

Validity and reliability evidence for the Basic Psychological Need Satisfaction and Frustration Scale among Spanish secondary school students in physical education

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ABSTRACT

The present study aimed to adapt the Basic Psychological Need Satisfaction and Frustration Scale to the Spanish Physical Education (PE) context and to provide validity and reliability evidence for use among secondary school students. A purposive sample of 1,604 secondary school students (831 boys, 51.8%; 761 girls, 47.4%; and 12 with missing gender information, 0.7%; mean age = 15.01, SD = 1.32) participated in this cross-sectional study. The students received two mandatory 60-minute coeducational physical education (PE) lessons per week. Convergent validity was met with average variance extracted values ranging from .50 to .65. Discriminant validity was established with latent correlations ranging from -.54 to .78, and from -.53 to .82 for the heterotrait–monotrait ratio of correlations. Internal consistency was supported by acceptable Cronbach's alpha, McDonald's omega, and Raykov's rho values for six primary-order factors, and by satisfactory coefficient scores for the two hierarchical factors. Temporal stability was met through intraclass correlation coefficients ranging from .70 to .85. Structural equation analyses provided criterion validity evidence, showing positive relationships between need satisfaction and autonomous motivation, and between need frustration with controlled motivation and amotivation. The Basic Psychological Need Satisfaction and Frustration Scale has been shown to be a valid and reliable instrument for measuring secondary school students' perceptions of need satisfaction and need frustration in the Spanish physical education (PE) context.

KEYWORDS

Self-Determination Theory; Autonomy; Competence; Relatedness; Need-Based Experiences

1. INTRODUCTION

Physical Education (PE) seeks to equip students with sufficient autonomy, competence, and meaningful peer interactions across a broad range of movement patterns and physical activities in the classroom to promote lifelong physical activity and sports during leisure time (SHAPE America—Society of Health and Physical Educators, 2014). In this context, Self-Determination Theory (SDT; Ryan & Deci, 2017) is one of the most robust frameworks for examining how the students' perception of autonomy, competence, and relatedness may contribute to their learning in the PE lesson, through the lens of basic psychological needs (Van den Berghe et al., 2014; Vasconcellos et al., 2020).

Central to SDT is the premise that three basic psychological needs are essential and universal psychological nutrients for the natural tendency toward personal growth, humanity, and well-being (Ryan & Deci, 2017). To explain this human tendency, SDT proposes a dual-process model built on the distinction between need satisfaction and need frustration (Vansteenkiste et al., 2020). Specifically, need satisfaction is believed to contribute to proactivity, integration, and well-being, representing the core of the bright side of human existence (Vansteenkiste et al., 2020). In this regard, the satisfaction of the need for autonomy concerns a sense of choice, initiative, and willingness in undertaking actions (Vansteenkiste et al., 2020). Relatedness satisfaction involves a sense of mutual care, belonging, and genuine, close bonds with others (Vansteenkiste et al., 2020). Competence satisfaction denotes a sense of mastery, effectiveness, and capacity to accomplish goals (Vansteenkiste et al., 2020).

By contrast, need frustration is thought to lead to passivity, vulnerability, and ill-being, forming the core of the dark side of human existence (Vansteenkiste et al., 2020). Considering that need frustration involves the personal experience of active privation of each need (Bartholomew et al., 2011), the frustration of the need for autonomy refers to feelings of pressure, conflict, and being compelled. Given that need frustration involves the personal experience of active privation of each need (Bartholomew et al., 2011), the frustration of the need for autonomy refers to feelings of pressure, conflict, and compulsion to engage in unwanted actions (Vansteenkiste et al., 2020). Relatedness frustration involves feelings of loneliness, alienation, and social exclusion (Vansteenkiste et al., 2020). Competence frustration involves feelings of ineffectiveness, clumsiness, and failure to attain goals (Vansteenkiste et al., 2020).

The distinction between need satisfaction and need frustration has been psychometrically supported by SDT-based research (Cordeiro et al., 2016; Longo et al., 2016). This body of research has broadly demonstrated that need satisfaction and need frustration did not fall along a single need-fulfilment continuum but instead represent two clearly different yet moderately related variables. Theoretically, SDT-based research has argued that need satisfaction and need frustration have an asymmetrical relationship (Vansteenkiste et al., 2020), such that low need satisfaction does not necessarily mean the presence of need frustration. In other words, low need satisfaction may merely reflect a lack of perception of bright aspects that define a psychological experience (such as volition, mastery, or belonging) (Bartholomew et al., 2011; Vansteenkiste et al., 2020). Therefore, low need satisfaction fails to adequately capture the active nature of dark elements typical of any experiences of need frustration, such as feelings of conflict, helplessness, or social rejection (Bartholomew et al., 2011; Vansteenkiste et al., 2020).

