator curves for the Integrated Regulation (IR) to identify PAQ-C's score of three group (**A**, Total group; **B**, Boys; and **C**, Girls). Data as shown as mean. $^{**}p < 0.01$; $^{*}p < 0.05$.

Moreover, significant differences were obtained when comparing the results for the different PF tests by gender. Specifically, boys achieved higher scores on the CRF, standing broad jump, sit-ups and 5 × 10 m shuttle run tests, while girls scored better on the sit and reach test. Although our findings are consistent to other studies (Schutte et al., 2016; Fang et al., 2017; Castro-Piñero et al., 2019; Lang et al., 2019). The interpretation of the score results should be carefully considered due to the lack of significant differences in the PA levels. Several scientific evidences highlighted an association between both factors, when higher PA practice levels are registered, an increase in PF levels is expected (Dollman et al., 2005; Dumith et al., 2011; Rauner et al., 2013; Schutte et al., 2016; Palou et al., 2019; Riso et al., 2019). The most plausible explanation for these differences by gender may be due to aspects of evolutive growth, which would allow boys to perform physical tests in a different way (Fang et al., 2017). Nevertheless, when the PFGS is considered, the gender difference was not observed, suggesting that our findings are in line with those found in the literature mentioned above. Concerning the individual results, the CRF test scores for both genders showed similarities with those identified as healthy indexes (35 and 42 ml /kg /m for girls and boys, respectively) in other studies (Lang et al., 2019). The results of the scores for lower and upper body muscle strength (mean scores) are similar to those obtained by Castro-Piñero et al. (2019) and by Segura-Jiménez et al. (2016), but there were no significant differences by gender in terms of upper limb strength levels, probably due to the different tools or the measurement period during the academic year used in each study. For PF, cardiorespiratory and muscular fitness are an important health marker associated with the risk of metabolic syndrome (Webber et al., 2008; Møller et al., 2009; Ahn et al., 2011; Welk et al., 2011; Rauner et al., 2013; Benítez-Porres et al., 2016a,b; Fang et al., 2017; Chacón-Cuberos et al., 2018b; Castro-Piñero et al., 2019; Lang et al., 2019; Zurita-Ortega et al., 2019) and, therefore, both measures and results are relevant for our research.

Taking into account the relationship between PA and PF, our results reveal both, a positive association between both factors and significant differences in the scores for the individual PF tests and the PFGS according to the classification and identification of the schoolchildren as physically active or not. Specifically, our results support the evidence that at any age, being physically active is synonymous of less difficulty and effort in facing physical tasks (Jaakkola et al., 2015). This could explain the increase in PF performance for physically active schoolchildren at both, at general and individual level (Rauner et al., 2013). Contrarily, lower levels of PF were observed in inverse situations (classification of schoolchildren as sedentary) (Dollman et al., 2005; Dumith et al., 2011; Rauner et al., 2013; Schutte et al., 2016; Wang et al., 2016; Palou et al., 2019; Riso et al., 2019). Regarding the FP test data at an individual level, there is a slightly positive trend identified with a better CRF score for physically active school children. But conversely to the results of previous studies, no statistically significant differences were observed (Ardoy et al., 2011; Cvejic et al., 2013; Rauner et al., 2013; Segura-Jiménez et al., 2016; Fang et al., 2017; Kolimechkov, 2017; Castro-Piñero et al., 2019).

The differing results could be explained by the fact that is that practice intensity has not been considered in the current study when measuring PA levels. In addition, there is some

controversy about using a self-reported questionnaire to measure and assess PA because it is considered an indirect and subjective measure at these ages that may lead to an overestimation of PA practice levels (Palou et al., 2019; Riso et al., 2019). There are several investigations supporting the reliability and validity of this PAQ-C instrument for collecting this information (Biddle et al., 2011; Benítez-Porres et al., 2016a; Wang et al., 2016; Voss et al., 2017; Hidding et al., 2018), and in addition, the Spanish adaptation obtained a high test-retest reliability (ICC = 0.96) and a Cronbach's Alpha coefficient of $\alpha = 0.76$, which allows us to state a satisfactory internal consistency (Benítez-Porres et al., 2016b). Riddoch et al. (2009) made two very important findings that could explain the discrepancies found in this research compared to the previous scientific literature. Thus, the reality of PA practice at these ages differs from adults or adolescents. A high percentage of schoolchildren do not comply with the minimum recommendations for MPA and VPA practice preestablished by the WHO. Furthermore, PA is rarely performed during prolonged periods and intensities providing a good cardiorespiratory condition, since their normal activity rhythms are mostly characterized by short periods of activity.

On the other hand, schoolchildren classified with a physically active profile obtained higher scores for FP tests related to agility (Shuttle run 5 × 10 m), abdominal strength-resistance (abdominals), lower body strength (Standing Broad Jump) and flexibility (Sit and reach), obtaining an overall index (PFGS). These data show clear significant differences depending on whether they are identified as physically active or not.

In summary, our research findings are in line with scientific evidence showing differences in PF level according to PA levels (Dollman et al., 2005; Ardoy et al., 2011; Dumith et al., 2011; Cvejic et al., 2013; Rauner et al., 2013; Schutte et al., 2016; Segura-Jiménez et al., 2016; Wang et al., 2016; Fang et al., 2017; Kolimechkov, 2017; Castro-Piñero et al., 2019; Palou et al., 2019; Riso et al., 2019). The differences observed between the PFGS score in this investigation and other studies could be due to the lack of unification (aspects to be considered in the PF assessment) since each study measures different tests and/or particular aspects (in some studies only aerobic fitness, muscle strength or both are measured). Ardoy et al. (2011) highlights the promotion of other PF components along with those mentioned above, such as flexibility and agility, since they are directly involved in improving PF. Finally, the significant differences found when comparing active and non-active school children for weight and BMI reinforce our findings and statements regarding the relationship between all these elements (Ness et al., 2007; Collings et al., 2013; Rauner et al., 2013; Henriksson et al., 2016; Palou et al., 2019).

At these ages, children spend a considerable amount of time in educational institutions (Ahn et al., 2011), where the PE subject could play an important role in generating and promoting healthy lifestyles beyond the classroom itself (Moreno et al., 2008, 2009; Ahn et al., 2011; Dudley et al., 2011; Gillison et al., 2013; Fernández-Bustos et al., 2019; Sierra-Díaz et al., 2019). Through the SDT it is possible to explain the impact and influence that PE has on schoolchildren. Accordingly, our results showed significant differences in the IR score when classifying the schoolchildren as physically active or not. Moreover, when the influence of IR on the relationship between PA and PF was tested, the IR partially mediated that relationship.

Integrated regulation is the first level within the ME, which is based on the premise that external or environmental factors exist as conditioning factors to explain behavior and participation at these ages in any activity (Ryan and Deci, 2000; Moreno et al., 2009; Dudley et al., 2011; Gillison et al., 2013; Sierra-Díaz et al., 2019). Within the classroom context, one of the main purposes for the PE teacher is to achieve a better knowledge and awareness among students about the benefits of the PA practice and adequate PF levels have for their current and future health (Moreno et al., 2008, 2009; Dudley et al., 2011; Gillison et al., 2013; Chacón-Cuberos et al., 2018b; Castro-Sánchez et al., 2019; Fernández-Bustos et al., 2019; Sierra-Díaz et al., 2019). In our research, the differences between physically active and non-active schoolchildren could be related to the identification and internalization of the benefits of the PA practice for health improvement.

Additionally, the higher the student's PF, the higher their motor skills are likely to be, which will provide feedback on this pattern of active and healthy behavior, due to the optimal experience in the motor learning and technical skills acquired at PE lessons (Sierra-Díaz et al., 2019). Moreover, if we compare physically active and non-active students, the first ones will be able to overcome the challenges with less difficulty and effort together with higher guarantees of success. This is a consequence of a higher PF level (Dollman et al., 2005; Dumith et al., 2011; Rauner et al., 2013; Schutte et al., 2016; Wang et al., 2016; Palou et al., 2019; Riso et al., 2019), which will give them greater enjoyment and satisfaction in practice (Dudley et al., 2011; Gillison et al., 2013; Chacón-Cuberos et al., 2019; Sierra-Díaz et al., 2019).

The major finding of this study was that IR could be used to discriminate between physically active or non-active schoolchildren both, on an overall assessment and differentiating by gender. The established cut-off points were 5.88 (total group and female subgroup alone) and 6.37 for boys. As far as we know, this is the first study defining these cut-off points based on IR. The AUC value (general group and girls) is close to 0.70, which could invalidate the results of the diagnostic test at the clinical level, given the potential repercussions of an erroneous classification related to the presence or absence of disease. However, both tests presented acceptable levels of specificity for such discrimination and classification (Metz, 1978). Additionally, the PLOC-2 measuring instrument that allows IR recording is not a clinical diagnostic test, and also, comparatively low or similar AUC values are continuously published within this context (Benítez-Porres et al., 2016a; Voss et al., 2017). Therefore, our results could be considered as suitable as a test for differentiating levels of IR according to this classification for schoolchildren.

Finally, even though the PAQ-C questionnaire has demonstrated its validity for recording PA levels (Biddle et al., 2011; Benítez-Porres et al., 2016a; Wang et al., 2016; Voss et al., 2017; Hidding et al., 2018), the results could be influenced by the measurement instrument, being a possible limitation of this study. For this reason, it would be interesting to support the

results already obtained by using better measuring instruments for a direct quantification of the PA levels. Further research is needed in order to corroborate the main findings.

CONCLUSION

To our knowledge, this is the first study that considers the mediating role of IR on the levels of PA and PF practice in school children. The findings of this novel study provide new information about the role of IR in PE classes as a supporting factor for the acquisition of not only healthy and active habits at these ages, but also for the improvement of PF levels. In addition, our findings establish a difference in the IR scores obtained by the schoolchildren according to their classification as physically active or not active, allowing us to establish cut-off points by ROC analysis. This analysis differentiates both the group of schoolchildren at a general level and by gender when classifying them according to the levels of PA practice. These cut-off points could be a useful and inexpensive way to assess the school population, in order to implement intervention strategies, especially in terms of structuring the content to be taught in the classroom. The aim is to improve motivation toward the teaching-learning process and, thus, increase the levels of PA and, consequently, improve the levels of PF.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article/**Supplementary Material**.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the University Ethics Committee of the Catholic University of Murcia (UCAM) reviewed and approved the research in accordance with the principles set out in the Declaration of Helsinki (Code: CE031802). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Written, informed consent was obtained from the individuals' legal guardian/next of kin for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

GG-G and NG-G conceptualized and designed the study and carried out the statistical analysis. FG-F, LM-A, and PM-P recruited the subjects. GG-G, NG-G, and AE-G collected the data. AE-G and FG-F organized the database. GG-G, NG-G, AE-G, PM-P, FG-F, and LM-A wrote the first manuscript draft. GG-G and LM-A developed the final manuscript draft, the English proofreading, and reviewed and edited the final version of the manuscript. All authors contributed to the manuscript revision and approved the definitive manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01910/full#supplementary-material

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Motivation, Discipline, and Academic Performance in Physical Education: A Holistic Approach From Achievement Goal and Self-Determination Theories

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The analysis of disciplined behaviors and academic performance in a school context has become one of the main concerns within the educational community. Physical Education is highlighted as a key subject to analyze students' behavior. Researchers and Physical Education teachers are interested on the motivational processes that predict positive student outcomes in order to support them. Thus, the main purpose was to determine a predictive model of disciplined behaviors and academic performance in Physical Education students. The Achievement Goal Theory and Self-Determination Theory acted as the theoretical framework. A total of 919 Spanish secondary school students participated in the study. The studied variables were task-oriented motivational climate, basic psychological needs, autonomous motivation, disciplined behavior, and academic performance. Data collection included Spanish validated questionnaires. The Mplus statistical program was used to perform a structural equation model of prediction. It included antecedents (task-oriented climate), motivational processes (basic psychological needs and autonomous motivation), and consequences (disciplined behavior, Physical Education and overall students' performance). The results revealed that positive outcomes (discipline and academic performance in Physical Education) were positively predicted by autonomous motivation; autonomous motivation was positively predicted by basic psychological needs and these, in addition, by the task-oriented climate. The results highlighted the importance of the task-oriented motivational climate and the mediating role of the basic psychological needs and autonomous motivation in order to generate these positive student outcomes in Physical Education. This study could be a useful resource for teachers, since it offers the motivational variables that lead students to achieve disciplined behaviors and academic performance in Physical Education. Intervention programs based on the results of the present study could be applied in Physical Education classes in order to obtain better behavioral as well as cognitive positive student outcomes.

Keywords: teacher climate, motivation, structural equations model, discipline, academic performance, Physical Education

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INTRODUCTION

The understanding of cognitive mechanisms related to students' discipline behaviors and academic performance has become the most worrisome aspect to secondary Physical Education (PE) teachers (Gutiérrez and López, 2012b). Thus, discipline in the school environment has become one of the main concerns of the educational community since it is a key indicator that the teaching–learning process is carried out successfully. The educational structure aims to promote prosocial behaviors in order to generate the most favorable conditions for the teaching–learning process that will allow the student to achieve an adequate performance (Barkoukis et al., 2014; Sánchez-Oliva et al., 2014).

Teaching strategies are essential to create an adequate classroom context that enables the implementation of planned tasks. In fact, teachers who promote a conducive environment for learning and engagement, in which students collaborate in its development, will achieve the learning objectives (Noltemeyer et al., 2019; Núñez and León, 2019). On the contrary, those teachers who do not encourage a classroom context with involved, autonomous, and participatory students will have more difficulties in achieving the planned teaching objectives (Granero-Gallegos et al., 2020a). Regarding the teacher's contribution to the disciplined behaviors promotion, the proper application of teaching skills and attitudes reduces disciplinary problems. Teaching skills in PE allow a better group control and give the teacher more time for corrections and provide feedback to students, increasing their participation, autonomy, and effectiveness in the classroom, and consequently academic achievement (Gutiérrez et al., 2009; Wade et al., 2020).

The relationship between teacher skills and student academic performance has been extensively studied (Taylor et al., 2014). Participative methodologies that focus the teaching–learning process on the student, positive corrections, and giving autonomy to students are associated with positive consequences (Gil-Arias et al., 2020), such as disciplined behaviors (Gutiérrez et al., 2010) and academic performance in PE (Cid et al., 2019). However, the very complex reality of PE lessons in secondary education sometimes forces the teacher to stop focusing on the students' academic performance to give priority to more controlled instructional approaches in order to avoid disruptive behaviors (Granero-Gallegos et al., 2020a).

Among the difficult conditions of the classroom context, student motivation is highlighted as a key variable when analyzing secondary school discipline behaviors and academic achievement (León et al., 2015; Rahimi and Karkami, 2015; Chik and Abdullah, 2018) but also in PE achievement (Gutiérrez and López, 2012b; Sevil et al., 2017). In this regard, research in the psychosocial field provides an appropriate framework to integrate learning skills with coexistence skills. Conflict, disruptive behavior, disobedience to teachers' instructions, and non-compliance with sanctions are phenomena closely linked to school amotivation (Vera and Moreno-Murcia, 2016; Anderson et al., 2019). Thus, this research is based on the Achievement Goal Theory (AGT) (Nicholls, 1984) and the Self-Determination Theory (SDT) (Ryan and Deci, 2020) as the framework that allows to explain and predict how the PE students' behavior can be regulated (Vasconcellos et al., 2019).

The interpretation that people are intentional organisms, directed by certain objectives and acting rationally in accordance with them, is the fundamental idea of the AGT (Nicholls, 1984). In achievement contexts, beliefs consistently guide behavior. This theory assumes that the greatest point of interest for individuals in performance contexts such as PE lies in demonstrating competence and ability. Thus, the motivational climate transmitted by the teacher through the structuring and teaching pathway of PE classes may be a task-oriented motivational climate, where skill judgment is based on the level of task mastery being achieved (striving to improve), or an ego-oriented motivational climate, where social comparison between students is promoted, understanding success when they show greater skill than others (Wallhead et al., 2013).

On the other hand, the SDT has been one of the theoretical models that have contributed the most to a better understanding of the cognitive, emotional, and behavioral patterns related to student progress (Ryan and Deci, 2020), especially in PE (Van Den Berghe et al., 2014; Vasconcellos et al., 2019). According to this theory, the origin of motivation can be more internal or external for the student (more or less self-determined) depending on if they are freely engage in their activities (Ryan and Deci, 2017). Specifically, SDT distinguishes between different dimensions of motivation (autonomous, controlled, and amotivation). Autonomous motivation is the most self-determined one and involves the behavior regulation with the experiences of volition, psychological freedom, and reflective self-endorsement (Aelterman et al., 2012). Studies developed in secondary school PE students have linked the more self-determined motivation to positive and adaptive outcomes at affective (e.g., well-being) (Standage et al., 2012), cognitive (e.g., academic achievement) (Ntoumanis and Standage, 2009), and behavioral levels (e.g., discipline) (Moreno-Murcia et al., 2011; Zimmerman and Kitsantas, 2014). Within the SDT, three basic psychological needs (BPNs) lead to self-determined behaviors (Ryan and Deci, 2017). The BPN of autonomy is satisfied when the students have the initiative in their behavior and the opportunity to choose; the BPN of competence is linked to the effective interaction with the environment, while the BPN of relatedness is related to positive interactions and group membership. Previous research has demonstrated the positive predictive capacity of BPNs on autonomous motivation in PE (Koka, 2014; Sánchez-Oliva et al., 2014; Ferriz et al., 2016; Van Den Berghe et al., 2016).

Complementary to the SDT, the Hierarchical Model of Motivation (Vallerand and Ratelle, 2002; Vallerand, 2007) was created in order to improve and relate the constructs of the SDT and originated the integral analysis of motivational and cognitive processes (McCarthy, 2011). The Hierarchical Model of Motivation explains the determinants of motivation processes and its consequences, becoming the main theory to explain motivation in the PE, sport, and exercise field (Clancy et al., 2016). In this way, the motivational climate that the teacher promotes in PE lessons constitutes one of the fundamental elements influencing the satisfaction of BPNs, acting as mediators

between social factors and the self-determined type of regulation experienced by students (Tessier et al., 2010). According to previous research, SDT and AGT could be integrated in order to achieve a better motivational process understanding and its positive consequences (Duda, 2013). Furthermore, in a PE context, the teacher encourages a motivational climate, characterized by a variety of challenging tasks at the personal level, where cooperation is necessary to achieve a common goal, and where the students can have their own initiative, covering their BPNs. This will lead to a more self-determined motivation, having positive affective, cognitive, and behavioral consequences (Cox and Williams, 2008; Abós et al., 2017).

Previous research on the teaching of PE has been limited by the analysis of antecedents, motivational processes, and consequences in an isolated manner (Cid et al., 2019). Although the discipline has been a well-studied construct in the general educational context (Zimmerman and Kitsantas, 2014), studies in the field of PE are less abundant. Research has pointed out that the perception of a task-oriented classroom environment was positively related to self-determined reasons to maintain disciplined behavior. It was also associated with the student's perception, mainly related to strategies based on responsibility and intrinsic reasons that the teacher used to maintain discipline (Spray and Wang, 2001; Gutiérrez and López, 2012a; Granero-Gallegos et al., 2020b). The study conducted by Spray and Wang (2001) in a group of English students reported that those who had a higher feeling of competence in PE expressed more self-determined reasons for maintaining and adequate behavior during the sessions. On the other hand, Moreno et al. (2011) analyzed a sample of Spanish secondary school students, determining that intrinsic motivation was positively related to the three BPNs, as well as with the discipline behavior. Other studies analyzed students' discipline and self-regulation measures as a predictor of academic performance and did not only analyze the disciplined behavior as a consequence (Zimmerman and Kitsantas, 2014).

Academic performance at school, measured as the final score of the student (Sternberg, 2015), has been traditionally studied and explained by individual variables, mainly intellectual, but also by personality and contextual factors. Some authors state that the cognitive variables are the most important for predicting academic achievement and explaining most of the phenomena (Poropat, 2011). However, other authors support that the study of contextual and personality variables provides a better and more complete explanation of academic performance. In a recent study, Baños et al. (2020) presented a predictive model of academic performance based on the individual's satisfaction. Student motivation is shown as a relevant variable because motivation is related to the learning goals that students have, which, in turn, evoke different mental situations in students, resulting in them having a positive or negative attitude toward study. This determines the effort invested to achieve learning and academic performance. A meta-analysis presented by Taylor et al. (2014) highlighted the role of motivation on school achievement. They also found that self-determined motivation was associated with higher academic performance. In PE, academic performance and metacognitive skills have been predicted by motivational variables in previous research (Chatzipanteli et al., 2015; Kirby et al., 2015; Sevil et al., 2017). In a longitudinal study, Barkoukis et al. (2014) indicated that a more self-determined motivation obtained higher academic performance in PE and, in addition, a less self-determined motivation explained lower qualifications.

Finally, several studies demonstrated the association between academic performance and disciplined behaviors in a high school context (Zimmerman and Kitsantas, 2014; Noltemeyer et al., 2019), but scientific research testing predictive models of both disciplined behavior and academic achievement in PE (Gutiérrez and López, 2012b) is limited. To our knowledge, these studies do not integrate AGT and SDT constructs. At this point, and given the relevance of motivational variables to regulate behavioral and cognitive outcomes of students in PE, the aim of this study was to determine a predictive model of disciplined behaviors and academic performance (overall and specific) in PE secondary school. We hypothesized that (1) task-oriented climate will predict autonomous motivation through the BPNs (Cox and Williams, 2008) and that (2) autonomous motivation will predict disciplined behaviors (Spray and Wang, 2001) and (3) academic performance (Cid et al., 2019).

MATERIALS AND METHODS

Design and Participants

A cross-sectional study design with on-probability-based sampling was used. The sample consisted of 919 secondary school students, from 10 educational centers from two regions in Spain, aged between 12 and 18 years old (M = 14.63; SD = 1.54). The sample was composed of students from both genders, male (n = 433, M_{age} = 14.62, SD_{age} = 1.61) and female (n = 486, M_{age} = 14.64, SD_{age} = 1.49). In order to represent the different characteristics of the population, 42 classes (clusters) were randomly selected. Each cluster consisted of a group of approximately 21 students.

Measurements

The Spanish version (Cervelló et al., 2010) of the Learning and Performance Orientation in PE Classes Questionnaire (Papaioannou, 1994) was used to measure task-oriented motivational climate in PE classes, as in previous research (Gil-Arias et al., 2020). The questionnaire begins with the sentence "In my PE classes. . ." and the factor is composed of 13 items (e.g., "The PE teacher is most satisfied when all the students learn something new" or "I am very satisfied when I learn new skills and games"). The factor reported a McDonald's Omega of 0.86. Confirmatory factor analysis showed adequate adjustment indexes: χ^2 = 749.90; $p < 0.001$; χ^2/df = 2.44, CFI = 0.93, TLI = 0.92, RMSEA = 0.04, SRMR = 0.07.

The Spanish version (Moreno-Murcia et al., 2008b) of the BPNs in the Exercise Scale (Vlachopoulos and Michailidou, 2006) was applied to measure BPNs in the PE context, as in previous research (Jiménez et al., 2015). The questionnaire begins with the initial question "In my PE classes. . ." and it is composed of a total of 12 items, of which four measured autonomy (e.g., "The way I conduct classes is an expression of myself"), four related

to competence (e.g., "I am able to manage the demands of a PE class"), and the other four measured the relatedness factor (e.g., "I interact in a very friendly way with the rest of the class"). Each factor reported a McDonald's Omega of 0.81, 0.81, and 0.91, respectively. Confirmatory factor analysis showed adequate adjustment indexes: $\chi^2 = 168.172$; $p < 0.001$; $\chi^2/df = 3.36$, CFI = 0.96, TLI = 0.95, RMSEA = 0.05, SRMR 0.05.

The Spanish version (Moreno-Murcia et al., 2009) of the Perceived Locus of Causality Scale (Goudas et al., 1994) was used to measure autonomous motivation in PE, as in previous research (Ferriz et al., 2016). The questionnaire begins with the question "I participate in the PE classes. . ." and the factor is composed of eight items (e.g., "because PE is stimulating"). Autonomous motivation was calculated through intrinsic regulation (e.g., "because I enjoy learning new skills") and identified regulation (e.g., "because I can learn skills that could be used in other areas of my life") (Haerens et al., 2010). The factor reported a McDonald's Omega of 0.97. Confirmatory factor analysis showed adequate adjustment indexes: $\chi^2 = 452.908$; $p < 0.001$; $\chi^2/df = 2.96$, CFI = 0.95, TLI = 0.94, RMSEA = 0.05, SRMR = 0.07.

The Spanish version (Cervelló et al., 2004) of the Discipline and Indiscipline Behavior in PE Inventory was used to measure discipline behaviors in PE classes, as in previous research (Gutiérrez and López, 2012b). The questionnaire begins with the statement "In my PE classes. . ." and the factor consists of 10 items (e.g., "you address yourself with respect to the teacher"). The factor reported a McDonald's Omega value of 0.87. Confirmatory factor analysis showed adequate adjustment indexes: $\chi^2 = 399.68$; $p < 0.001$; $\chi^2/df = 2.42$, CFI = 0.99, TLI = 0.99, RMSEA = 0.04, SRMR = 0.04.

All the instruments were anchored on a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

PE academic performance and *Overall academic performace* were measured through a single item that reported the qualifications in the previous evaluation in PE and the rest of the subjects, respectively. This type of measure has been used in previous research (Baños et al., 2020).

Procedures

The research was fully approved by the Ethics Committee of the local University following the guidelines of the Helsinki Declaration. In order to carry out the research, PE teachers and directors of the secondary schools were contacted. All students and their parents or legal tutors were informed about the study, which was anonymous. Subsequently, they signed a consent form to voluntarily participate in the study. Data collection occurred directly in the PE classes. An investigator provided questionnaires to the participants and informed them about how to fill them in, solving the questions that might appear during the process, ensuring an adequate concentration climate and avoiding the presence of the PE teacher. The estimated time to complete the instruments was 15 min.

Statistical Analysis

Data analysis was performed using the statistical programs IBM SPSS Statistics 25.0 (IBM Corp, 2017) and MPlus 7.4 (Muthén and Muthén, 2012). The psychometric properties of the questionnaires were calculated, including an initial exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to test the instruments' factor structure. The reliability of the study measurements was analyzed through McDonald's Omega because Cronbach's Alpha requires equal loads for all items in the same factor (Zhang and Yuan, 2016) and also that the numerical data should be continuous. Moreover, McDonald's Omega has shown evidence of better accuracy to Likert-type ranging responses and values above 0.70–0.80 implying reliable measures (Revelle and Zinbarg, 2009).

The structural equation model (SEM) proposed was analyzed with the aim of testing the association between the study variables. The indicators of the latent variables in the SEM were the items of the different scales. To estimate the value of the parameters and the adjustment indexes in both CFA and SEM, robust maximum likelihood (MLR) estimation method was employed due to the Likert nature of the items. Model adjustment was assessed with a combination of the χ^2/df test (<5) and the adjustment indexes (Kline, 2011). The *P*-value was established at level 0.05. A comparative adjustment index (CFI) and Tucker–Lewis index (TLI) close to or above 0.90 together with a root mean square error of approximation value close to or below 0.06 and the standard root mean square residual (SRMR) close to or below 0.08, respectively, were considered indicative of an acceptable model fit (Hu and Bentler, 1999).

RESULTS

Preliminary Analyses

Descriptive statistics, correlation matrix, means and standard deviations of all major variables, as well as Pearson's correlations among the study variables are shown in **Table 1**. Results revealed a positive and significant relationship between task-oriented climate, the three BPNs, autonomous motivation, and disciplined behavior. Academic performance in PE was significantly positively associated with task-oriented climate, the three BPNs, and discipline, while overall academic performance was significantly positively associated with relatedness and PE academic performance.

Structural Equation Modeling

A complete structural regression model was presented to test the study hypothesis, including antecedents (task climate), predicting BPNs (which in turn will predict motivational process), and, thereafter, the consequences (discipline, PE academic performance, and overall academic performance). The model shows adequate adjustment indexes: $\chi^2 = 2464.38$; $p \leq 0.001$; $\chi^2/df = 2.56$, CFI = 0.90, TLI = 0.90, SRMR = 0.07, and RMSEA = 0.04. The model explained 46% of the variance in discipline, 2% in PE academic performance, and 1% in overall academic performance.

Figure 1, which shows the latent variables, illustrates that the task climate has a positive effect on BPNs (autonomy $\beta = 0.73$, $p < 0.001$; competence $\beta = 0.91$, $p < 0.001$; and relatedness $\beta = 0.60$, $p < 0.001$). BPNs have a positive effect on autonomous

TABLE 1 | Descriptive analyses, values, and correlations.

	M	*SD*	1	2	3	4	5	6	7
(1) Task climate	4.09	0.65							
(2) BPN autonomy	3.19	0.84	0.52**						
(3) BPN competence	3.79	0.82	0.49**	0.58**					
(4) BPN relatedness	4.18	0.84	0.42**	0.47**	0.50**				
(5) Autonomous motivation	3.82	0.92	0.67**	0.55**	0.61**	0.43**			
(6) Discipline	4.26	0.59	0.63**	0.42**	0.48**	0.50**	0.50**		
(7) PE performance	3.72	1.07	0.13*	0.12*	0.28*	0.27**	0.08	0.26**	
(8) Academic performance	3.65	1.02	0.10	−0.01	0.03	0.15**	−0.04	0.24**	0.63**

**Correlation is significant at 0.05 level; **Correlation is significant at 0.01 level. BPN, basic psychological need; PE, Physical Education.*

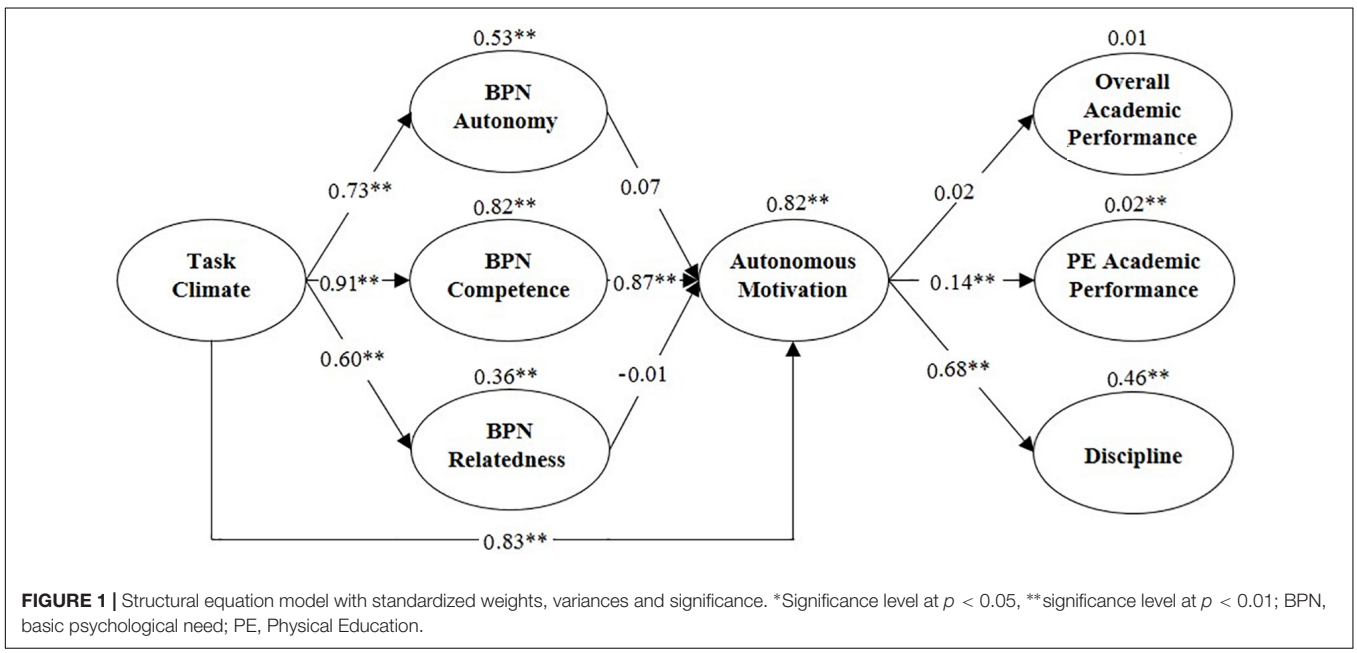

FIGURE 1 | Structural equation model with standardized weights, variances and significance. *Significance level at $p < 0.05$, **significance level at $p < 0.01$; BPN, basic psychological need; PE, Physical Education.

motivation (autonomy β = 0.07, $p = 0.77$; competence β = 0.86, $p < 0.001$; relatedness β = −0.01, $p = 0.85$). Autonomous motivation has a positive effect on PE academic performance (β = 0.14, $p < 0.001$) and discipline (β = 0.68, $p < 0.001$), but with no effect on overall academic performance (β = 0.02, $p = 0.32$). Moreover, there is an indirect effect of basic task climate and autonomous motivation, mediated by the three BPNs (β = 0.83, $p < 0.001$).

DISCUSSION

The aim of this study was to determine a predictive model of disciplined behaviors and academic performance in PE secondary school, integrating AGT and SDT constructs. A SEM was tested in order to determine the hypothesis of the study. The results showed the relevance of task-oriented climate and the mediating role of BPNs and autonomous motivation to predict students' disciplined behavior and PE academic performance. The study could support PE teachers' interventions in order to achieve student adaptative consequences.

The first hypothesis, stating that *task climate will predict autonomous motivation through the basic psychological needs*, was confirmed by the results. The task-oriented climate predicted BPNs, which, in turn, predicted autonomous motivation. Our findings are consistent with previous research integrating AGT and SDT frameworks, evidencing the relationship between motivational climate and student motivation (Braithwaite et al., 2011; Duda, 2013; Cid et al., 2019). As an example, Standage et al. (2006) found a positive relationship between the motivational climate involving the task and self-determined motivation (intrinsic). In a predictive study, Gutiérrez et al. (2010) examined the relationship among pupils' perceptions of the motivational climate, and pupils' intrinsic motivation in PE in a sample of 2189 Spanish adolescents, aged between 13 and 17 years. They tested a SEM, and the most important predictors of pupils' intrinsic motivation were the perceived mastery climate. In the same line, Baena-Extremera et al. (2015) and Jaakkola et al. (2017) tested other SEMs and also task-oriented climate predicted self-determined motivation. In addition, a motivational climate intervention has produced changes in students' self−determined motivation in school PE classes (Bortoli et al., 2017). In a

recent study, Cecchini et al. (2020) proposed an intervention throughout an academic year in PE to encourage a task-oriented climate, in which an increase in self-regulated forms of motivation was found.

Basic psychological needs are considered to modulate the effects of socio-contextual factors (e.g., PE teacher attitude) on the students' self-determined motivation (Vasconcellos et al., 2019; Ryan and Deci, 2020). In a previous study involving 155 high school students, Moreno et al. (2011) stated that task-oriented climate was positively and significantly associated with the three BPNs, as in the present study. In the same line, the work developed by Kirby et al. (2015) showed that the style and the intervention of the teacher in the PE classes determined the satisfaction of the three BPNs. Another example was the intervention study conducted by Abós et al. (2017) in which the experimental group reported significant improvements on the three BPNs through an acrosport teaching unit based on developing a task-oriented motivational climate. Similarly, Bechter et al. (2019) demonstrated the positive effects of a teacher training-based program on student-centered learning intervention on BPNs in 554 Australian PE students. Following the same line, Gil-Arias et al. (2020) compared a student-centered intervention to a traditional teacher-centered one using AGT and SDT as a framework to explain how the social–contextual factors surrounding one teacher's employment of these two pedagogical approaches influenced students' motivation levels. They found that student-centered learning context improves the BPNs as in the present study, where the task-oriented climate improved the BPNs satisfaction of autonomy, competence, and relatedness.

However, despite the fact that many studies highlighted the role of classroom climates in catalyzing a higher student autonomous motivation and the modulating effect of BPNs on student autonomous motivation (Braithwaite et al., 2011; Duda, 2013; Vasconcellos et al., 2019), only some of them analyzed the task-oriented motivational climate as an antecedent of the motivational process in PE, including the mediating role of BPNs (Cox and Williams, 2008; Sevil et al., 2016; Abós et al., 2018). An intervention program based on task-oriented climate was applied by Sevil et al. (2016), and they found that a student-centered learning context enhances BPNs of autonomy and competence, as well as students' intrinsic motivation. Moreover, Cox and Williams (2008) tested structural equation modeling, showing that competence, autonomy, and relatedness satisfaction mediated the relationship between teacher climate and self-determined motivation as well as in our current study. However, in the study by Cox and Williams (2008), the BPN of satisfaction significantly and positively predicted the self-determined motivation, while in the present study, only competence acted as a significant predictor of autonomous motivation. These results are also in line with those of Sevil et al. (2016) in that the BPN of competence significantly increased after an intervention program. As competence satisfaction refers to the people's need to believe that they are effective in a specific situation context, and based on the obtained results, teachers should prioritize its support by using positive feedback, questioning and adapting the tasks to the student developmental needs and competence level (Abós et al., 2018).

In summary, the developed studies in PE (as well as in sport context) reveal the importance of the task-oriented climate and the role of BPNs in the emergence of more self-determined forms of motivation (Aelterman et al., 2013). Teacher intervention should have a strong influence on the BPNs and consequently on the students' autonomous motivation. Thus, the PE teacher must involve students in decision-making in the process of organizing and directing the sessions, favoring their autonomy and leadership; success must be defined and evaluated in terms of effort and personal progress; mistakes should be part of the teaching–learning process; participation and commitment to the proposed activities should be emphasized; the tasks set must be varied and adjusted to the level of competence of the students; a wide range of teaching styles should be employed (cognitive, creative, socializing, individualizing, and participatory teaching styles); different strategies for grouping students, as well as a private evaluation, meaningful and relative to personal progress and mastery of the task, should be used (Moreno et al., 2011; Bortoli et al., 2017; Cecchini et al., 2020).

The second hypothesis stated that *autonomous motivation will positively predict disciplined behaviors*. The results of the study confirmed the second hypothesis. Autonomous motivation positively predicted disciplined behaviors. Our findings are in line with previous research that demonstrated the predictive capacity of self-determined motivation on prosocial behaviors (Hodge and Lonsdale, 2011; Adie et al., 2012; Sánchez-Oliva et al., 2014). Based on SDT, Sánchez-Oliva et al. (2014) tested a complete model of structural regression in PE students by analyzing antecedents, motivational process, and positive disciplined behaviors. The results showed how BPNs support predicted student autonomous motivation through the BPNs satisfaction, and the self-determined motivation predicted positive discipline behaviors in PE (respect, self-control, cooperation, and tolerance). The role of the teacher should be based on the establishment of different sets of strategies aimed at increasing the students' confidence, being able to contribute to the teaching–learning process with a number of positive aspects. Among these aspects, the participation in the tasks by the students with an optimal level of self-esteem, the development of a proactive attitude, the promotion of the capacity for teamwork, and the perception of having less fear for making mistakes among the rest of colleagues are worth mentioning. All these aspects will lead to a greater feeling of union and belonging among the students, as well as the perception of a task-oriented motivational climate that will incite the students to have a positive predisposition toward the learning tasks, leading to disciplined behaviors (Tessier et al., 2010; Sánchez-Oliva et al., 2015).