The SDT tenets (Ryan & Deci, 2017) and previous person-centred research (Burgueño et al., 2023) have indicated that need satisfaction and need frustration can co-occur in the PE classroom, with each leading to specific motivational and learning-related outcomes. SDT holds the assumption that needs satisfaction primarily energises autonomous motivation (i.e., engaging in behaviour for enjoyment, curiosity, alignment with one's lifestyle, and the recognition of the benefits itself). Alternatively, need frustration is theorised to catalyse controlled motivation (i.e., engaging in a behaviour to meet self-imposed and social demands aiming at gaining contingent self-worth and material rewards while avoiding negative feelings and punishments) and amotivation (i.e., the absence of intention to engage in a behaviour). SDT also suggests cross-paths between need-based experiences and the quality of motivation, meaning that need satisfaction would secondarily buffer against controlled motivation and amotivation, just as need frustration would secondarily undermine autonomous motivation (Ryan & Deci, 2017; Vansteenkiste et al., 2020). In the specific PE context, both Van den Berghe et al.'s (2014) systematic review and Vasconcellos et al.'s (2020) meta-analysis reported positive relationships between students' need satisfaction and their autonomous motivation, and a negative association between need satisfaction and amotivation. Similarly, Vasconcellos et al. (2020) found positive associations between need frustration and amotivation, negative relationships with autonomous motivation, and no relationship with controlled motivation among students in PE. Despite these findings, emerging SDT-based studies (Abós et al., 2022; García-González et al., 2023; Tilga et al., 2020) have revealed positive associations between students' need frustration and controlled motivation in PE.

To gain a better insight into the distinctive roles that need satisfaction and need frustration may play in each of the life domains, including PE, it is important to develop valid and reliable scales that measuring need-based experiences simultaneously and are consistent with the distinction between need satisfaction and need frustration. In this regard, the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015; Van der Kaap-Deeder et al., 2020) has become the international benchmark instrument for measuring both need satisfaction and need frustration simultaneously (Grubbs et al., 2025). In the validation study in the general life domain, Chen et al. (2015) provided psychometric support for both a 24-item, six-factor correlated model (i.e., the satisfaction and frustration of each of the three needs) and a hierarchical two-factor model (i.e., a hierarchical factor of need satisfaction and another for need frustration), as well as evidence for internal consistency, discriminant validity, criterion validity, and cross-cultural invariance. Subsequently, Grubbs et al. (2025) added evidence for the instrument's invariance across 32 countries and 22 languages. Beyond this cross-cultural evidence, the instrument has been adapted to specific life domains, including work, family, intellectual disability, exercise and sport, education, and specifically PE (Van der Kaap-Deeder et al., 2020).

In the specific PE context of PE, Haerens et al. (2015) initially adapted the scale for use in the Dutch PE setting with Belgian secondary school students. Later, this PE version was adapted to the Estonian PE setting with secondary school students (Tilga, Hein, et al., 2020) and to the Mexican context one with primary students (Zamarripa et al., 2020). While Haerens et al. (2015) and Tilga, Hein, et al. (2020) studies were not validation studies themselves, they gathered evidence for a hierarchical two-factor model, which included a hierarchical factor of need satisfaction (comprising the primary-order factors of autonomy, relatedness, and competence satisfaction) and another for need frustration (comprising the primary-order factors of autonomy, relatedness, and competence frustration). Reliability was demonstrated with satisfactory Cronbach's alpha scores, and discriminant validity was established with a correlation below -.40 between the two need-based experiences in both studies. Although Zamarripa et al.'s (2020) validation study identified item 1 as having poor psychometric performance, marginal Cronbach's alpha scores for the six factors, and only partial support for gender invariance, it underpinned both the six-factor correlated model and the hierarchical two-factor model.