Most of the research on disciplined behaviors has been based on AGT, finding a strong relationship between students' perception of a motivational climate involving the task and discipline in PE (Spray, 2002; Cervelló et al., 2004; Moreno et al., 2011). The study developed by Vera and Moreno-Murcia (2016) revealed that students with motivational profiles oriented to the task showed more self-determined reasons to be disciplined. Similarly, Martínez-Galindo et al. (2012) showed that the strategies based on the teacher's responsibility and intrinsic reasons to maintain discipline were related to the perception

of a task-oriented motivational climate and with the students' disposition to be disciplined. Task-oriented motivational climate also predicted the student identified and intrinsic reasons for being disciplined. Similarly, Moreno-Murcia et al. (2008a) found that task-oriented students perceived the strategies used by the teacher to maintain discipline in the classroom based on cooperation with others and responsibility in their own behavior, resulting in an increased self-determined motivation. The authors pointed out the importance of creating learning-oriented classroom environments because it also guided students toward a positive discipline, due to the high predictive capacity that this type of climate has shown in the tested model. Likewise, teachers must transmit implicit and explicit keys oriented toward effort, personal improvement, and acquisition of skills, which will lead to an increase in self-determined motivation. As a consequence, students will show more disciplined behavior (Adie et al., 2012).

In PE school context, disciplined behaviors have been approached from different motivational theories in an isolated manner (AGT or SDT). There are few studies that have been carried out integrating the constructs of the AGT and the SDT. We could find only one study where both constructs are integrated (Moreno et al., 2011), but they observed that the motivational climate was the main predictor of the discipline, rather than autonomous motivation in a regression analysis. This is why the present study represents an improvement when evaluating how the classroom climate predicts disciplined behaviors of the students, mediated by the autonomous motivational processes of the students in a complete predictive model. In brief, the main purpose for teachers would be to favor the appearance of disciplined behaviors through the application of interactive skills (e.g., open tasks in the form of problem situations, which encouraged personal challenge and self-regulation of learning) that allow students to perceive a task-oriented motivational climate. This perception will lead to a better achievement of BPNs and, as a consequence, a more autonomous motivation leading to disciplined behaviors.

The third hypothesis stating that *autonomous motivation will positively predict academic performance* was further confirmed by the results. Autonomous motivation positively predicted PE academic performance. Our findings are consistent with previous research based on SDT such as the longitudinal study by Barkoukis et al. (2014), which, after a 3-year intervention period, demonstrated that self-determined profiles were associated with higher ratings in the PE subject. Similar results were found by Standage et al. (2006) regarding the levels of self-determined motivation reported by students who positively predicted PE teacher qualifications. The assumption that autonomous motivation increases positive outcomes not only in the educational context (Ryan and Deci, 2020) but also in PE (Standage et al., 2006; Cid et al., 2019) is fundamental to SDT.

On the other hand, the AGT postulates that the motivational climate generated by the teacher (e.g., the keys to success or failure that define an activity) can influence positively or negatively at different levels in the classroom. In the same way, the study developed by Gutiérrez and López (2012b) found a positive and significant association between the task-oriented learning climate promoted by the teacher and the students' grades in PE. Similar results were found by Şahin et al. (2018), showing that the task climate was determined as predictor of academic achievement among PE and sports undergraduate students. Thus, the way the teacher structures and develops his classes can generate in students a series of adaptive behaviors in the classroom, including academic performance (Sevil et al., 2017).

As previously described in the literature, academic performance has been addressed from AGT and SDT in an isolated manner in the PE context, but few studies have been carried out by integrating both frameworks or perspectives. An exception is the study developed by Sevil et al. (2017), revealing a significant and positive relationship between task-oriented climate, BPNs, self-determined motivation, and academic performance. However, the study conducted by Sevil et al. (2017) in Spanish secondary students showed that the task-oriented motivational climate (instead of the autonomous motivation) predicted academic performance in PE (35% of the explained variance). Similarly, Cerasoli et al. (2014) sought to clarify the relationships between intrinsic motivation, mastery goal orientation, and performance by using a three-wave panel study and hypotheses drawn from SDT and AGT. They reported that mastery goals mediated (explained) the relationship between intrinsic motivation and academic performance.

Despite the high correlation found in the present study between the PE grades and overall grades, autonomous motivation toward PE did not act as a significant predictor of overall academic performance. These results are not in line with previous studies in that self-determined motivation predicted academic performance in other subjects (Wentzel, 2017). A large empirically based literature has demonstrated the positive relationships of the most autonomous forms of classroom motivation with academic outcomes (Howard et al., 2017). Specifically, Taylor et al. (2014) conducted a meta-analysis highlighting the significant role of intrinsic motivation on predicting school achievement. The results may be due to the instruments used for the study, where motivation of a specific subject (PE) was analyzed, and need not be in agreement with students' overall academic motivation. The prospective to measure motivation from a more contextual point of view is proposed, assessing the possible level of prediction of the students' motivation on their specific and overall academic performance (Baños et al., 2020).

Traditionally, academic performance in PE has been associated with individual factors, but more and more studies indicate the teacher–student and student–student interactions as well as motivational processes as key factors of academic performance in PE (Sevil et al., 2017). In this sense, it is essential that the teacher favors task-oriented climates that satisfy BPNs, leading to autonomous motivation. Some authors point out that cognitive skills (intelligence, hours of study) are the most affected as determinants of academic achievement in the literature (Poropat, 2011), which could explain the low

prediction rate of motivational processes on performance in PE. However, the study of motivational factors can provide a more complete perspective for the teaching–learning process to conclude successfully.

There are few studies that have jointly analyzed motivation, disciplined behaviors, and academic performance. Based on AGT, Gutiérrez and López (2012b) analyzed motivation, students' behavior, and academic achievement in a sample of 2,189 PE students. The results showed that the task-oriented climate predicted the discipline behavior, although the best predictor of academic performance was the teachers' assessment of student behavior. Complementary, Baños et al. (2018) analyzed the effect of teachers' gender on the motivational climate, disciplined behaviors, future practice intentions, and academic performance. Finally, a recent study by Cid et al. (2019) tested a SEM where PE grades were predicted by autonomous motivation and in turn by BPNs, which were also predicted by task-oriented climate. Therefore, the motivational climate in PE classes enhanced by the PE teacher has a significant impact on the BPNs satisfaction. This fact has a positive impact on how PE students regulate their behavior, as well as on how the autonomous regulation has a significant impact in PE grades (Cid et al., 2019). The teaching role is decisive in creating the best contextual conditions to generate adaptive behaviors on students and to carry out the teaching–learning process in order to culminate in a successful manner as well.

Thus, the testing of a predictive model including disciplined behaviors and academic performance as positive student outcomes of motivational processes (integrating AGT and SDT frameworks) is the main strength of this study. The results are in line with the postulates of the Hierarchical Model of Motivation (Vallerand, 2001), which emphasizes the importance of antecedents in the emergence of more self-determined motivation forms and its consequences. In addition, this study provides a more complete knowledge of the motivational processes underlying disciplined behaviors and the academic performance of PE secondary students. The main limitation of the study is the cross-sectional design, which does not allow generalizations such as the experimental designs that are proposed as prospective. It would be also appropriate to continue to dig into this research topic but in other educational stages and including other antecedents regarding the "dark side" of student motivation as ego-oriented climate, controlled motivation, amotivation, and other consequences, such as undisciplined behavior, extracurricular sports practice, or physical activity levels. Furthermore, it would be also interesting to propose a triangulation of methods, obtaining information from the teacher and external observers. To conclude, this study contributes to the knowledge of students' behavior and will help teachers to foment environments that optimize the teaching–learning process and lead students to a more autonomous motivation and its positive cognitive (PE academic performance) and behavioral (discipline) consequences.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The University Ethics Committee of the University of Extremadura reviewed and approved the research in accordance with the principles set out in the Declaration of Helsinki. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

FC and AG-A conceptualized and designed the study. FC, AG-A, LM-A, and MC recruited the subjects. MC and LM-A collected the data. FC and MC organized the database. FC and AG-A carried out the statistical analysis. FC, LM-A, MC, and AG-A wrote the first manuscript draft. FC, AG-A, and LM-A developed the final manuscript draft, contributed to English proofreading, and reviewed and edited the final version of the manuscript. All authors contributed to manuscript revision and approved the definitive manuscript.

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Active Methodologies in Higher Education: Perception and Opinion as Evaluated by Professors and Their Students in the Teaching-Learning Process

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The goal of this study is both to determine the opinion that professors and students at the university have of active methodologies and to describe the perception and opinion of the modes of organization, methodological focuses, and evaluation systems that define the teaching-learning process. On surveying the professors and the students in their classes, we found significant differences in 32 of the 92 variables in common. The content of these results shows that professors and students are believe they are making progress toward a learning-centered model, that implementation of active methodologies implies new functions in their teaching practice.

Keywords: active methodology, higher education, professor, student, perception, opinion, learning process

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INTRODUCTION

Teaching and learning practices in higher education are undergoing a number of changes that have significant implications for the nature of students' learning experience. The traditional approach to teaching in Spain, as in many parts of the world, involved one-way transmission from lecturer to students (Ituma, 2011).

From various studies analyzed (García Valcárcel, 1993; Alonso and Méndez, 1999; Kember and Kwan, 2000; Biggs, 2005; Monereo and Pozo, 2006; Kember, 2009; Attard et al., 2010; Hynes, 2017; Gómez and Gil, 2018; Cabral and Duarte, 2019; Dominguez et al., 2019; Zamora-Polo and Sánchez-Martín, 2019), we confirm continued use of the traditional model – also called the knowledge transmission or teacher-centered model, which focuses on the teacher, transmission of information, and expository style, but also a greater presence of the model that focuses on student learning, also called learning facilitation, the constructivist model, student-centered learning model or learning paradigm (Kolb, 1976; Imbernón and Medina, 2006; León and Crisol, 2011). The two orientations coexist in teaching methodology, understood here as different modes of organization, methodological focus, and evaluations system that stress the reproduction of knowledge and the role of methodology in the construction and/or transformation of knowledge (Samuelowicz and Bain, 2002). In higher education, calls have been made for active learning experiences that place the student at the center of learning rather than accepting students as passive

listeners (Boyer, 1990; Felder and Brent, 1996; Qualters, 2001; Jungst et al., 2003; Machemer and Crawford, 2007; Zamora-Polo and Sánchez-Martín, 2019).

FROM THE TRADITIONAL TEACHING MODEL TO STUDENT-CENTERED LEARNING

The teaching-centered model gives special importance to the figure of the teacher, who is considered as the fundamental source of information and knowledge. In this model, the teacher is the one who knows, and it is his/her responsibility to transmit that knowledge well, leaving students the sole task of reproducing the knowledge (Gargallo-López et al., 2017). Further, responsibility for curricular design and development belongs exclusively to the teacher, including mode of organization of the instruction, choice of content, and teaching methods and evaluation procedures. The same is true for transformation of knowledge. In this case, reproduction is sought as a product of learning. This model does not seek student involvement in either construction of knowledge or decision-making about how that knowledge about students' learning; it does not stress development of skills like cooperative work. It focuses on competence rather than cooperation, with minimal and one-way interaction between student and teacher. Instruction will only occasionally be two-way in order to keep students' attention or ensure understanding of the content treated in order to resolve questions. Ordinarily, such classes are based on explanation, using lecture, student note-taking, and memorization so that students can repeat the knowledge later. Students are usually evaluated by the traditional exam. The learning-centered model, in contrast, stresses the student's learning. Knowledge is understood as personal construction, fruit of cooperation between teacher and students. The product of learning should be exchange of knowledge. Although the teacher is responsible for curricular design, this model requires joint work of the teacher and his/her colleagues, as well as cooperation with the students. The student is invited to design his/her learning pathways and to commit him- or herself actively in the process (Machemer and Crawford, 2007), such that the responsibility for organization and transformation of knowledge is shared. The student's conceptions are used as the basis for preventing errors and promoting conceptual change. Teacher-student interaction is two-way to negotiate meanings. The student's cooperative work is promoted for joint construction of knowledge and development of skills, attitudes and values necessary in his/her student and subsequent professional life. This method seeks a significant evaluation methodology that uses diverse sources of information gathering and that gives the students feedback (Hernández, 2012), helping them to mobilize processes of self-evaluation (Hannafin, 2012) and self-regulation of the learning process.

The literature shows quite a few publications recommending the learning-centered model in various areas of knowledge (Tagg, 2003; Zabalza, 2006, 2011; Menachery et al., 2008; Prieto and coord, 2008; McLean and Gibbs, 2010; Bista, 2011; Brackin, 2012; Mostrom and Blumberg, 2012; Campbell, 2012; Hunt and Chalmers, 2013; Nitza, 2013; Sue, 2014; Cebrián-de-la-Serna et al., 2015; Schweisfurth, 2015), as well as studies analyzing experiences implemented (Tien et al., 2002; Koles et al., 2005; Tessier, 2007; Armbruster et al., 2009; Salaburu et al., 2011; Roy and McMahon, 2012; Bruehl et al., 2014; Chen et al., 2015; Lucieer et al., 2016; Zamora-Polo and Sánchez-Martín, 2019). This body of research indicates that we are undergoing a methodological renewal that involves the use of new forms of organization (modes of organization), teaching methodologies (methodological focuses), and evaluative processes (evaluation systems) in accordance with new professional profiles and a new way of understanding learning that is crucial for the transition from a teaching-centered methodology to a one centered in learning that encourages active learning.

Of the many broad definitions of active learning, all basically involve something more than passive listening (Qualters, 2001; Lammers and Murphy, 2002; Jungst et al., 2003). Active learning is a broad, commonly used term "generally defined as any instructional method that engages students in the learning process" (Prince, 2004, p. 223). The student's active participation requires the implementation of active methodologies with repercussions for both the educational process and the mechanisms used to evaluate the degree and quality of learning acquired. Thus, lectures have lost their leading role as the only or main method in university classrooms and must be combined with other methodologies, termed active: seminars, learning projects, mentored projects, readings, reviews, document analyses, case studies, bibliographic searches, problem-based learning, virtual platforms, practical class sessions, etc. – all more oriented to the student's independent work and active learning. Active learning does not negate the need for lectures, but it provides opportunities for students to reflect, evaluate, analyze, synthesize, and communicate on or about the information presented (Fink, 2003).

The presence of active methods in university classrooms will be effective as long as the professor takes the student's participation into account in organizing and proposing the teaching and learning methodologies, as well as the evaluation methods. Although many experiences of the implementation of active methodologies have been observed (Fernández-Pérez, 1989; Exley and Dennick, 2007; López-Noguero, 2007; Rué, 2007; López-Pastor et al., 2011) in various subjects in different fields of knowledge, many quite innovative teachers – whether employing active methodological strategies or not – continue to base their classes on dictation, readings, explanations, etc. that leave the student in a state of passivity, preventing students from achieving significant learning. Educators have proposed widely varying examples of pedagogical strategies or techniques for active learning including, for instance, case studies, team projects, simulations and role playing, internships, peer tutoring, and challenging discussions (Chickering and Gamson, 1987; Bonwell and Eison, 1991; Meyers and Jones, 1993; Chi, 2009; Carr et al., 2015). What do these teaching strategies have in common? The theory behind these techniques is based on a constructivist view of learning. Constructivism posits that people build knowledge by acting on the world around them and reflecting on their experiences. Being

constructive means ensuring that all components of the teaching-learning process are developed unanimously, so that both the methodological focuses (teaching methods) and the evaluation systems (evaluation procedures) are designed to achieve the desired competences and learning outcomes (Gibbs, 1994; Biggs, 2005).

But the problem stems from the fact that this methodology, which fosters active learning, is often misapplied or not applied at all, meaning that active methodologies are present only in theory. It is not enough that the use of active methodologies attributes a very significant role to the student, who constructs his/her knowledge from certain guidelines, activities, or scenarios designed by the professor. Through these activities, the professor must encourage the student to (Crisol, 2013): become responsible for his/her own learning, developing skills in searching for, selecting, analyzing, and evaluating information, participate in activities that enable him/her to exchange experiences and opinions with peers, commit him- or herself in processes of reflection on what to do, how to do it, and what results to achieve, proposing specific actions in order to improve, interact with his/her environment to intervene socially and professionally in it, through activities such as projects, case studies, and problem solving, develop autonomy, critical thinking, collaborative attitudes, professional skills, and self-evaluation capability.

These key issues help to determine how to organize students' learning, how to evaluate students, and how both professor and student should act. Since these issues represent the three fundamental components of these methodologies, they formed the major focus of the study we present.

First, we have the organizational component, that is, the scenario or scenarios in which the teaching-learning processes will be developed. In this study, these are determined as modes of organization, following the classification by De Miguel (2006), De Miguel and coord. (2009) and the Ministry of Education and Culture [MEC] (2006): theoretical classes, seminars, workshops, practical classes, tutorials, outside internships, independent individual work and study, and group work.

The second part forms the procedural technical component, formulated as methodological focuses, also following the classification presented by De Miguel (2006), De Miguel and coord. (2009): participatory lecture, oral presentation of student projects, seminar, case studies, problem-based learning, portfolios, independent work, cooperative work, project-oriented learning, learning contracts, and concept maps.

The last component is the evaluative, determined as evaluation systems: objective tests, long-answer tests, oral exams, papers and projects, reports/memoranda on practical class sessions, tests on execution of real tasks, self-evaluation systems, observation techniques, portfolios, and concept maps.

It is not easy to shift from a teaching-centered focus to one centered on learning (Heise and Himes, 2010). This shift requires organizational changes, new infrastructures and equipment, cooperative work by professors, and integrated curriculum design (De La Sablonnière et al., 2009), all of which require motivation and commitment from professors and students, as well as training programs for professors (Maclellan, 2008), since they continue to organize and plan around lecture classes.

De La Sablonnière et al. (2009) have, however, performed studies on students' perceptions of a variety of class environments. Since the research on students' perceptions of active learning opportunities and environments is limited and contradictory (Machemer and Crawford, 2007), this article provides data from a study whose fundamental goal was to determine the opinion that professors and students at the University of Granada (UGR) have of active methodologies and to describe the perception (frequency of use) and opinion (appropriateness of use) of the modes of organization, methodological focuses, and evaluation systems that define the teaching-learning process. This study is based on the conviction that there is a need for empirical data to help to improve the quality of teaching-learning in the university.

MATERIALS AND METHODS

Participants

The study was performed at the UGR, whose teaching centers are divided into five areas of knowledge: Arts and Humanities, Sciences, Health Sciences, Social Sciences and Law, and Technical Sciences (Engineering and Architecture). The population in this study is the set of all professors and students of the UGR.

According to the UGR's Research Faculty Services (Personal Docente Investigador), during the 2016/2017 academic year the faculty was composed of a total of 4126 professors (54.7% men and 45.3% women) affiliated with the different areas. The data on students published by the Office for Data, Information, and Planning gives the student population as 46 483 (60.40% men and 39.60% women).