Whereas the Basic Psychological Need Satisfaction and Frustration Scale has been demonstrated to be a psychometrically reliable measure of both need satisfaction and need frustration in the PE context, to the best of our knowledge, there is no evidence in Spain of a single instrument

with sufficient sensitivity to measure the secondary school students' perception of need satisfaction and frustration simultaneously in the PE setting. To date, Spanish researchers have often used separate, purpose-specific scales to measure the students' perception of need-based experiences in PE. Specifically, the Spanish PE version (Moreno-Murcia et al., 2008) of the Basic Psychological Needs in Exercise Scale (Vlachopoulos & Michailidou, 2006) and PE adaptations (Burgueño et al., 2019; Sicilia et al., 2013) of the Psychological Need Thwarting Scale (Bartholomew et al., 2011). Although they are valid and reliable measures of need-based experiences separately, it is important to note that using two different instruments resulted in low practical usefulness in practice (Longo et al., 2016). Particularly, the measurements of need-based experiences were made using an unbalanced number of items (Longo et al., 2016), with some need-based experiences assessed through four items while others were measured with three items (e.g., relatedness frustration; see Burgueño et al., 2019). Moreover, there were concerns that many of these items might not adequately capture the content they aimed to measure (Longo et al., 2016). To illustrate, the item "I feel that the way classes are taught is a true expression of who I am" (Moreno-Murcia et al., 2008; Vlachopoulos & Michailidou, 2006) was categorised as an autonomy satisfaction item. However, it could better express a direct outcome derived from perceiving autonomy as satisfied rather than the characteristic experiences of choice, initiative, or willingness that define autonomy satisfaction. Consequently, it captured integrated regulation (an autonomous form of motivation) because the content involved a harmonious alignment between the way the lesson is delivered and the student's identity. A second example would be "I feel some of the students around me are envious when I achieve success" (Bartholomew et al., 2011; Sicilia et al., 2013), which was coded as a relatedness frustration item. Nevertheless, the feelings of envy failed to capture the experiences of social rejection or loneliness, which operationalise relatedness frustration, and the expression "I achieve success" is consistent with the conceptualisation of competence satisfaction. In an attempt to address the contextual weaknesses in assessing students' perceptions of need-based experiences in the Spanish PE setting, there is a need for an integrated instrument that measures the students' perceptions of need satisfaction and need frustration simultaneously.

Therefore, the objective of this research is to adapt the Basic Psychological Needs Satisfaction and Frustration Scale to the Spanish PE context and to provide validity and reliability evidence for use among secondary school students. To this end, we first aim to gather validity evidence based on the instrument's internal structure using a confirmatory factor analysis approach and a series of multigroup factor analyses. Second, we tend to assess reliability through analyses of

internal consistency and temporal stability. Third, we aim to examine convergent and discriminant validity. Fourth, we tend to provide further evidence of criterion validity by exploring the relationship between need satisfaction and need frustration with the quality of motivation through multiple structural equation models. Consistent with SDT tenets (Ryan & Deci, 2017; Vansteenkiste et al., 2020) and following previous SDT-based research in PE (Abós et al., 2022; García-González et al., 2023; Tilga, Kalajas-Tilga, et al., 2020; Vasconcellos et al., 2020). We hypothesise that need satisfaction would be positively associated with autonomous motivation, and negatively associated with controlled motivation and amotivation. We also expect that need frustration would be positively related to controlled motivation and amotivation and negatively related to autonomous motivation.

2. METHODS

2.1. Participants

A purposive sample of 1604 secondary school students (831 boys, 761 girls, and 12 without information), aged between 13 and 18 years ($M_{age}=15.01$, $SD=1.32$), participated in this cross-sectional study. All students were enrolled in eight public secondary schools from three medium-sized cities in [details masked for review]. The participating students were in second ($n=408$, 25.43%), third ($n=446$, 27.81%), and fourth ($n=470$, 29.30%) grades of compulsory secondary education, and in first ($n=280$, 17.46%) grade of post-compulsory secondary education. Most of them identified as White ($n=1489$, 92.80%) and had a middle socioeconomic status. Furthermore, 1139 (71.01%) students self-reported engaging in leisure-time physical activity and sports, while 465 (28.99%) did not participate in any. All students received two 60-minute coeducational lessons per week, since PE is a mandatory curricular subject in both secondary and post-secondary education. Classroom sizes ranged from 20 to 32 students.

To evaluate the instrument's temporal stability, a second independent sample of 45 students (23 boys and 22 girls, $M_{age}=14.51$, $SD=1.16$) with characteristics similar to those of the previous sample was also recruited. This group completed the instrument twice, with a two-week interval between the first and second administration.