This study used a non-probabilistic convenience sample according to the students and teachers that could be accessed. This sampling method ensures that the sample represents the various subgroups of a population based on the characteristics of the population in the exact proportion the researcher wishes (Hernández et al., 2006). From the total population of professors at the UGR, 32 professors participated in this study, along with the students in their respective classes.

By sex, the faculty were distributed as follows: 34% (n = 11) were men and 66% women (n = 21). As to age, 37.5% (6 men and 6 women) were 41–50 years of age, 18% (1 man and 6 women) 51–60, 25% (2 men and 6 women) 31–40, and 18.8% (2 men and 4 women) under 30.

As to discipline, 46.9% (15 professors) of the faculty who participated in the study belonged to the field of Social Science and Law, 25% (8 professors) to Arts and Humanities, 12.5% (4 professors) to Technical Sciences, 9.4% (3 professors) to Health Sciences, and 6.3% (2 professors) to Sciences.

As to education, 65.6% of the professors said that they had received specific training in active methodologies. Although a total of 84.4% used active methodologies in their teaching, only 59.4% (19 professors) took their students' opinion into account when proposing the teaching-learning methodologies.

As to the students, we had 32 class sections (one class per instructor), comprising a total of 1234 students. Of this total, 54.7% (675 students) were women and the remaining 45.3% (559 students) men. By age, 77.3% (N = 954 students) were 18–22 years old, 22.6% (N = 279 students) 23–27, and only 10% (N = 1 student) over 28.

By field of knowledge, 39.2% (N = 484 students) belonged to Social Sciences and Law, 18.3% (N = 226 students) to Arts and Humanities, 17.3% (N = 214 students) to Health Sciences, and 1.1% (N = 14 students) to Sciences. 18.8% (N = 233 students) percent of all students are Physical Education students.

Regarding year in degree program, 40.8% (N = 503 students) were registered in the first year of their degree programs, 27.5% (N = 339 students) in their second year, 15.6% (N = 192 students) in their third year, and 16.2% (N = 200 students) in their fourth year.

Of the total student population, 67.1% (N = 828 students) stated that their professors used active methodologies in teaching, while 32.9% (N = 406 students) believed that their professors used traditional methodologies. Only 30% (N = 369 students) of those who believed their professors used active methodologies believed that this method took the students' opinion into account when proposing the methodologies to be used in class; 37.2% (N = 459 students) of the students believed that the professors did not take their opinion into account in the methodological approach to the teaching-learning process. In contrast, 27.2% (N = 336 students) of the students believed that the professors neither used active methodologies nor took students' opinions into account in establishing the methodologies. The other 5.6% (N = 70 students) believed that the professor took students' opinion in determining the methodology in the teaching-learning process even if he/she did not use active methodologies.

Design of the Study and Instruments

The research presented here is quantitative, and transversal and descriptive in approach. Starting from an exploratory, descriptive, and comparative research model, it explores the opinion that university professors and students have of the use of active methodologies at the UGR. It describes the perception of these two groups (professors and students) of the different modes of organization, methodological focuses, and evaluation systems, and compares the opinions and perceptions of the professors with those of the students.

This study is developed within the framework of an analytic-synthetic method, starting from use of the questionnaire as research instrument in order to approximate reality in an objective and generalizable way.

The goal of this study is both to determine the opinion that professors and students at the UGR have of active methodologies and to describe the perception (frequency of use) and opinion (appropriateness of use) of the modes of organization, methodological focuses, and evaluation systems that define the teaching-learning process, based on the following declarative hypotheses:

> H1: There are statistically significant differences between the professors' opinions and those of the students in their classes concerning the use of active methodologies.
>
> H2: There are statistically significant differences between the perception (frequency of use) and opinion (level of appropriateness) of the professors and of the students in their classes concerning the use of modes of organization, methodological focuses, and evaluation systems.

For this study, we chose the research instrument of a "survey" questionnaire (Buendía and Colas, 1997), understood as a set of carefully prepared questions on the actions and issues considered relevant to the research and to be verified by the population or sample participating in the study (Sierra Bravo, 1988). In other words, the goal of this instrument is to obtain information on the study population's relation to the study variables (professors, students, fields of knowledge) in a systematic and orderly way.

The questionnaires used "Opinion and Perception of the professors concerning the use of active methodologies at the University of Granada (OPPUMAUGR)," and "Opinion and Perception of the students concerning the use of active methodologies at the University of Granada (OPEUMAUGR)" (León and Crisol, 2011; Crisol, 2013). The questionnaires have not been published previously and were developed from the bibliography and the researchers' relationships to the topic of study (Johnson et al., 1999; Marín and Teruel, 2004; De Miguel, 2006, De Miguel and coord., 2009; Ministry of Education and Culture [MEC], 2006; Monereo and Pozo, 2006; Barkley et al., 2007; Moust et al., 2007; Imbernón and Medina, 2008; Sánchez, 2008; Caurcel et al., 2009; Fernández, 2009; Learreta et al., 2009; Vallejo-Ruiz and Molina-Saorín, 2011).

Both were distributed in two parts, the first on Opinion of the use of active methodologies, and the second on Perception and Opinion of the teaching-learning process.

The OPPUMAUGR questionnaire is composed of 126 items. The first part "Opinion of active methodologies," has 68 items divided into 5 dimensions: methodological renewal (13 items), use of active methodologies (28 items), teaching professional context (9 items), context in the university (6 items), and context in university classrooms (10 items). The second part, "Perception and Opinion of the teaching-learning process," is composed of 60 items divided into 3 dimensions: modes of organization (16 items), methodological focuses (22 items), and evaluation systems (22 items).

The OPEUMAUGR questionnaire, in contrast, is composed of 93 items. The first part "Opinion of active methodologies," has 32 items in 4 dimensions: methodological renewal (11 items), use of active methodologies (9 items), context in the university (4 items), and context in university classrooms (8 items). The second part has the same structure as the OPPUMAUGR questionnaire.

The first part of the questionnaires uses a Likert-type scale with 4 degrees of response, 1: Disagree completely, 2: Disagree, 3: Agree, and 4: Agree completely. The second part, for the "Frequency of use (perception)" uses the following degrees of response 1: Not at all, 2: A little, 3: Some 4: A lot. For "Appropriateness of use (opinion)," the responses are 1: Completely inappropriate, 2: Not very appropriate, 3: Appropriate, and 4: Very appropriate.

Both questionnaires have a high coefficient of reliability. The OPPUMAUGR coefficient is.893, with a confidence level of 95%

TABLE 1 | T-Student for related samples.

Items	Mean teachers	Mean students	*t*	*P*
The professor's work style is different when he/she uses active methodologies in the classroom.	3.69	2.68	6.082	0.000
The use of new teaching methodologies is accompanied by new models of evaluation.	3.56	2.72	3.134	0.004
Different pedagogical methods are used depending on the students' characteristics.	3.19	2.15	5.188	0.000
Lectures are usually accompanied by other modes of teaching.	3.28	2.51	4.412	0.000
Lecturing is increasingly accompanied by active methodologies.	3.25	2.71	4.295	0.000

Methodological renewal.

TABLE 2 | T-Student for related samples.

Item	Mean teachers	Mean students	*t*	*P*
The use of active methodologies fosters interdisciplinarity of content.	3.19	2.68	2.739	0.022
Active methodologies promote the acquisition of autonomous learning tools.	3.31	2.79	2.895	0.007
The use of active methodologies fosters research in the classroom.	3.25	2.61	3.575	0.001
The use of active methodologies fosters group work and learning among students.	3.25	2.85	2.420	0.010

Use of active methodologies.

TABLE 3 | T-Student for related samples.

Item	Mean teachers	Mean students	*t*	*p*
The spaces devoted to teaching do not facilitate the use of active methodologies.	3.53	2.47	5.643	0.000
The infrastructures and equipment are designed for lectures.	3.41	2.79	3.227	0.003
The high number of students per class makes it difficult to use active methodologies.	3.72	3.00	3.505	0.001

Context in the university.

TABLE 4 | T-Student for related samples. Frequency of use (perception).

Item	Mean teachers	Mean students	*t*	*P*
Seminars	2.53	2.15	1.792	0.015
Practical classes	3.72	2.88	4.754	$\leq$ 0.000
Tutorials	3.34	2.81	2.572	0.083

Modes of organization.

TABLE 5 | T-Student for related samples.

Item	Mean teachers	Mean students	T	P
Seminars	3.44	2.82	3.524	0.001
Practical classes	3.78	3.38	2.696	0.011
Tutorials	3.69	3.19	2.853	0.008
Individual study and work	3.53	3.02	2.852	0.008
Group study and work	3.34	2.93	2.163	0.038

Appropriateness of use (Opinion). Modes of organization.

($p \leq 0.05$). The OPEUMAUGR coefficient is 0.933, at 95% ($p \leq 0.05$) confidence level.

Procedure and Date Analysis

To gather data on the professors, we used the "Limesurvey" online tool for survey administration, which enabled us to translate the data directly to the SPSS tool, as well as to send multiple emails, permit participants to save the scale without completing it fully so that they could return later to complete it, and remind the participants to complete and submit their response to the scale.

Data collection for the groups of students was performed face to face, explaining to each class goal of the study and the subsequent use of the data obtained.

For the analysis, we used descriptive statistics and differential analysis using the T-Student for related samples. This method enabled us to determine the statistically significant differences between the 92 items in common between the faculty and their classes of students.

RESULTS AND DISCUSSION

On surveying the professors and the students in their classes, we found significant differences in 32 of the 92 variables in common. To facilitate interpretation of the results, we present them in two sections: differences between the opinion of the professors and the students in their classes on active methodologies, and differences between the perception and opinion of the professors and the students in their classes on the teaching-learning process (modes of organization, methodological focuses, and evaluation systems).

We now present the descriptive analysis and comparison of means for each item within its dimension. The tables present the scores (mean, *t*-test, and two-tailed Sig.) of the items for which we found significant differences.

TABLE 6 | T-Student for related samples.

Item	Mean teachers	Mean students	*t*	*p*
Oral presentation of student projects	2.81	2.42	2.065	0.047
Case studies	3.38	2.27	5.245	0.000

Frequency of use (perception). Methodological focuses.

TABLE 7 | T-Student.

Item	Mean teachers	Mean students	*t*	*p*
Oral presentation of student projects	3.44	2.81	3.528	0.001
Seminars	3.28	2.80	2.520	0.017
Case studies	3.38	2.88	2.308	0.028
Independent work	3.47	3.06	2.381	0.024

Opinion (Appropriateness of use) professors/class sections. Methodological focuses.

TABLE 8 | T-Student for related samples.

Item	Mean teachers	Mean students	*t*	*P*
Short-answer tests	2.94	2.34	2.753	0.010
Oral exams	2.72	2.19	2.256	0.031

Frequency of use (perception). Evaluation systems.

TABLE 9 | T-Student for related samples.

Item	Mean teachers	Mean students	*t*	*p*
Oral exams	3.31	2.60	3.392	0.002
Papers and projects	3.53	3.20	1.997	0.055
Reports/Memoranda on practical sessions	3.22	2.81	1. 982	0.056
Portfolio	2.88	2.35	2.227	0.033

Appropriateness of use (opinion). Evaluation systems.

Differences Between the Professor's Opinion and Those of Their Students on Active Methodologies

We obtained statistically significant differences in a total of 12 items of the dimensions evaluated by both professors and students concerning the use of active methodologies.

By dimension, for the dimension "methodological renewal," **Table 1** confirms that the professors show greater agreement with their students in observing that the professor's work style is different when he/she uses active methodologies in the classroom; that the use of new teaching methodologies is accompanied by new models of evaluation; that the professor uses different pedagogical methods depending on the characteristics of the class; that the lectures are usually accompanied by other modes of instruction; and that the lecture is accompanied increasingly by active methodologies (**Table 1**).

In the dimension "use of active methodologies," **Table 2** shows, overall, that the professors again agree more than their students in evaluating the following statements: the use of active methodologies fosters interdisciplinarity of content; active methodologies promote the acquisition of tools for independent learning; use of active methodologies fosters research in the classroom; and use of active methodologies fosters group work and learning among students.

As to "context in the university," **Table 3** shows, again, that the professors agree and the students disagree that the spaces dedicated to teaching do not facilitate the use of active methodologies and that infrastructure and equipment are designed for lectures. Although we find statistically significant differences between professors' and students' opinion that the high number of students per class hinders the use of active methodologies, both professors and students agree in this case.

Differences Between the Perception and Opinion of Professors and Their Students Concerning the Teaching-Learning Process (Modes of Organization, Methodological Focuses, and Evaluation Systems)

In this case, to determine whether there are significant differences between perception (Frequency of use) and opinion (Appropriateness of use) and the nature of these differences concerning Modes of Organization (Dimension 1), Methodological Focuses (Dimension 2), and Evaluation Systems (Dimension 3) among the 32 professors and their respective classes, we asked both groups to evaluate what both frequency of use (perception) and appropriateness of use should be (opinion).

As to modes of organization, **Table 4** shows that significant differences were obtained in only 3 of the 8 modes presented.

As to use of seminars, both professors and their classes believe that this method is used infrequently in the teaching-learning process, but the class believes that it is used even less frequently than do the professors.

As to the use of practical classes and tutorials as a mode of organization, the students' perception shows that these modes are used less than does their professors' perception, whereas the professors state that they use these modes some or quite a lot in organizing instruction.

As to opinion concerning appropriate use of the modes of organization presented, **Table 5** shows that the professors succeeded in using these modes to a greater extent. The professors also believed more strongly than their students that they used the following modes of teaching organization well: seminars, practical classes, tutorials, independent study and work, and group study and work as organizational modes of instruction.

It is striking that the opinions of both professors and students agree in assigning similar means to the use of practical classes, tutorials, and independent study and work. Both believe that the use of these modes is appropriate or very appropriate for organizing undergraduate teaching. The opinions of the professors and their students differ, in contrast, on the use of the seminars and group study and work; the professors believe use of these modes to be more appropriate.

For frequency of use of the different methodological focuses, we see statistically significant differences in only 2 of the 11 active methods proposed (**Table 6**).

These results show that, although professors and students agree in believing that oral presentation of student projects is used little or some, professors believe that it is used more. The use of case studies shows some contradiction; professors believe that they use case studies some and/or a lot in their teaching, whereas their classes perceive that they use case studies less.

As to opinion on the teaching methods, differences arise between professors and class sections on 4 of the 11 focuses. In all four, the professors rate these methods higher, as appropriate or very appropriate for instruction in undergraduate teaching, whereas the students on average score these methods between not very appropriate and appropriate (**Table 7**).

Only in the use of independent work can we conclude agreement, as both professors and students believe that independent work is appropriate or very appropriate, although the professors give it a higher score.

For evaluation systems, we observe statistically significant differences in the perception of frequency of use of short-answer tests and oral examinations. In this case, the professors again score them higher (**Table 8**).

Although the differences between professors' opinions and those of their students are noticeable – the use of both tests is between "a little" and "some" – the professors again perceive that they use these systems some, while the students perceive that they use them little (**Table 9**).

Finally, as to opinion on the use of evaluation systems, we find significant differences on 4 of the 11 evaluation methods presented. These are oral exams, papers and projects, reports and memoranda on practical classes, and the portfolio. In all cases, the professors believe that these methods are more appropriate in instruction, as they score them higher. We would highlight, however, that, despite significant differences of opinion between the professors and their classes on use of papers and projects, professors' and students' opinions are closer on this evaluation method; both consider its use as an appropriate or very appropriate method for evaluating students' learning.

CONCLUSION

The study reflects the opinion and perception of both teachers and students on the use of active methodologies. These results can help the university community to improve its teaching practice. It provides knowledge about the different perception that teachers and students have of teaching & learning processes. It is not frequent to have academic studies in which teachers' and students' perspectives are part of the same research.

The results shows that the professors believe they are making progress toward a learning-centered model, as the instructors believe that implementation of active methodologies implies new functions in their teaching practice.

Students' perception of the utility of the methodological focuses are positive. The students generally had a positive attitude toward active learning, especially when they were made aware of the reason for the use of the active techniques. As to use of active methodologies, the findings stress that they foster interdisciplinarity and research and promote the development of learning tools, as well as group work and learning among the students. The main difficulty in implementing these methods is the high number of students per class, which does not make it easy to the develop active methodology. From this study, some recommendations can be made to bring, both to the classroom and university.

Differences Between the Professor's Opinion and That of His/Her Students on Active Methodologies

The findings show statistically significant differences in the responses given by the 32 professors and their students on active methodologies, confirming Hypothesis 1.

The content of these results shows that the professors believe they are making progress toward a learning-centered model, as the instructors believe that implementation of active methodologies implies new functions in their teaching practice (Zabalza, 2006, 2011), use of evaluation systems different from those habitually used (Cebrián-de-la-Serna et al., 2015), and obligation to use methods adapted to the characteristics of the students, as well as combined use of lecture and other, active modes of teaching (Salaburu et al., 2011).

This conclusion is also stressed in the study by Yuretich (2003) of students' perception of the utility of the methodological focuses, which obtained equally positive evaluations for use of lecture and active learning methodologies. Other studies found that the students generally had a positive attitude toward active learning, especially when they were made aware of the reason for the use of the active techniques (Qualters, 2001; Jungst et al., 2003).

As to use of active methodologies, the findings stress that they foster interdisciplinarity and research and promote the development of learning tools, as well as group work and learning among the students.

Ventosa (2004) obtains similar results, highlighting that use of active methods promotes students' analysis and reflection, contributing to students playing an active role in the acquisition of knowledge. The main difficulty in implementing these methods is the high number of students per class, which does not make it easy to the develop active methodologies (Yuretich, 2003; Machemer and Crawford, 2007; Vreven and McFadden, 2007).

The spaces, infrastructure, and equipment are also considered as designed for imparting lectures, in line with studies by De La Sablonnière et al. (2009).

Differences Between the Opinion and Perception of Professors and Their Students Concerning the Teaching Process

As to modes of organization, we can conclude that statistically significant differences exist in the use of practical classes and tutorials, which show that they are used more often by the professors than the students indicate. In the opinion of both professors and students, the mode of organization least used is the seminar.

Both professors and students agree in believing that practical classes, tutorials, and independent study and work are the most appropriate modes of organization for instruction. The students view seminars and group study and work as less appropriate (Johnson et al., 1991; Phipps et al., 2001; Vreven and McFadden, 2007; Cavanagh, 2011; Herrmann, 2013).

As to methodological focuses, both professors and students believe that oral presentations of student projects are used little in university classrooms (Carr et al., 2015). The professors believe that they habitually use case studies, although their students perceive them as using this method less.

Professors and students believe that independent work is the most appropriate teaching method. The students state that use of oral presentations of their projects, seminars, and case studies are not very appropriate for instruction, whereas the professors find these methodological focuses to be appropriate (Armbruster et al., 2009; Bruehl et al., 2014).

Finally, we draw the following conclusions concerning the use of evaluation systems. Both professors and students perceive that short-answer tests and oral examinations are not used frequently to evaluate their learning.

In contrast to their students, the professors believe it less appropriate to use both oral examinations and reports and memoranda of practical classes in evaluating students' learning, perhaps due to the stage fright involved in oral exams and the excessive time required to prepare reports and memoranda (Ituma, 2011).

Professors and students agree in viewing papers and projects as appropriate for evaluating learning, as opposed to the portfolio, which they view as not very appropriate. Some studies, however, consider the portfolio as beneficial as a process for self-regulating learning that requires greater responsibility and motivation (Zimmerman, 2002).