2.2. Instruments

Need-based experiences in PE

The students' perceptions of need-based experiences were measured using the Spanish version of the Need Satisfaction and Need Frustration Scale adapted for the PE context. The scale is

headed by the stem “In my PE lessons...”, and followed by 24 items that, into four items per factor, measure the satisfaction and the frustration of the needs for autonomy, competence, and relatedness (see Appendix A for items). Items are rated on a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Quality of motivation for PE

The students’ perception of the quality of their motivation for PE was assessed using the third version of the Perceived Locus of Causality Scale for Physical Education (Ferriz et al., 2015). The instrument is headed by the stem “I participate in PE lessons because...”, and followed by 24 items that, grouped into four items per factor, measure intrinsic motivation (e.g., “PE is fun”), integrated regulation (e.g., “I consider PE to be a part of my life”), identified regulation (e.g., “I want to learn new skills), introjected regulation (e.g., “I want to get a good report in PE”), external regulation (e.g., “I’ll get in trouble if I don’t”), and amotivation (e.g., “I don’t see why we should have PE”). Each item is rated on a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree). A mean score for autonomous motivation was calculated by averaging items from intrinsic motivation, integrated regulation, and identified regulation. Similarly, a mean score for controlled motivation was estimated by averaging items from introjected regulation and external regulation. The hierarchical three-factor model obtained an acceptable fit to the observed data: $\chi^2(df=244)=1061.409$, $p<.001$, $\chi^2/df=4.350$; CFI=.927; TLI=.918; SRMR=.066; RMSEA=.067 (90% CI=.054–.071). Coefficient H was .94 for autonomous motivation, .90 for controlled motivation, and .81 for amotivation.

2.3. Procedure

The Need Satisfaction and Need Frustration Scale was adapted to the Spanish PE context following the guidelines outlined by the International Test Commission (2018). Firstly, the back-translation strategy was used, involving a panel of three translators who initially translated the content of each item from English into Spanish. Then, a different panel of three translators translated the 24 items back from Spanish into English. Secondly, an equivalence judgement was made by a new translator with broad expertise in SDT applied to PE and one of the study’s researchers, resulting in agreement between the original version of the scale and the last version translated from Spanish. Thirdly, three different experts in SDT applied to PE adjusted the content of each item to make it suitable for a typical PE lesson, also considering the Mexican PE version of the instrument. To illustrate this, the four autonomy satisfaction items were revised to emphasise the key elements of

choice, decision-making, opinion, and/or willingness, helping to contextualise the content of each in the PE lesson (see Appendix A). Item 12 was revised because the expression “I feel disappointed with” is not an accurate term to measure competence frustration in Spain. The experts unanimously agreed on changing it to “I feel clumsy” (see Appendix A). Item 22 was also revised because the idea “just superficial relationships with classmates” failed to retain the active privation that defines relatedness frustration. This expression was unanimously replaced with “I feel that my classmates despise me” (see Appendix A). Fourthly, three new experts in SDT applied to PE individually performed a qualitative analysis of the adapted Spanish items to assess their domain representativeness (i.e., the degree to which the content of the item in question adequately represents and measures the target variable), and domain relevance (i.e., the degree to which the content of each item is relevant to the target variable) through a 4-point Likert-type scale (Sireci & Faulkner-Bond, 2014). Once the assessment reports from each expert were received, the Content Validity Index (CVI; Lynn, 1986) was computed for both criteria in each of the 24 items, indicating acceptable values above .85 (Lynn, 1986). Each of the 24 items obtained a CVI score of 1 for representativeness and relevance. Fifthly, a pilot study with 24 secondary school students was conducted to assess their understanding of the items, and no problems or difficulties were identified. Overall, the adaptation process provided content validity evidence for the Spanish PE version of the Need Satisfaction and Need Frustration Scale.

The present study has the approval from the Ethics Committee of the [masked details for review process], as well as all permissions and authorisations from the school management teams of each involved school, and written informed consent signed by the parents of every participating student. After coordinating with each PE teacher to set a date for data collection, the questionnaire was administered in a quiet classroom setting, in the PE teacher's absence, with the researchers present. The research team explained to the students that their participation was voluntary and anonymous, and they could withdraw from the study at any time during the questionnaire's administration. The researchers also emphasised that there was no compensation for participation, and there were no right or wrong answers because the researchers only aimed to know students' perceptions of PE lessons. Moreover, the research team was available to address any questions participants might raise throughout this process. The questionnaire took about 20 minutes to complete.