LIMITATIONS AND STRENGTHS

The notable strengths of this work are the sample size and the theme, which can contribute. However, despite the novelty and interest of the topic and the results provided in this study. The sample is composed of university students from a single autonomous region and, in addition, no probabilistic sample design was carried out, so the results cannot be generalized.

Further studies should be performed in which other research designs are proposed, On the other hand, it would also be convenient to perform longitudinal researches, with various data collections, in which the effectiveness of use of active methodologies.

The study provides interesting results for the university environment. The study reflects the opinion and perception of both teachers and students on the use of active methodologies. These results can help the university community to improve its teaching practice.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: https://hera.ugr.es/tesisugr/21224043.pdf.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

EC-M: term, conceptualization, methodology, investigation, resources, writing – original draft, writing – review and editing, visualization, and project administration. MR-L: term, conceptualization, methodology, investigation, writing – original draft, writing – review and editing, visualization, and supervision. MC-C: term, conceptualization, methodology, investigation, formal analysis, data curation, writing – original draft, writing – review and editing, visualization, and supervision. All authors contributed to the article and approved the submitted version.

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Students' Perceptions of Teachers' Corrective Feedback, Basic Psychological Needs and Subjective Vitality: A Multilevel Approach

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The way students perceive corrective feedback has repercussions on what they learn and think. Based on the self-determination theory, the aim of this study is to test a model of multilevel mediation that examines the relationships between the perception of corrective feedback with its degree of acceptance (perceived legitimacy) at the team level and the subjective vitality of students at the individual level, mediated by the satisfaction of the three psychological needs, in the context of physical education. The participants were 742 students aged between 10 and 13 years old (52.6% men, 47.4% women) in 29 physical education groups. The results of the multilevel structural equation modeling analysis found at the group (between) level a positive and significant relationship between corrective feedback and perceived legitimacy ($B_{between}$ = 0.49, $p < 0.01$), as well as a positive and significant relationship between perceived legitimacy and the needs of competence ($B_{between}$ = 0.66, $p < 0.05$) and relatedness ($B_{between}$ = 0.95, $p < 0.01$). In addition, there was a positive and significant association between competence and subjective vitality ($B_{between}$ = 2.06, $p < 0.01$), and a negative and significant association between relatedness and subjective vitality ($B_{between}$ = −0.85, $p < 0.01$). Also, on an individual (within) level, the needs of autonomy (B_{within} = 0.09, $p < 0.05$), competence (B_{within} = 0.27, $p < 0.01$), and relatedness (B_{within} = 0.17, $p < 0.01$) were positively and significantly associated with subjective vitality. Finally, corrective feedback showed a positive indirect effect on subjective vitality through perceived legitimacy and competence, while the indirect effect was negative through perceived legitimacy and relatedness. In conclusion, on an individual level, students who perceive their basic psychological needs to be met in turn, increase their subjective vitality. At the group level, the results are discussed. These findings suggest that teachers might be best advised to ensure that their students accept corrective feedback, by having it couched in a manner that suggests that learning and improvement can follow, and communicated in an autonomy-supporting way.

Keywords: teacher, corrective feedback, physical education, self-determination theory, psychological well-being

INTRODUCTION

Providing corrective feedback within the physical education class or training is inevitable, as it is inherent to the teaching process (Mouratidis et al., 2010). However, because of its negative nature (for it does not focus on the approval of a performance), it could have undesired repercussions on students (Mouratidis et al., 2010; Tristán et al., 2017, 2018). Therefore, it is necessary for the teacher to create a learning environment that leads students to not perceive it as threatening, challenging, unfair, and/or unjustified. Corrective feedback (Mouratidis et al., 2010; Carpentier and Mageau, 2013, 2016) or structure during the activity (Haerens et al., 2013), is defined as statements that convey information about aspects to be improved after poor performance (Mouratidis et al., 2010; Carpentier and Mageau, 2013, 2016).

The great diversity of students within the physical education class may lead to different outcomes in the way corrective feedback is perceived (Henderlong and Lepper, 2002; Mouratidis et al., 2010; Asún et al., 2020), that is why it is considered that perceived legitimacy, or the degree of acceptance of corrective feedback, is critical to its benefit within a learning environment (Mouratidis et al., 2010; Ríos, 2015; Tristán et al., 2017, 2018). In general, studies of negative feedback (and that have not considered the legitimate perception of the students about it self) have related it negatively to intrinsic motivation (Koka and Hein, 2003; Hollembeak and Amorose, 2005; Koka and Hein, 2006) and perceived competence (Koka and Hein, 2003). Furthermore, it has been observed that negative feedback can have a detrimental effect on students' self-esteem, self-efficacy and motivation to learn (Kim, 2004; Hattie and Timperley, 2007; Shute, 2008; Voerman et al., 2012).

Recently, one of the theories that has studied the phenomena resulting from teacher-student interaction is the Self-Determination Theory (SDT; Deci and Ryan, 1985; Ryan and Deci, 2017). More specifically, one of its mini-theories, the Basic Psychological Needs Theory (BPNT), which assumes the existence of three basic psychological needs: autonomy (experience of choice and psychological freedom with respect to one's action), competence (experience of effectiveness in social interactions and learning tasks) and relatedness (feeling of connection with other people and belonging to a group). Those three needs are considered to be essential nutrients for growth, integrity and physical, and psychological health (Deci and Ryan, 2000; Ryan and Deci, 2002, 2017). The BPNT also states that the satisfaction of basic psychological needs generates psychological well-being, whose indicator for "excellence" is subjective vitality, defined as the feeling of possessing energy, dynamism and vigor (Ryan and Frederick, 1997). Furthermore, this theory considers that the development of well-being is a function of the social context and its potential to satisfy psychological needs (Deci and Ryan, 2000; Ryan and Deci, 2000, 2002, 2017). From this perspective, in the field of physical education, the teacher can be seen as a social agent, representing a figure of authority and leadership for the students, given that the intervention of a teacher in the classroom plays a determining role in the satisfaction of basic psychological needs (Ntoumanis and Standage, 2009; Wilson et al., 2012; Curran and Standage, 2017; Tristán et al., 2019) and these, in turn, in the students' perceptions of vitality (Tristán et al., 2019).

Despite this, the literature has not sufficiently delved into corrective feedback, students' legitimate perception (perceived legitimacy) and their relation to the satisfaction of basic psychological needs in the context of physical education, even though according to SDT, basic psychological needs mediate students' motivation and psychological well-being. It is therefore essential to understand how the teacher should communicate corrective feedback so that it is perceived by students in a legitimate way and can meet their needs of autonomy, competence and relatedness, for it is possible that their perception of corrective feedback in the physical education session, regardless of whether it conveys a message of low competence, does not generate feelings of incompetence, low autonomy and poor relatedness, and does not undermine the intrinsic motivation of students to continue with task practice.

There is some indirect support for this position in the literature, although studies have been conducted in sports settings (Mouratidis et al., 2010; Carpentier and Mageau, 2013, 2016; Ríos, 2015; Tristán et al., 2017, 2018). The results in these investigations have found that corrective feedback can be positively related to the satisfaction of each of the basic psychological needs (Carpentier and Mageau, 2013, 2016; Ríos, 2015; Tristán et al., 2017), this is to the extent that corrective feedback is given in a style that supports autonomy and is therefore perceived as legitimate by the athletes (Mouratidis et al., 2010; Ríos, 2015; Tristán et al., 2017, 2018). It has also been found that when corrective feedback is conveyed in a friendly, tolerant, respectful and understanding manner, athletes experience higher levels of intrinsic motivation and autonomy (Mouratidis et al., 2010; Carpentier and Mageau, 2016), self-esteem (Carpentier and Mageau, 2013), self-confidence (Carpentier and Mageau, 2016), and greater subjective vitality (Ríos, 2015; Carpentier and Mageau, 2016).

Although sport and physical education classes share many elements in common, they also have different purposes and means to achieve them (Wallhead and O'sullivan, 2005), which is why testing the phenomena that occur in sport in physical education also becomes relevant. Furthermore, it is necessary to take into account that the benefits that could be derived from participation in physical education classes do not occur automatically, but depend on the quality of teacher-student interactions (Bailey, 2006). In this sense, the provision of corrective feedback within the physical education class becomes a way to improve and self-regulate student learning (Contreras-Pérez and Zuñiga-González, 2017), thereby becoming a very important aspect of teacher intervention.

Together with this, the physical education class represents the only space in which many children and teenagers can carry out physical activity (Villagrán et al., 2010; Abarca-Sos et al., 2015). In consequence, studying the aspects that intervene in the physical and psychological health of the students takes importance. Despite the fact that the model hypothesized in this work has been tested in the context of sports (Ríos, 2015), so far, there is a gap in the literature about the consequences that corrective feedback

might have on the satisfaction of psychological needs and on the perceptions of vitality within the physical education class.

On the other hand, although the variables involved in this study (corrective feedback, legitimate perception, basic psychological needs, and subjective vitality) have been theorized as individual constructs, the coexistence, collaboration, participation, and playing that takes place among the students within the classes could generate different perceptions from a group perspective, in other words, the perception of a group/team, may vary from the individual perspective of each of the students. Which is why it is also necessary to analyze the multilevel perspective, as previous studies have done (e.g., Papaioannou et al., 2004; Wilson et al., 2012; Beauchamp et al., 2014).

For all these reasons, the main contributions of this study to the previous literature are: (1) to test the hypothesized model in the context of the physical education class, (2) to bring the multilevel approach into the study of these relationships. Therefore, the general objective of the study is to test, in the context of physical education, a model of multilevel mediation (see **Figure 1**) that examines the relations between the variables of corrective feedback, the degree of acceptance of corrective feedback (legitimate perception) at the group level and the subjective vitality of students at the individual level, mediated by the satisfaction of the three psychological needs. In addition, the following hypotheses have been put forward: (1) corrective feedback will have an indirect effect on subjective vitality through the legitimate perception and satisfaction of the need for autonomy; (2) corrective feedback will have an indirect effect on subjective vitality through the legitimate perception and satisfaction of the need for competence and, (3) corrective feedback will have an indirect effect on subjective vitality through the legitimate perception and satisfaction of the need for relatedness.

MATERIALS AND METHODS

Procedure and Participants

The principals of the selected schools were contacted through a letter explaining the purpose of the study and requesting authorization for the administration of the instruments by providing them with a copy of the instruments. Due to the multilevel approach of this study, all students in the sixth-grade groups of the participating schools were considered. The selection criteria were that the groups should have at least one physical education class per week taught by a physical education professional, while at the individual level it was established that the participant was a regular student at the school. The exclusion criteria were: that the student had a cognitive disability that prevented him/her from answering the questionnaire consciously/autonomously. The signature of the informed consent letter was requested from the student's parent or guardian. Only those students who submitted informed consent participated in the study. The questionnaires were answered anonymously between May and June 2019, under the supervision of a researcher in a classroom during a school day, and without the presence of the physical education teacher. The purpose of the research was explained to the students as well as the voluntariness and confidentiality of the answers and use of the data. They were also informed that there were no correct or incorrect answers and they were asked to answer honestly. In order to guarantee homogeneity in the conditions of data collection, the interviewers were previously trained. Data collection procedure followed the ethical standards recommended by the American Psychological Association (APA).

Due to the complexity to cover the large number of schools in the metropolitan area of Monterrey, Mexico, that could be selected in a representative sample, a convenience sample was chosen, having as a common variable in all the selected schools being from areas with medium and low-medium socioeconomic status.

The participants were 742 students (52.6% men, 47.4% women) and 29 physical education groups/class from public primary schools, located in the metropolitan area of Monterrey, México. The organization of the groups/classes carried out by the schools before the beginning of the school year was taken, so the authors did not intervene in the organization of these groups. The age range of the students was between 10 and 13 years old (M = 11.35, SD = 0.49) and had one or two physical education classes per week (M = 1.57 and SD = 0.40). Classes duration were between 40 and 60 min each class (M = 45.43, SD = 5.47).

Regarding the power analysis, this sample should have sufficient statistical power to detect relevant relationships at the individual level. According to sample size and statistical power calculations in multiple regressions, assuming a low effect size (f^2 = 0.05) for a maximum number of predictors (5) and an alpha level of 0.05, in order to attain a statistical power level of 0.80, the required sample size would be 263 (Faul et al., 2009). The study sample at the individual level was composed of 742 students, thus, larger than the required to attain an adequate power level.

Considering the group level of analysis, previous literature indicate that a statistical power of at least 0.80 can be obtained with samples of about 30 groups with around 20 members (Bell et al., 2014). In this study, the multilevel analysis were run with 742 students belonging to 29 physical education groups, with a group average size of 25.6 students per group.

Measures

To measure perceptions of corrective feedback received by the students and their perceived legitimacy, an adapted version to the physical education context of the Amount of Corrective Feedback Scale in sport was used (Tristán et al., 2013). This scale is made up of four subscales with four items each (16 items in total): corrective feedback scale, legitimate perception, opportunity to learn, and illegitimate perception. For the purpose of this study, only the corrective feedback and perceived legitimacy subscales were used. All items were answered using a Likert response scale in a range of 1 (*completely disagree*) to 5 (*completely agree*). An example of an item in the corrective feedback subscale is: "*Is it true that your physical education teacher points out mistakes?*" In the perceived legitimacy subscale, an example of an item is: "*If my*

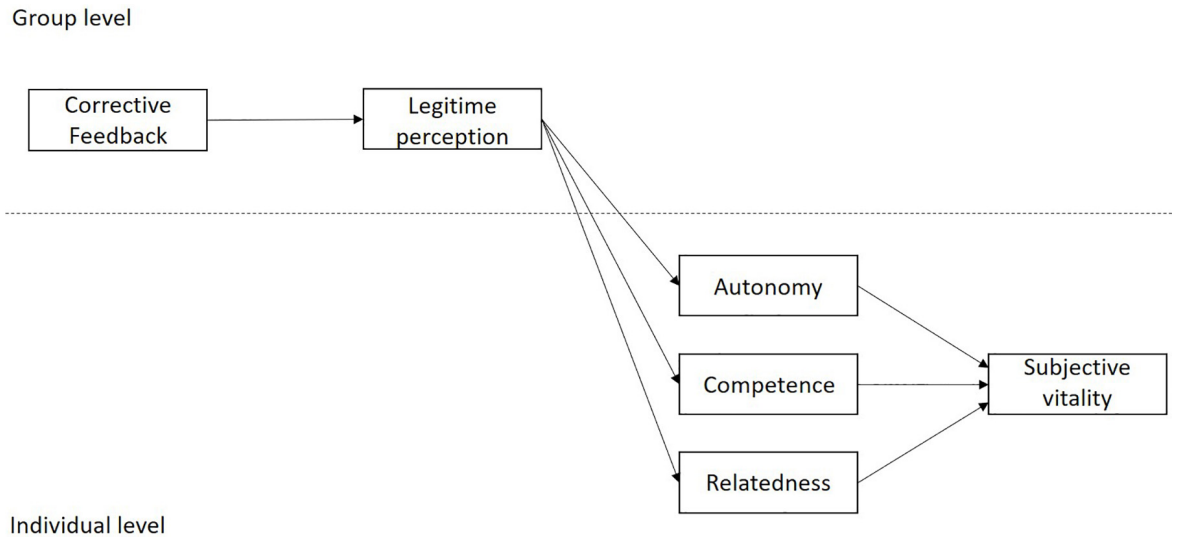

FIGURE 1 | Graphical representation of the hypothesized conceptual model.

teacher points out my mistakes, I find that he (she) has a fair reason to do so."

To assess the satisfaction of basic psychological needs, the Mexican Scale of Satisfaction of Basic Psychological Needs in Physical Education was used, adapted and validated by Zamarripa et al. (2017). This instrument presents three subscales that measure the needs of autonomy, competence and relatedness through a total of 16 items with a Likert-type response scale of seven points, in a range of 1 (*strongly disagree*) to 7 (*strongly agreement*). To measure the need for autonomy, the instrument uses six items headed by the statement: "In this physical education class ...." An example of an item in this subscale is *"my opinion counts as to what activities I want to practice."* For the need for competence, the corresponding subscale is made up of five items, preceded by the heading: *"In this physical education class...,"* and an example of an item is: *"I think I'm pretty good."* Finally, to assess the need for relatedness the subscale is made up of five items preceded by the statement: *"With the other students in my physical education class I feel..."* and where an example of a response is: *"understood."*

Subjective vitality was measured through an adaptation to the context of physical education of the Spanish Subjective Vitality Scale in its Mexican version (López-Walle et al., 2012; Castillo et al., 2017). This scale is composed of six items with a Likert response scale, whose range is from 1 (*not true*) to 7 (*true*). An example of an item is *"I feel encouragement and enthusiasm (alive) and full of life (vital)."*

The adaptations of the instruments were carried out by a panel of experts in physical education as well as active physical education teachers. The instruments were also piloted with reduced samples of primary level physical education students to verify the adequate compression of the items.

Data Analysis

Descriptive analyses were performed for each of the study variables (mean, standard deviation, skewness and kurtosis). The normality of the data was determined following Muthén and Kaplan (1985, 1992) and Ferrando and Anguiano-Carrasco (2010), who recommend coefficients of skewness and kurtosis in a range of -1, 1. The Pearson correlation test was carried out to analyze the interrelations between the variables and establish the level of association between them. To evaluate the reliability of the scales used, internal consistency analyses were performed using Cronbach's alpha as an indicator. Descriptive and correlation analyses were performed using SPSS 25.0 software.

To assess the factorial structure of the hypothesized model, confirmatory factor analysis (CFA) was carried out using the Maximum Likelihood (ML) as the estimation method. The model fit indices used were chi-square (χ^2), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI), and the standardized root mean square residual (SRMR) (Hu and Bentler, 1999; Kline, 2005).

In order to justify data aggregation for the two variables considered at the team level (corrective feedback and legitimate perception), within-group agreement, interrater reliability and between group discrimination were tested. To evaluate within-group agreement, several indices were estimated: the Average Deviation Index (ADI, Burke et al., 1999), the $r_{WG(J)}$ (James et al., 1984), and the intraclass correlation coefficients ICC1 (Bliese, 2000). The following cut-off values were used as indicators of within-group agreement: ADI values below 0.83 for a 5-point Likert response scale (Burke and Dunlap, 2002), ICC1 values higher than 0.05 (LeBreton and Senter, 2008), and $r_{WG(J)}$ values above 0.70 (Bliese, 2016). ICC2 was used to estimate the reliability of the group mean (interrater realibility), with values above 0.70 considered as satisfactory (Bliese, 2000). To determine

the existence of statistically significant discrimination between groups, one-way analysis of variance (ANOVA) was used.

Finally, to assess the hypothesized structural model, multilevel structural equation modeling (MSEM) was used with Mplus software (Muthén and Muthén, 1998–2010), using maximum likelihood estimation. According to Zhang et al. (2009), in this study the proposed model was a 2-2-1-1 model, where corrective feedback and perceived legitimacy were level two variables, and basic psychological needs satisfaction (autonomy, competence, and relatedness), and subjective vitality were level one variables (see **Figure 1**). To test the significance of the indirect effects, the Monte Carlo (MC) confidence interval (CI) method was used, using the web estimator provided by Selig and Preacher (2008). This method has been suggested to determine indirect effects in multilevel models (Preacher and Selig, 2012).

RESULTS

Descriptive Statistics

Table 1 presents the descriptive statistics of the variables of the study. Skewness and kurtosis values, followed a normal distribution. Cronbach alpha values were above 0.70, except for autonomy which showed a value of 0.68. Thus, according to Peterson (1994), the reliability level of the whole scale is to be considered satisfactory, with the exception of the autonomy subscale which presented an adequate degree of reliability. Additional reliability analyses were run for the autonomy subscale. Concretely, the Omega coefficient (McDonald, 1999) and the composite reliability value (Rho) (Raykov, 2001) were estimated, which turned out to show adequate values (Omega = 0.75, rho = 0.75). Considering these results, and taking into account the theoretical relevance of the variable, it was decided to maintain the autonomy subscale in the model. Finally, all the correlations between the analyzed variables were positive and statistically significant ($p < 0.01$) with exception of the relationship between group legitime perception and autonomy.

Confirmatory Factor Analysis

Two alternative CFA models were tested: a four factors model (corrective feedback, legitimate perception, basic psychological needs satisfaction and subjective vitality), and the hypothesized six factors model (corrective feedback, perceived legitimacy, need for autonomy, need for competence, need for relatedness, and subjective vitality).

The four factors model showed non-satisfactory fit to data [$\chi^2(397) = 1644.56$, $\chi^2/gl = 4.142$ $p < 0.001$; RMSEA = 0.06; CFI = 0.82; TLI = 0.80; SRMR = 0.06], while the hypothesized six factors model showed a satisfactory fit to data [$\chi^2(390) = 875.46$, $\chi^2/gl = 2.224$ $p < 0.001$; RMSEA = 0.04; CFI = 0.93; TLI = 0.92; SRMR = 0.04]. Additionally, all the items in the six factors model showed statistically significant factor loadings in their corresponding factors ($p < 0.01$).

Justification of Data Aggregation

The ADI value for corrective feedback was 0.78 ($SD = 0.19$) and for perceived legitimacy was 0.64 ($SD = 0.11$). The $r_{WG(J)}$ value for corrective feedback was 0.74 and for perceived legitimacy was 0.87. The ICC1 value for corrective feedback was 0.063 and for perceived legitimacy was 0.069. All these values together indicated that there was within-group agreement on perceived corrective feedback and perceived legitimacy. The ICC2 value for corrective feedback was 0.63 and for perceived legitimacy was 0.65, indicating acceptable interrater reliability (Bliese, 2000). Finally, the ANOVA results for corrective feedback [$F_{(28,713)} = 2.747$, $p < 0.001$] and perceived legitimacy [$F_{(28,713)} = 2.914$, $p < 0.001$] indicated statistically significant differences between the groups in perceived corrective feedback and perceived legitimacy. According to these values, justification for data aggregation at the group level for corrective feedback and perceived legitimacy was supported, and thus, to test the proposed model using multilevel structural equation modeling.

Multilevel Structural Equation Modeling

The hypothesized multilevel model presented adequate goodness of fit indices [$\chi^2(5) = 16.898$, $\chi^2/gl = 3.38$ $p < 0.01$; RMSEA = 0.057; CFI = 0.98; TLI = 0.92; SRMR within = 0.001, SRMR between = 0.16].

Figure 2 shows the results of the multi-level mediation model. First, at the group level (between level), a positive and statistically significant relation ($B = 0.49$, $p < 0.01$) can be observed between corrective feedback provided by the teacher and perceived legitimacy. A positive but not significant relation ($B = 0.17$, $p > 0.05$) between perceived legitimacy and psychological need satisfaction of autonomy. A positive and significant relation between perceived legitimacy and psychological needs satisfaction of competence and relatedness ($B = 0.66$, $p < 0.05$; $B = 0.95$, $p < 0.01$, respectively), as well as a negative and not significant association between psychological need of autonomy

TABLE 1 | Descriptive statistics, reliability, and correlation between study variables.

	M	*SD*	α	Skewness	Kurtosis	1	2	3	4	5
1 Group corrective feedback	3.90	0.25	0.76	−0.25	−0.25	–				
2 Group legitime perception	4.27	0.20	0.73	−0.47	0.02	0.63**	–			
3 Autonomy	4.47	1.17	0.68	−0.16	−0.45	0.19**	0.03	–		
4 Competence	5.16	1.19	0.81	−0.58	0.36	0.15**	0.12**	0.36**	–	
5 Relatedness	5.44	1.33	0.92	−0.73	0.18	0.14**	0.15**	0.39**	0.55**	–
6 Subjective Vitality	5.14	1.11	0.79	−0.61	−0.08	0.20**	0.10**	0.27**	0.46**	0.43**

*M, Mean; SD, Standard deviation; α, Cronbach's alpha; **p < 0.01.*

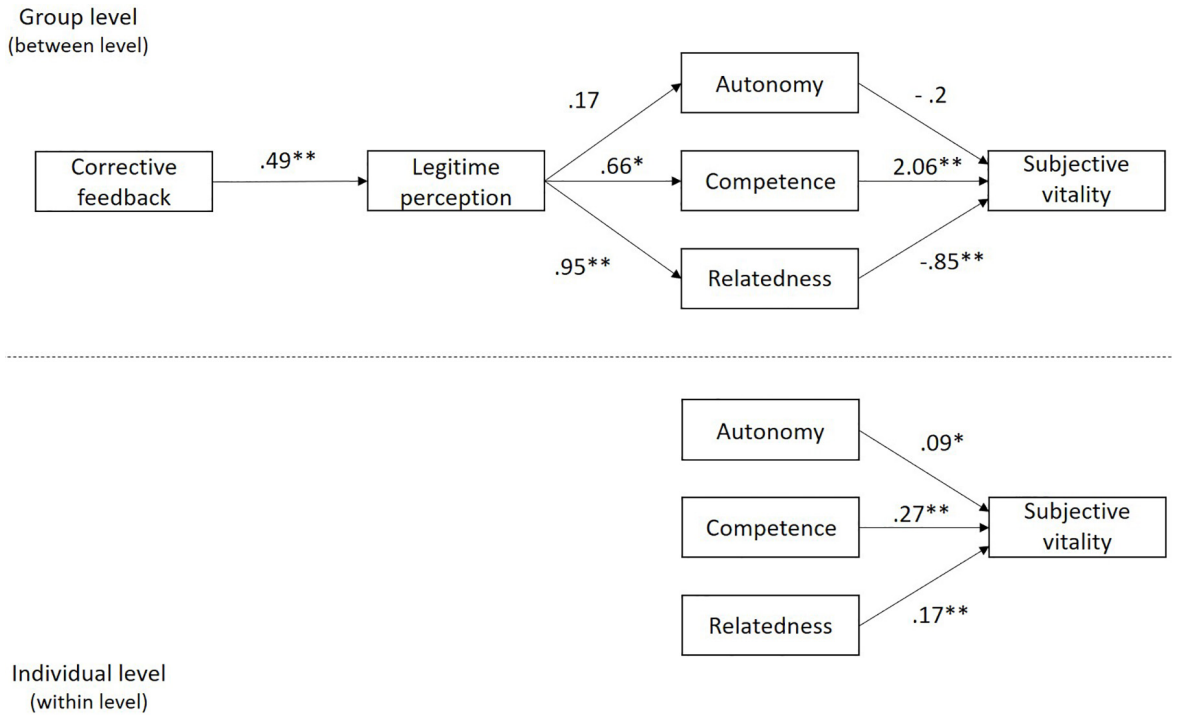

FIGURE 2 | Non-standardized results of the hypothesized model. *$p < 0.05$; **$p < 0.01$.

and subjective vitality ($B = -0.20$, $p > 0.05$). A positive and statistically significant relation between psychological need satisfaction of competence and subjective vitality ($B = 2.06$, $p < 0.01$), and finally, a negative and significant association between psychological need satisfaction of relatedness and subjective vitality ($B = -0.85$, $p < 0.01$).

Additionally, at the individual level (within level), results showed a positive and statistically significant relation between basic psychological needs satisfaction (autonomy, competence, and relatedness) and subjective vitality ($B = 0.09$, $p < 0.05$; $B = 0.27$, $p < 0.01$; $B = 0.17$, $p < 0.01$, respectively).

Regarding the between level indirect effects, corrective feedback showed a positive and significant relationship with subjective vitality trough perceived legitimacy and psychological need satisfaction of competence (unstandardized estimate of the indirect effect = 0.67, $p < 0.05$, 95% MC CI = 0.23, 0.36); moreover, corrective feedback showed a negative and significant relationship with subjective vitality trough perceived legitimacy and psychological need satisfaction of relatedness (unstandardized estimate of the indirect effect = −0.4, $p < 0.05$, 95% MC CI = −0.86, -0.1). Those results allowed concluding that perceived legitimacy and the satisfaction of the basic psychological needs of competence and relatedness, mediated the relationship between corrective feedback and subjective vitality.

Finally, in order to know the type of mediation of perceived legitimacy and the satisfaction of basic psychological needs (competence and relatedness) in the relationship between corrective feedback and subjective vitality, an alternative model with a direct relationship between corrective feedback and subjective vitality was tested. The fit of the partial mediation model was adequate [$\chi^2(4) = 10.029$, $\chi^2/gl = 2.507$ $p < 0.05$; RMSEA = 0.045; CFI = 0.99; TLI = 0.95; SRMR within = 0.001, SRMR between = 0.15].When comparing the partial mediation model with the hypothesized full mediation model, the differences between the two nested models on RMSEA were non-relevant (ΔRMSEA = 0.012), but ΔTLI and ΔCFI values (ΔTLI = 0.029; ΔCFI = 0.010) showed relevant differences, indicating that the alternative partial mediation model was the best fitting model. Moreover, the relationship between corrective feedback and subjective vitality was significant ($B = 0.67$, $p < 0.05$). Thus, partial mediation was supported.

DISCUSSION AND CONCLUSION

The general aim of this study was to test, under the postulates of the Self-Determination Theory (Ryan and Deci, 2017), a model that examined the relations between corrective feedback, legitimate perception at the group level and subjective vitality at the individual level, mediated by the satisfaction of basic psychological needs. Although a similar model has already been tested in the field of sports (Ríos, 2015; Tristán et al., 2017), it had not been applied in physical education and had not been approached from a multilevel perspective.

Starting from the group level, a positive and significant association was observed between corrective feedback and the perceived legitimacy of physical education groups. Up to the time of the writing of this manuscript, there are no known

studies at the group level that analyze these two variables. Nevertheless, this finding is similar to that reported in previous studies at the individual level in the sports context (Mouratidis et al., 2010; Ríos, 2015; Tristán et al., 2017), and therefore, just as in the trainer-athlete relationship (Mouratidis et al., 2010; Carpentier and Mageau, 2013, 2016; Ríos, 2015; Tristán et al., 2017, 2018), physical education students also perceive their teacher's corrections as fair and reasonable (legitimate) when they are given in an autonomy-supportive style.

Similarly, it was found at group level that legitimate perception was positively and significantly associated with competence and relatedness needs, an association that also occurs at individual level in the field of sports (Ríos, 2015; Tristán et al., 2017). Therefore, in the physical education class, it is also important for teachers to ensure that their students have a high degree of acceptance of the corrective feedback they have provided, and that their competence and relatedness needs are met. However, the association between legitimate perception and the need for autonomy, contrary to the sports context (Ríos, 2015; Tristán et al., 2017), was not significant. This could be explained by the fact that students do not perceive a sense of choice and freedom about how to act to correct their mistakes (Taylor et al., 2010), and those perceptions of autonomy are more likely to fluctuate depending on the context (Cox et al., 2008).

In addition to the above, also at a group level, and contrary to what has been hypothesized in this work, and to what has been reported at an individual level in the field of sports (Adie et al., 2008; López-Walle et al., 2012; Ríos, 2015; Garza-Adame et al., 2017), as well as in physical education (Taylor and Lonsdale, 2010; Tristán et al., 2019), the need for autonomy was not positively or significantly related to subjective vitality, which was the case for the need for competence and was also the strongest relation found in the proposed model. On the other hand, the least expected result was the association between the need for relatedness and subjective vitality, which was negative and significant. These results seem to show that the functional meaning of the need for competence may be greater than the needs of autonomy and relatedness in the field of physical education (Standage et al., 2006). In other words, the physical education groups with a higher satisfaction of their need for competence showed greater subjective vitality (Taylor et al., 2010). In addition, in a study (Wilson et al., 2012) that analyzed at a group level and as a single factor basic psychological needs, these were not significantly associated with ill-being variables (motivation and engagement), which is partly consistent with some results of this study.

Finally, at the individual level, a positive and statistically significant relation was observed between the autonomy, competence and relatedness needs, and subjective vitality, which is similar to that found in sport-related research (Adie et al., 2008; López-Walle et al., 2012; Garza-Adame et al., 2017) and supports the idea that basic psychological needs are more individual constructs (Ryan and Deci, 2017). However, more studies need to be done at the group level to be clearer about the satisfaction of psychological needs and their role on subjective vitality.

Complementarily, in the first hypothesis raised for this work, it was expected to find a positive indirect effect between corrective feedback and subjective vitality through legitimate perception and the satisfaction of the need for autonomy. The results obtained showed a non-significant indirect effect. This result could be related to the negative association between autonomy and subjective vitality presented in this study, because autonomy is more likely to fluctuate according to context and is more strongly derived from situational factors such as social relations with the physical education teacher and classmates (Cox et al., 2008). This result indicates that teachers, when providing corrective feedback, need to do so in an empathetic, accurate and option-oriented manner, as well as providing the opportunity for active participation of students in decision making, in order for them to experience greater autonomy (Carpentier and Mageau, 2013, 2016).

Hypothesis two established that corrective feedback would have a positive indirect effect on subjective vitality through legitimate perception and the need for competence. The results obtained confirmed what was established in the hypothesis, since a positive and significant indirect effect was found among these variables. In that sense, this finding is added to the apparent prominence of the need for competence found at group level in the model analyzed. As mentioned above, in the context of physical education, physical competences are very visible (Taylor et al., 2010), so high perceptions of competence by students, together with legitimate perceptions of corrective feedback provided by the teacher, are associated with higher subjective vitality.

Hypothesis three stated that corrective feedback would have a positive indirect effect on subjective vitality through the need for relatedness, however, the results obtained showed a significant but negative indirect effect, which was contrary to what was expected. This could be explained by the fact that the need for relatedness is more likely to fluctuate according to the context and may derive more strongly from situational factors such as social relations with the physical education teacher and classmates (Cox et al., 2008). This result allows us to point out, after having analyzed each psychological need, that the need for competence may be less sensitive to situational influence (Cox et al., 2008) and publicly more visible and prominent in physical education than the perceptions of autonomy and relatedness (Standage et al., 2006; Cox et al., 2008).

The results obtained in this study represent an important contribution to the literature due to the scarcity of research related to corrective feedback in physical education classes. It is to be notice that corrective feedback in this study has been approached from both a group and individual perspective, and it corroborates what has been suggested in previous studies (Koka and Hein, 2005), where despite of focusing on error, when communicated in an assertive manner, corrective feedback can favor perceived competence.

In addition to the contributions of this study, limitations must also be recognized. Firstly, in comparison to other studies using multilevel analysis (Wilson et al., 2012; Beauchamp et al., 2014; Estreder et al., 2019), this study had participants distributed in few physical education groups, which may have had an impact on representativeness as well as on the power of the test and therefore on not detecting potentially significant relations. Secondly, this study measured whether the student perceived that

their teacher provided corrective feedback, but not how often it was provided. Future studies could consider measuring the frequency of perceived corrective feedback, as well as including the level of perception and acceptance among boys and girls. Finally, future studies could further study the corrective feedback received, as well as its legitimate and illegitimate perception and symptoms of well-being/ill-being with a multilevel approach, as well as conducting research with longitudinal designs.

In conclusion, at group level, when physical education students perceive the corrective feedback provided by their teachers as legitimate, they perceive their psychological needs for competence and relatedness to be more satisfied, with only the satisfaction of the need for competence being associated with greater perceptions of vitality. At the individual level, the satisfaction of the need for autonomy, competence and relatedness is associated with increased perceptions of vitality. Therefore, it is important that teachers ensure the acceptance of corrective feedback given to students by adopting an autonomy-supportive style.

PRACTICAL APPLICATIONS

The results of the present study suggest that for corrective feedback to have a positive impact on physical education students, it must be provided under characteristics that guarantee its acceptance by the students and thus be perceived as more vital, so that there is adequate communication and interaction between the teacher and his/her students. These results can contribute to the development of training programs for in-service and pre-service physical education teachers to make their classroom intervention more effective. Similarly, the suggestions and findings of the present study could be used for the development of teacher performance assessment tools from the perspective of an external evaluator.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Comité de Investigación de la Facultad de Organización Deportiva under registration number: REPRIN-FOD-67. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

JT, APV-T, JML-W, and IT contributed to the conception and design of the study. APV-T, AG-G, and IT organized the database and performed the statistical analysis. APV-T and JT wrote the first draft of the manuscript. APV-T, JT, IT, JML-W, and AP wrote the sections of the manuscript. AG-G and AP global review of the article and relevance of the translation. All authors contributed to manuscript revision, read and approved the submitted version.

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Influence of Organized vs Non Organized Physical Activity on School Adaptation Behavior

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It is now well-established that physical activity has positive effects on both physical and mental health. However, the influence of organized physical activity (i.e., programs controlled and supervised by a trainer) on school adaptive behavior of adolescents with disabilities and/or behavioral disorders remains unclear. School behavior adaptation involves the ability to learn, conform to school norms and manage school activities without major behavior conflicts. A cross-sectional study was conducted to test the differences between organized physical activity and non-organized physical activity in an after school program. Eighty Romanian adolescents were recruited and allocated to three groups: (a) with disabilities [Ds; $N = 17$, $M_{age} = 14.55$ years ($SD = 1.16$), 12 males and 5 females], (b) with conduct disorders [CDs, $N = 21$, $M_{age} = 14.52$ years ($SD = 1.11$) 16 males and 5 females], and (c) participants who had not shown signs of conduct disorders or disabilities [as a control group; $N = 42$, $M_{age} = 14.2$ years ($SD = 0.46$) 20 males and 22 females]. Personality traits, school behavior, and sensorimotor coordination were assessed by using the Eysenck personality questionnaire—junior scale, school in-adaptability questionnaire scale, and Vienna Test System Sport (SMK—sensorimotor coordination test) respectively. Multivariate analysis of variance MANOVA (3×3) and discriminant analysis were used to examine differences between the psychological and sensorimotor coordination outcomes across three groups and three types of physical activity context: (a) organized physical activity, (b) non-organized physical activity, and (c) no physical activity. The findings indicate that not participating in an organized physical activity program results in a reduced level of physical mobility and consequently is associated with maladaptive social and psychological outcomes. Thus, we argued that attending in an organized physical activity program is more beneficial for participants with disabilities and/or behavior disorders, due to an increase in the probability of school integration and development of their motor skills. Clearly more research is needed in order to investigate these effects in neurophysiological levels.

Keywords: physical activity, disabilities, conduct disorders, school behavior, adolescents

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INTRODUCTION

Adolescence has often been described as a period of turmoil during which: (a) young people are more at risk for emotional maladjustment, and (b) physical activity typically declines or is completely avoided (Skinner and Piek, 2001). Particularly among adolescents with either disabilities or conduct disorders, the aforementioned issues could be more prominent. Thus, it is assumed that being involved in an organized practice of physical activity during adolescence could prevent such maladjustments (Moore and Werch, 2005; Taliaferro et al., 2008). Participating in organized physical activity during adolescence at schools in after-school programs (in addition to the regular physical activity sessions included in the compulsory teaching program) has been shown to promote the development of psychological skills (Owen et al., 2014; Esteban-Cornejo et al., 2015; Hills et al., 2015; Timo et al., 2016), and improve school behavior (Rasberry et al., 2011; Beckmann and Elbe, 2015; Naylor et al., 2015), as well as motor function (Hands et al., 2009; McIntyre et al., 2015). In contrast, lack of physical activity (inactivity) has been associated with mental health risks (Delisle et al., 2010; Biddle and Asare, 2011; Elinder et al., 2011), and impairment of learning (Davis et al., 2011). Physical activities in an organized setting refer to the use of sports halls or fields with availability of appropriate equipment's for sports activities (team or individual) and physical activity lessons. In these types of activities, under the supervision of a trainer, facilities are adapted to meet a participant's demands. Participants, in this organized setting, usually are required to follow their trainer's guidance (Vella et al., 2016) to perform extracurricular activities (Rasberry et al., 2011) and the environment is usually competitive (Eime et al., 2013). However, this is not the case in non-organized activities, whereas the type of activities are indicated by lack of practical instructor training or lack of structured activities (Walters et al., 2009).

Although, the benefits of physical activity in school adjustment and academic performance are well documented for typically developing adolescents (Fox et al., 2010; Rasberry et al., 2011; Booth et al., 2014; Jewett et al., 2014), the effects of physical activity on adolescents with conduct disorders and adolescents with disabilities are less understood (Stathopoulou et al., 2006; Kasser and Lytle, 2013; Clow and Edmunds, 2014). By considering that the adolescents with the above-mentioned conditions are part of the regular school system, there is high demand for research in this area (Malone et al., 2012; Sachlin and Lexell, 2015).

The present study focuses on school adjustment comparing adolescent groups in terms of the variables included in the study such as personality traits: extraversion; neuroticism; and psychoticism (Rhodes and Smith, 2006), school behavior: rebelliousness and school neuroticism (Clinciu, 2014), and motor functions: sensorimotor coordination (Perkins and Noam, 2007). These variables were reported (Rhodes and Smith, 2006; Reiss, 2009; Poitras et al., 2016) by distinct groups of adolescents (i.e., adolescents with disabilities, adolescents with conduct disorders, typically developing adolescents).

Physical Activity Involvement Among Adolescents With Disabilities

In general, it has been shown that adolescents with physical disabilities are less involved in physical activities, particularly in school. For instance, McIntyre et al. (2015) reported that adolescents with decreased motor abilities tend to avoid participating in physical activities. The rate of participation in leisure activities of adolescents with disabilities is associated with several variables, such as the degree of coordination (e.g., sensorimotor coordination), communication capacity, cognitive functions, and poor rehabilitation outcomes (Henderson and Bryan, 1997). These variables are particularly important for social integration of adolescents with disabilities (Bult et al., 2011) given the fact that the level of social inclusion is dependent on community access rather than on the high number of friendships (Simplican et al., 2015).

Numerous studies have provided evidence that participation in leisure physical activities increases well-being and life satisfaction of adolescents with disabilities (Johnson, 2009; Yazicioglu et al., 2012). For example, Dahan-Oliel and Shikako-Thomas (2012) highlighted significant improvements not only in motor functions of adolescents with disabilities, but also regarding their perceived quality of life and friendships as a consequence of participating in an organized physical activity program during the school programs. Additionally, other researchers (e.g., Shapiro and Martin, 2014) have reported participation in physical activity fosters growth and development of friendships outside of these settings. Furthermore, Edwards (2015) pointed out that physical activity could allow consolidation of the abilities required for social co-existence and for increasing social cohesion.

Physical Activity Involvement Among Adolescents With Conduct Disorders

One disability that affects around 5% of adolescents worldwide is conduct disorder (Erskine et al., 2017). Conduct disorder is defined as a repetitive and persistent pattern of behavior in which the basic rights of others or major appropriate norms are violated, such as failure to conform to norms, or cruel and aggressive behavior (American Psychiatric Association [APA], 2013). Research has shown that conduct disorder can occur in childhood and adolescence, and adolescents with learning disabilities have an increased risk of developing associated conduct disorders (Sadock and Sadock, 2007; American Psychiatric Association [APA], 2013). According to Mahoney and Stattin (2000), participation in organized leisure activities (e.g., sports) was negatively associated with antisocial behavior compared with participation in unorganized leisure activities (e.g., recreation centers). However, the efficacy of social rehabilitation and reintegration through physical activity remains a challenge to develop sufficient empirical support, especially for disadvantaged groups (Archie et al., 2007; Desha et al., 2007). The shared nature of benefits in school sport participation has been demonstrated in several other studies. Alternatively, Jewell et al. (2015) highlighted that school sport participation

during adolescence was significantly associated with higher self-rated mental health in young adulthood. For instance, Samek et al. (2015) found that adolescents involved in sports showed fewer conduct disorder symptoms than those not involved in sports. Furthermore, it was found that conflict behavior rates peak when adolescents with conduct disorders participate in unsupervised after school programs (Jewell et al., 2015). Therefore, this means that a careful management of physical activity or sports in an organized framework would be most beneficial for adolescents with conduct disorders improving their opportunities to adapt to school and social norms.

The Present Study

There are a number of potential reasons for analyzing the benefits of organized physical activity participation in adolescence regarding school integration (Marcus et al., 2000; Reiss, 2009; Biddle and Asare, 2011). To the best of our knowledge no previous studies have yet focused on the relationship between organized physical activity and personality traits, school behavior and sensorimotor coordination among different groups of adolescents (adolescents with disabilities, adolescents with conduct disorders, and adolescents who develop normally). Adolescents who develop normally have no physical or mental disabilities and are free from any diagnosed disorders, are also known as typically developing adolescents (Pan et al., 2015). Moreover, the research conducted on adolescents with disabilities and adolescents with conduct disorders regarding school integration are rather scarce. When considering the fact that there are no differences in the education system between those with and without disabilities, we therefore assumed no differentiation would be necessary between groups. In this study, all adolescents with disabilities or conduct disorders were diagnosed by trained physicians in public hospitals and were assessed by qualified school district personnel according to the guidelines of the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-V; American Psychiatric Association [APA], 2013). Additionally, school behavior outcomes should be an important factor in the development of the adolescent regarding school integration, acknowledging whether the individual suffers from a disability or a disorder. Therefore, the present research aimed to fill this gap by evaluating the effectiveness of organized physical activity on school behavior, psychological, and sensorimotor coordination among different groups of adolescents: adolescents with physical disabilities (Ds), adolescents with conduct disorders (CDs), and participants who had not shown signs of conduct disorders or disabilities (as a control group; Cs). On the basis of the literature (Heaven et al., 2008; Johnson, 2009; Rockhill et al., 2009; Dahan-Oliel and Shikako-Thomas, 2012; Yazicioglu et al., 2012; Hoolis et al., 2014; Shapiro and Martin, 2014; Edwards, 2015) we hypothesized that: (a) the participants in Ds group will show significantly lower scores of sensorimotor coordination in comparison to other groups, and (b) the participants in Cs group will show higher levels of school behavior in comparison to other groups. We also hypothesized that adolescents participating in organized physical activity will report significantly lower scores of psychoticism, school neuroticism and rebelliousness in comparison to adolescents not taking part in physical activity.

MATERIALS AND METHODS

Participants

Originally 120 Romanian adolescents voluntarily participated, 80 of which completed all questionnaires and were therefore included in the present study (48 boys and 32 girls; M_{age} = 14.3 years, SD = 0.9): (a) Seventeen adolescents with physical disabilities (Ds) diagnosed with associated motor deficiencies. (b) Twenty-one adolescents with conduct disorders (CDs). (c) Forty-two participants who had not shown signs of conduct disorders or disabilities (as a control group; Cs). With approval and financial support from both the European Social Fund and the Romanian Government, a group of adolescents participated in our research study investigating the relevance of the qualitative level of psychological and motor components designed to improve school adaptation in this age group. Therefore, only adolescents with disabilities and conduct disorders, as well as typically developing adolescents were included in the study.

The participants of these three groups were distributed according to the involvement in physical activity after school programs, such as: (a) organized practice of physical activity (OPA)—their performance was controlled by the coach or instructor (controlled physical activity 3–4 times per week); (b) non-organized practice of physical activity (NOPA)—their performance was not controlled by the coach or an adult (unstructured physical activity 1–2 times per week); or (c) no physical activity (NPA)—they were not involved in any physical activity or do not participate in any form of organized sport or physical activity after the school program.

Instruments

To assess personality traits we used the Romanian validated version of Grigoriu-Şerbănescu (1984) the Junior Eysenck Personality Questionnaire—Junior EPQ (Eysenck and Eysenck, 1975), measuring extraversion (action orientated; enthusiastic; talkative; assertive), neuroticism (irritable, nervous, apprehensive), and psychoticism (hostile, aggressive, impersonal, foolhardy), which was developed for individuals ages 10–18 years old (81 items). Participants responded on a dichotomous scale (yes = 1, no = 0). Cronbach's alpha was used to determine the internal consistency reliability of the total score. were $\alpha = 0.28$, $\alpha = 0.79$, and $\alpha = 0.67$ for extraversion, neuroticism and psychoticism, respectively. However, due the poor reliability, extraversion was not included in the data analysis. To further assess the internal reliability of the Junior EPQ scores, item analyses were conducted (DeVellis, 2003). To test each item, the following criteria were adopted: (a) a minimum item-total correlation coefficient of $r = 0.40$ and (b) a mean inter-item correlation value of 0.20–0.70 (DeVellis, 2003; Piedmont, 2014). With the scale, the overall value of the corrected item-total correlation was observed to be in the range of 0.23–0.50 for psychoticism and 0.27–0.51 for neuroticism, respectively.

After exclusion extraversion, all items of the psychoticism and neuroticism fulfilled these criteria, providing evidence for the reliability of these two scales.

The SIQ—School In-adaptability Questionnaire (Clinciu, 2014) is a Romanian questionnaire consisting of 67 items covering the dimensions of school neuroticism (43 items; e.g., scholar stress, failing, $\alpha = 0.90$) and rebelliousness (24 items; e.g., school indiscipline, antisocial behavior, $\alpha = 0.80$). Participants responded on a dichotomous scale (yes = 1, no = 0). Reliability was good in the present study with Cronbach's $\alpha = 0.83$ for school neuroticism and $\alpha = 0.75$ for rebelliousness, respectively. The value of the corrected item-total correlation with the scale overall was observed to be in the range of 0.23–0.60 for school neuroticism and 0.22–0.55 for rebelliousness, respectively. Moreover, all items of the SIQ fulfilled the aforementioned criteria (DeVellis, 2003; Piedmont, 2014), providing evidence for the reliability of these scales.

To assess sensorimotor coordination, we used SMK (short form S1), from Vienna Test Systems Sport of the research Institute of Transilvania University in Braşov. This test is a computerized task using a joystick and was applied to measure the motor control ability (Mosoi and Balint, 2015) by utilizing the feedback in real time of sensorimotor information from the movement currently being executed by the adolescents. With this test, the task was to use a synchronous joystick to maneuver a circular yellow segment that is drawn as a piece of pizza into a required position with a tip touching a bar upright in the upside "T" position. The circle segment, which is standing on its tip, has three types of movement, including tilting to left/right, horizontal movement to left/right and movement along the depth perspective with corresponding change in size randomly made in a three-dimensional space. All the participants were properly instructed on how to use the joysticks. Overall, the test takes 15 min, including 5 min of a practice phase and 10 min of evaluation. A total test score was obtained based on the calculation of the actual positioning time of the segment at the desired position (Schuhfried, 2013).

Procedure

The current study was approved by the Transilvania University of Braşov (POSDRU/159/1.5/S/134378). The school inspectorate of Braşov County and the principals of the participating adolescents' schools were approached by a research team at the beginning of the procedure. Participation of adolescents was voluntary. Written informed consent from adolescents and their parents was obtained prior to participation in the study. The inclusion and exclusion criteria of the study were as follows: (a) are in the first year of grammar school; (b) take part in school classes every day; (c) take part in school physical exercise lessons every week; (d) do not take any medication; (e) complete both sessions. The measurements were conducted in 2 consecutive weeks. During the first week, participants completed the psychological questionnaires and during the second week they participated in the sensorimotor coordination assessment. The clinical groups completed the questionnaires on 3 consecutive days. Due to reduced concentration skills, this group required more time for the test than the other groups. Additionally, the sensorimotor test was conducted in individual sessions which took place in a quiet room at school, while questionnaires measurements were taken in group sessions. The teachers, caregivers, and the parents were comprehensively informed about the research project and the conditions of the participation. During the assessments with principals' agreements, the adolescents completed the EPQ, SIQ, SMK, as well as the demographic questionnaire.

Sample

The participants were divided into three distinct groups. The first non-clinical group consisted of participants from conventional schools, which were defined as typically developing adolescents. The second group included adolescents with disabilities represented by the "Inclusive School." These two groups were divided according to the participation on physical activities in after school programs. Lastly, the third group consisted of adolescents with conduct disorder selected from "Adolescents Psychiatry Hospital." In the first two groups the differences were between specific participation in physical activities in after school programs, where typically developing adolescents were involved in different sports and adolescents with disabilities were involved in exercise therapy to improve especially their mobility. The third group, controlled in a hospital institution, included adolescents with conduct disorders that were involved only in unorganized physical activities, because after school programs are not offered. In Romanian schools, adolescents with disabilities and conduct disorders were included in the compulsory teaching programs. Those with disabilities were taking part in exercise therapy to increase their motor adaptability toward different tasks or to prevent injury risks. Adolescents with conduct disorder, on the other hand, were practicing physical exercise to prevent antisocial interaction (Romanian Law Education, 1/2011, art. 48–50). Both groups participated in the school's general physical education program 100% of the time. In order to be included in data analysis, participants needed to have met the five criteria, as well as completed both the individual and group sessions.

Data Analysis

A multivariate analysis of variance (MANOVA) was conducted to examine the main effects of adolescent groups (Ds, CDs, and control group) and physical activity groups (OPA, NOPA, NPA) on all the dependent variables (EPQ, SIQ, and SMK scores). With such a 3×3 MANOVA, we also explored the interaction effect of adolescent groups $\times$ physical activity groups. In the analyses, in case of significant multivariate effect ($p < 0.05$) *post-hoc* comparisons (Tukey's HSD) were conducted. Partial eta squared (η^2) provided an index of effect size (Ferguson, 2009). Finally, the MANOVA was complemented by discriminant function analyses (Field, 2013).

RESULTS

Descriptive Results

Information, regarding age, sex, parental educational background (primary school; grammar school; university), family structure

(mono parental; intact family; divorce) and their current participation status in physical activity (no physical activities; non-physical activity; organized physical activity) was collected before starting the measurements. The Ds, CDs, and Cs were well matched on age and sex, but not on the family structure and parental educational backgrounds. Participants indicated the weekly frequency of organized physical activity (controlled physical activity 3–4 times per week) and non-organized physical activity after school programs (unstructured physical activity 1–2 times per week; not participate in any form of physical activity). The details of the participants included in this study are presented in **Table 1**.

Results of Comparison Groups

The results of the Box's M test ($p = 0.168$) were not significant and provided evidence for the assumption of equality of covariance matrices. Also, the tests of homogeneity of variance for all dependent variables were not significant (psychoticism, $p = 0.244$; neuroticism, $p = 0.066$; school neuroticism, $p = 0.084$; rebelliousness, $p = 0.653$; and sensorimotor coordination, $p = 0.094$). However, results of the MANOVA showed significant main effects for adolescents' groups [Wilk's Lambda, $\Lambda = 0.57$ $F(10, 138) = 4.44$, $p < 0.001$, partial $\eta^2 = 0.24$] and physical activity groups [$\Lambda = 0.73$, $F(10, 138) = 2.38$, $p < 0.012$, partial $\eta^2 = 0.15$] as well as a significant effect for the interaction of adolescents' groups × physical activity groups [$\Lambda = 0.76$ $F(10, 138) = 2.06$, $p < 0.032$, partial $\eta^2 = 0.13$]. Results of *post-hoc* comparisons, using Tukey's HSD, are presented in **Table 2**. Results of *post-hoc* comparisons adolescents' groups showed that: (a) CDs reported significantly higher scores of psychoticism, neuroticism, school neuroticism and rebelliousness than Cs; (b) CDs reported significantly higher scores of school neuroticism than Ds; (c) Cs reported significantly higher scores of sensorimotor coordination than Ds and CDs. The effect size found on adolescents groups was small, $\eta^2 = 0.18$ for rebelliousness (Cs < CDs) and $\eta^2 = 0.30$ for sensorimotor coordination (Ds; CDs < Cs).

Additionally main effects were obtained in the physical activity group showing that: (a) NOPA reported significantly higher scores of psychoticism and neuroticism than OPA, and (b) OPA reported significantly lower scores of school neuroticism and significant higher scores of sensorimotor coordination than Ds and CDs. The effect size found on physical activity groups was small, $\eta^2 = 0.16$ for sensorimotor coordination (NPA, NOPA < OPA).

Comparing the study variables in interaction of adolescents' groups × physical activity groups, a significant interaction effect emerged for psychoticism [$F(2, 73) = 5.05$, $p = 0.009$, partial $\eta^2 = 0.12$]. Adolescents with conduct disorder had a higher score compared with Ds and Cs groups. In these results adolescents with conduct disorders were compared only on the NOPA factor. Results showed that for the control group there is no significant difference between groups. In contrast, in the disability group there is a significant difference between NPA and NOPA. Indeed, adolescents from the NPA group had a higher score on psychoticism in comparison with the NOPA group. Another important aspect to consider is the OPA in relation to the variables included in analysis, where adolescents who are involved in OPA had less opportunities to develop maladaptive behaviors during their time at school. All the other variables included in the analysis show the differences between the groups, specifically the OPA. The main effects and interaction effect are presented in **Table 3**.

Results of Discriminant Function Analyses

For the three groups of adolescents, the discriminant analysis including psychoticism, neuroticism, school neuroticism, rebelliousness and sensorimotor coordination indicated two discriminant functions: F1 ($r_{can} = 50.$; Wilks $\lambda = 52.03$; $p < 0.001$), explaining 75.1% of the variance, canonical $R^2 = 0.38$, and F2 ($r_{can} = 0.82$; Wilks $\lambda = 14.59$; $p = 0.006$), explaining 24.9%, canonical $R^2 = 0.17$. Overall, 66.3% of the cases were correctly classified into the three groups of adolescents—47.1, 47.6, and

TABLE 1 | Descriptive statistics of the participants.

Group type		Ds (*N* = 17) *M* (*SD*)	CDs (*N* = 21) *M* (*SD*)	Cs (*N* = 42) *M* (*SD*)	Overall (*N* = 80)
Age (year)	Mean (SD)	14.55 (1.16)	14.52 (1.11)	14.2 (0.46)	14.36 (0.90)
Gender	Male	12	16	20	48
	Female	5	5	22	32
Family structure	Mono parental	3	3	13	19
	Intact family	12	7	31	50
	Divorce	–	11	–	11
Parental educational background	Primary school	4	6	4	14
	Grammar school	11	12	20	33
	University	2	3	18	23
No physical activities	Not participate in any form of physical activity	5	–	14	19
Non-organized physical activities	Unstructured physical activity 1–2 times per week	7	21	7	35
Organized physical activities	Controlled physical activity 3–4 times per week	5	–	21	26

Ds, Disabilities; CDs, Conduct disorder; Cs, control group.

83.3% for the Ds, CDs, and Cs, respectively. Sensorimotor coordination loaded highly on the first function (r = 0.86), whereas neuroticism (r = 0.70), rebelliousness (r = 0.57), school neuroticism (r = 0.48), and psychoticism (r = 0.46) loaded on the second function. As indicated in **Figure 1**, the discriminant function plot showed that the first function differentiated the Cs group from the CDs and Ds, whereas the second function differentiated the Ds from Cs and Cs from CDs group.

For the three groups of physical activity, the discriminant analyses including psychoticism, neuroticism, school neuroticism, rebelliousness and sensorimotor coordination also indicated two discriminant functions: F1 (r_{can} = 0.56; Wilks λ = 43.64; $p < 0.001$), explaining for 91.9% canonical R^2 = 0.39, and F2 (r_{can} = 0.94; Wilks λ = 4.61; p = 0.353) explaining 8.2% of the variance, canonical R^2 = 0.05. Altogether, 65% of the cases were correctly classified into the three groups of physical activity—26.3, 74.3, and 80.8% for the NPA, NOPA, and OPA. Sensorimotor coordination (r = 0.75), school neuroticism (r = −0.60), neuroticism (r = −0.36), and psychoticism (r = −0.35) loaded on the first functions, whereas rebelliousness (r = 0.84) highly loaded on the second function. As indicated in **Figure 2**, the discriminant function plot showed that in the first function the OPA group differentiated from the NOPA and NPA, whereas the second function differentiated the NPA from OPA, and OPA from NOPA group.

DISCUSSION

As mentioned in the literature review, although physical activity generally has been shown to have positive effects on physical and mental health, the influence of organized physical activity on school adaptive behavior of adolescents with disabilities and/or behavioral disorders remains unclear. Therefore the present research investigated the effects of organized physical activity on school behavior, psychological variables (personality factors), and sensorimotor coordination in different groups of adolescents. The three groups consisted of adolescents with disabilities, with conduct disorders, and individuals without diagnosed disabilities or conduct disorders as a control group. Increased knowledge of the role of physical activity in relation to these variables could potentially help teachers foster school integration among adolescents who suffer from Ds and CDs.

Organized Physical Activity on Personality Traits and School Behavior

The results of the study provided insight into the facilitating role of organized physical activity regarding adolescents' school adaptability. In particular, adolescents who practiced organized physical activity reported significantly lower scores of psychoticism and neuroticism than their counterparts who were not involved in organized physical activity. Moreover, adolescents who practiced organized physical activity reported significantly lower scores of school neuroticism in comparison to the adolescents who practiced non-organized physical activity or who did not practice physical activity at all. These results are consistent with previous research indicating, that school

TABLE 2 | The main effects of adolescent groups and physical activity groups on the study variables.

	Ds (*N* = 17) *M* (*SD*)	CDs (*N* = 21) *M* (*SD*)	Cs (*N* = 42) *M* (*SD*)	*F*	*p*	η^2	Tukey HSD[a]	NPA (*N* = 19) *M* (*SD*)	OPA (*N* = 26) *M* (*SD*)	NOPA (*N* = 35) *M* (*SD*)	*F*	*p*	η^2	Tukey HSD[a]
Psychoticism	5.29 (2.31)	6.57 (1.88)	4.86 (2.14)	3.03*	0.042	0.08	C < CD	5.74 (2.51)	4.5 (1.7)	5.89 (2.23)	2.52	0.087	0.06	OPA < NOPA
Neuroticism	9.47 (2.81)	12.67 (4.29)	10.14 (3.17)	2.86	0.064	0.07	C < CD	10.95 (2.95)	9.19 (2.65)	11.6 (4.22)	1.28	0.284	0.03	OPA < NOPA
School N	15.76 (7.44)	21.38 (9.45)	13.71 (8.97)	1.99	0.144	0.05	D, C < CD	18.79 (9.15)	10.23 (5.9)	19.14 (9.5)	2.03	0.138	0.05	OPA < NPA; NOPA
Rebelliousness	6.06 (2.56)	8.00 (2.32)	5.60 (2.67)	4.89*	0.011	0.18	C < CD	5.53 (2.65)	6.08 (2.57)	6.94 (2.80)	1.00	0.370	0.02	–
Sensorimotor C	1.52 (1.58)	2.76 (2.21)	5.14 (2.31)	15.6*	0.000	0.30	D, CD < C	2.94 (2.12)	5.73 (2.18)	2.71 (2.37)	7.16*	0.001	0.16	NPA, NOPA < OPA

*School N, School neuroticism; Sensorimotor C, Sensorimotor coordination; Ds, Disabilities; CDs, Conduct disorder; Cs, Control group; NPA, No physical activity; OPA, Organized physical activity; NOPA, Non-organized physical activity. All the Tukey's HSD post-hoc are significant at *p < 0.05.*

TABLE 3 | Comparison of the study variables across the three groups in interaction with physical activity.

		Ds M (SD)	CDs M (SD)	Cs M (SD)	*F*	*p*	η^2
Psychoticism	NPA	7.40 (2.07)	–	5.14 (2.44)			
	NOPA	3.71 (1.49)	6.57 (1.88)	6.00 (2.64)	5.05*	0.009	0.12
	OPA	5.40 (1.94)	–	4.29 (1.61)			
Neuroticism	NPA	9.80 (2.38)	–	11.36 (3.10)			
	NOPA	10.43 (3.59)	12.67 (4.29)	9.57 (4.03)	0.645	0.528	0.01
	OPA	7.80 (1.09)	–	9.52 (2.82)			
School N.	NPA	16.80 (7.36)	–	19.50 (9.85)			
	NOPA	15.29 (7.47)	21.38 (9.45)	16.29 (10.64)	1.33	0.270	0.03
	OPA	15.40 (9.04)	–	9.00 (4.35)			
Rebelliousness	NPA	6.60 (2.30)	–	5.14 (2.74)			
	NOPA	4.57 (2.63)	8.00 (2.32)	6.14 (2.91)	2.00	0.142	0.05
	OPA	7.60 (1.81)	–	5.71 (2.63)			
Sensorimotor C.	NPA	1.2 (1.78)	–	3.57 (1.91)			
	NOPA	0.57 (0.78)	2.76 (2.21)	4.71 (2.21)	0.763	0.470	0.02
	OPA	3.2 (0.83)	–	6.33 (1.95)			

*Ds, Disabilities; CDs, Conduct disorder; Cs, Control Group; NPA, No physical activity; OPA, Organized physical activity; NOPA, Non-organized physical activity; School N, School Neuroticism; Sensorimotor C, Sensorimotor Coordination. All the Tukey's HSD post hoc are significant at *p < 0.05.*

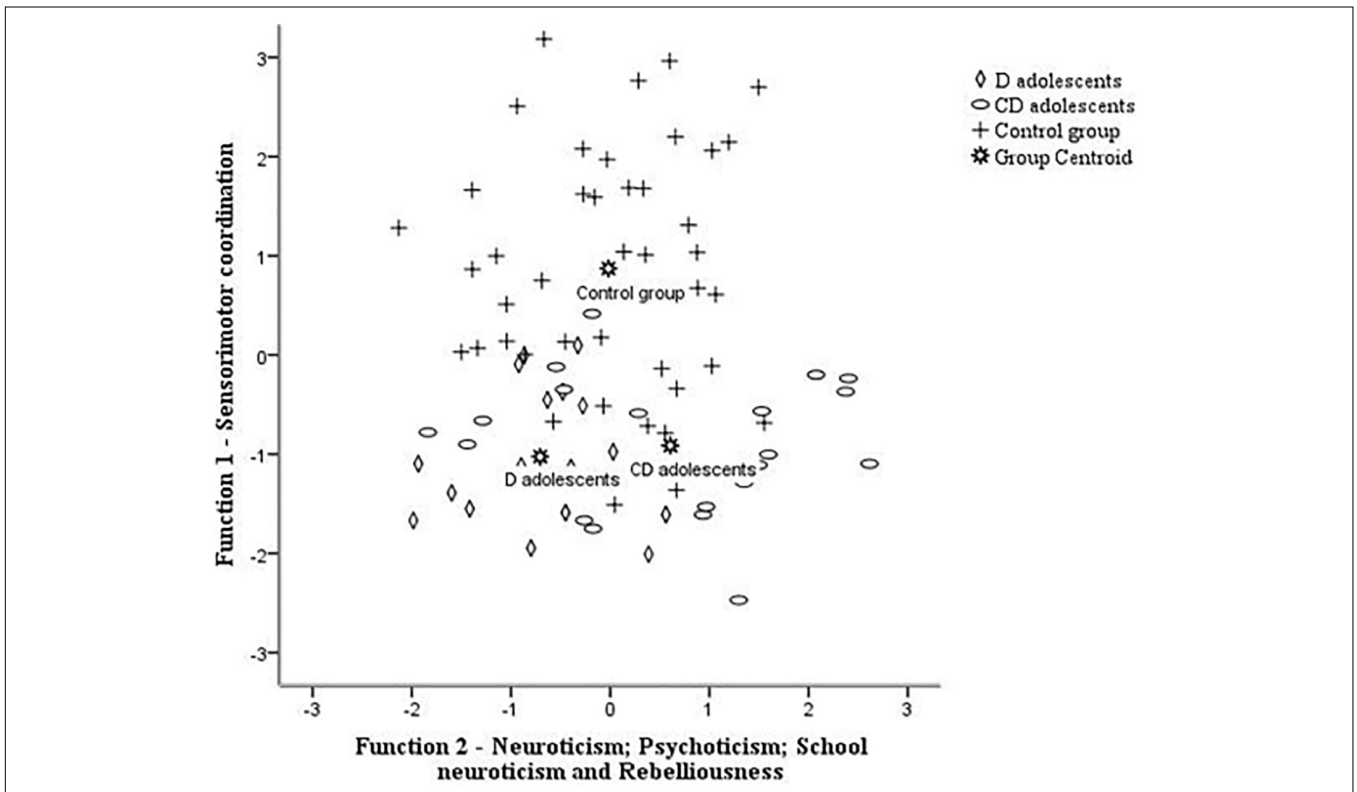

FIGURE 1 | Canonical discriminant function—distribution of adolescents groups based on significant scores of sensorimotor coordination in first function and neuroticism, psychoticism, school neuroticism, and rebelliousness in second function. Ds, disabilities; CDs, conduct disorders; Cs, control group.

neuroticism mainly occurs among adolescents who do not practice any physical activity in comparison with those who do practice organized physical activity (Berse et al., 2014). Taken as a whole, our results provided evidence for the positive relationship between organized physical activity and only a reduced level of maladaptive behavior (Carrasco et al., 2006; Rockhill et al., 2009; Esteban-Cornejo et al., 2015). Thus, the benefits of organized physical activity programs among adolescents should be further explored in the future through the prism of the remote effects of decreased recidivism (Rockhill et al., 2009). As expected, results of the present study also showed that adolescents with conduct disorder reported significantly higher levels of school

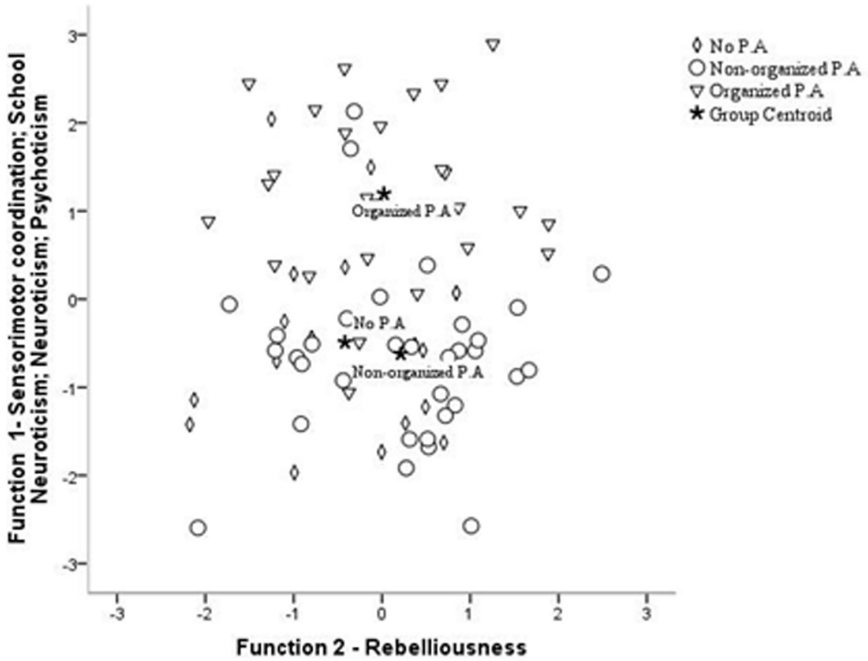

FIGURE 2 | Canonical discriminant function—distribution of physical activity groups based on the significant scores of sensorimotor coordination, school neuroticism, neuroticism, psychoticism, in first function and rebelliousness in the second function. OPA, Organized physical activity; NPA, No physical activity; NOPA, Non-organized physical activity.

neuroticism, rebelliousness, psychoticism, and neuroticism than adolescents with disabilities and/or the control group. Results also suggested that the risk of school in-adaptability (inferred from psychological and behavioral school outcomes) appeared to be higher among the adolescents with conduct disorders and on the adolescents who do not practice physical activity compared to those who are physically active. Hence, based on the facilitating role of organized physical activity regarding adolescents' psychological and behavioral school adaptability, it can be concluded that adolescents with conduct disorders could benefit the most from organized physical activity programs.

Organized Physical Activity on Sensorimotor Coordination

Regarding the sensorimotor coordination of the upper limbs, results of the present study showed a significant advantage for adolescents practicing organized physical activity. In particular, adolescents who practiced organized physical activity had significantly higher scores of sensorimotor coordination in comparison to the adolescents who practiced non-organized physical activity or who did not practice physical activity. However, contrary to our hypothesis, sensorimotor coordination in adolescents with conduct disorders was not significantly different from adolescents with disabilities. Even if the level of coordination seemed to be slightly less developed among Ds participants and CDs participants, adolescents who did not practice physical activity showed even lower scores of sensorimotor coordination. This result not only demonstrated the benefits of practicing physical activity for motor skills, as suggested in other studies (Dodge and Lambert, 2009; Walters et al., 2009; Mangerud et al., 2014; Mosoi and Balint, 2015), but also highlighted that not practicing physical activity may restrict the level of sensorimotor coordination in adolescents period (Quatman-Yates et al., 2012). These results are once again consistent with the risks for adolescents who do not practice physical activity found in previous studies (Burnett-Zeigler et al., 2012; Eime et al., 2013).

Overall, practicing physical exercise in after school programs with an organized framework should be an interactive way for adolescents to manage their free time. One benefit for taking part in an organized physical activity after school program could be the improvement of friendships between peers, as well as the reduction of risk for aggressive behavior or arrest, especially for adolescents with conduct disorders (Jewell et al., 2015; Simplican et al., 2015). These benefits likely develop the usefulness and responsibility of the individual in the team and in the competitive environment.

Limitations

To the best of our knowledge, the present study is the first survey on school integration via organized physical activities involving adolescents with disabilities and conduct disorders. Therefore, the generalizability of its results is subject to a number of limitations. For example, the cross–sectional nature of this study does not allow for examination of directionality, therefore it remains unclear whether or not the organized school physical activity caused a change in school behavior. Furthermore, the

relatively small number of participants in each of the groups (of adolescents and physical activities) and the use of self-reports could limit the generalizability of the results. In this study, the participants with conduct disorders were limited to unstructured activities due to their hospitalization status, which means the after school organized activities were missing. Therefore, in particular, future studies would need to include participants with conduct disorder who do not participate in any form of physical activity. Hence, applied research should conduct a longitudinal study with larger samples. This could provide deeper insights for understanding the effect of organized physical activities in after school programs on school adjustment, especially among adolescents with disabilities and conduct disorders. Another limitation refers to the cultural context in which the study was conducted (i.e., Romanian schools). Our results should not be interpreted in isolation especially about disadvantaged adolescents groups but rather under consideration of previous studies as a contribution to the growing body of evidence on the importance of participating in organized physical activity at school and in after school program. Additionally, futures studies should attempt to replicate these findings in other countries or different types of schools.

Implications for School Health

In order to foster adolescents' adaptability to school, personality traits, school behavior and sensorimotor coordination need to be observed and addressed concurrently. Sessions of organized physical activities could prevent the development of antisocial behavior, as well as the aggravation of the school environment. Involvement of adolescents in an organized physical activity after school program might be a particularly promising prevention strategy. Hence, to promote school adjustment, teachers should include didactic strategies for sport physical activities to increase the involvement of adolescents with conduct disorders, as well as disabled adolescents, in organized physical activities with help from families as well as the community (Edwards, 2015; Simplican et al., 2015). The adaptation and implementation of organized physical activities grounded within school programs represents one of the most important social desiderata in order to attract adolescents who do not practice any physical activity (Butler-Kort and Hagewann, 2011; Jewett et al., 2014; Nair et al., 2015). The development of organized physical activity within educational settings could represent a successful approach to public health in the long run (Abula et al., 2016; Marques et al., 2016) for a better adaptation of adolescents to the school and social environment (Bacarro et al., 2012; Drake et al., 2015; Hills et al., 2015), therefore preventing poor mental and physical health in young adulthood (Jewett et al., 2014).

CONCLUSION

In conclusion, the results of the present study point out the importance of being physically active as well as being involved in physical activity programs during adolescent years. Particularly, for behavioral problems of adolescents such as rebelliousness and school neuroticism as well as deficits in motor functions (poor sensorimotor coordination), organized physical activity in after school programs seem to offer potential for ameliorating these problems. Despite some limitations, our results also provide valuable information about the risks of adolescents who do not practice any physical activity. Arguably, decreasing strategies to manage organized physical activity decline may favor negative adaptive psychological and motor coordination outcomes similar to adolescents in Ds group and CDs group. Additional, applied research needs to be conducted, that focuses on personality traits (i.e., psychoticism and neuroticism) and school behavior (i.e., school neuroticism) among adolescents who did not practice physical activity in comparison to Ds and CDs adolescents who practiced physical activity. Future research concerning school behavior and organized physical activity could provide insight into whether participating in physical activities is associated with developing antisocial behavior. Furthermore, additional research could also potentially find a relationship between the reduction of sensorimotor coordination and the amount of free time experienced in adolescence. With this knowledge, adolescents could spend their free time furthering their development of sensorimotor coordination.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

This study was conducted in accordance with the Declaration of Helsinki. Written informed consent from all subjects was obtained and all data were rendered completely anonymous. The data of this study are open to the public and made available by the Transilvania University of Braşov through the project POSDRU/159/1.5/S/134378.

AUTHOR CONTRIBUTIONS

The original research was part of the post Ph.D. thesis of AAM, supervised by LB. AAM, wrote the first draft of the manuscript. GM, JB, and AM wrote sections of the manuscript. All authors made substantial contributions in conceptualization, methodology, to analysis and interpretation of the data, contributed to manuscript revision, read and approved the submitted version.

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CORRECTION
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Corrigendum: Influence of Organized vs Non Organized Physical Activity on School Adaptation Behavior

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In the published article, the order of the first name and the surname of the authors was incorrect. The first name of the first author was swapped with his middle name.

The names of the authors were incorrectly spelled as **Mosoi A. Alexandru, Beckmann Jürgen, Mirifar Arash, Martinent Guillaume and Balint Lorand**.

The correct spelling of the authors' names is **Adrian A. Mosoi, Jürgen Beckmann, Arash Mirifar, Guillaume Martinent and Lorand Balint**.

The authors apologize for this error and state that this does not change the scientific conclusions of the article in any way. The original article has been updated.

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