2.4. Data Analyses

Firstly, validity evidence based on the internal structure was examined using a confirmatory factor analysis approach and a multi-group analysis for gender and age invariance. Before confirmatory factor analysis, the trustworthiness of its results was underpinned by keeping a minimum ratio of 10 cases for each statistical parameter to be estimated (in this study, 1604 participants for 87 statistical parameters) (Kline, 2016). Confirmatory factor analysis was run using the maximum-likelihood method together with the 5000-resampling bootstrapping technique due to the violation of the multivariate normality assumption (a Mardia's coefficient=123.090, $p<.01$) (Kline, 2016). Assessment of the goodness of fit was made by an array of fit indices: coefficient between chi-squared and degree of freedom (χ^2/df), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Standardised Root Mean Squared Residual (SRMR), and Root Mean Squared Error of Approximation (RMSEA) with its 90% confidence interval (95%CI). Whereas a good fit is obtained with scores up to 5 for the χ^2/df coefficient, greater than .95 for CFI and TLI, and lower than .06 for SRMR and RMSEA, an acceptable fit is achieved by values as high as 5 for the χ^2/df coefficient, above .90 for CFI and TLI, and below .080 for SRMR and RMSEA (Kline, 2016). Standardised regression weights are appropriate with values higher than .50 (Kline, 2016).

Moreover, multi-group analyses for gender and age invariance were performed following the methodological proposal by Milfont and Fischer (2010). It tests the tenability of four increasingly constrained models to analyse configural invariance (i.e., no equality constraints), weak invariance (i.e., equality constraints on items' factor loading), strong invariance (i.e., equality constraints on items' factor loading and intercept), and strict invariance (i.e., equality constraints on items' factor loading, intercept, and error variance). In addition to these four models, structural weight invariance (i.e., equality constraints on items' factor loading, intercept, and error variance, and structural regression weights), and structural residual variance invariance (i.e., equality constraints on items' factor loading, intercept, and error variance, and structural regression weights and structural residual variance) were tested for second-order models (Milfont & Fischer, 2010). Support for the invariance assumption was based on differences of up to .010 in CFA and up to .015 in RMSEA between pairs of increasingly constrained models (Milfont & Fischer, 2010). For age invariance, two groups were created based on the median: the first consisting of 854 students ($M_{age}=13.98$; $SD=0.85$; 450 boys, 397 girls, and seven without gender-related information), and the second consisting of 750 students ($M_{age}=16.02$, $SD=0.82$; 381 boys, 364 girls, and five without gender-related information).

Secondly, average variance extracted (AVE) was calculated to gather convergent validity evidence, with values over .50 considered acceptable (Fornell & Larcker, 1981). Thirdly, the instrument's discriminant validity evidence was provided using correlations between latent factors from confirmatory factor analysis and the heterotrait-monotrait (HTMT) ratio of correlations, with values up to .85 deemed appropriate (Henseler et al., 2015). Fourthly, reliability evidence was analysed by estimating Cronbach's alpha, McDonald's omega, and Raykov's coefficients as measures of internal consistency, as well as the intraclass correlation coefficient (ICC) as a temporal-stability measure. Each coefficient was suitable with scores above .70 (Viladrich et al., 2017). Fifthly, the instrument's criterion validity evidence was assessed by examining the relationship between the students' perception of need-based experiences and the quality of their motivation through a two-step structural equation modelling (SEM) approach (Kline, 2016). The first step consisted of testing the robustness of the measurement model in which all target variables were freely correlated. The second step or structural model examined the paths from need-based experiences to the quality of motivation. Considering that students' motivational processes vary depending on their gender and age (Vasconcellos et al., 2020), both were introduced as covariates. Sixthly, descriptive statistics were computed for the study's variables.

3. RESULTS

Confirmatory factor analysis

The 24-item, six-factor correlated model showed a suitable fit to the observed data: χ^2 ($df=237$)=1046.834, $p<.001$, $\chi^2/df=4.417$; CFI=.947; TLI=.938; SRMR=.057; RMSEA=.052 (90%CI=.049–.054, $p\text{-close}=.164$). Figure 1 shows standardised regression weights ranging from .59 to .83, all of which were statistically significant ($p<.001$). In addition, the robustness of a second-order two-factor model that included a hierarchical factor of need satisfaction (comprising the primary-order factors of autonomy, competence, and relatedness satisfaction) and another for need frustration (comprising the primary-order factors of autonomy, competence, and relatedness frustration) was tested. It showed an acceptable fit: χ^2 ($df=243$)=1180.008, $p<.001$, $\chi^2/df = 4.853$; CFI=.925; TLI=.915; SRMR=.072; RMSEA=.060 (90%CI= .058–.063, $p\text{-close}=.001$). All structural standardised regression weights were statistically significant ($p<.001$), with values of .78 for autonomy satisfaction, .79 for competence satisfaction, and .72 for relatedness satisfaction on the hierarchical need satisfaction factor. Similarly, structural standardised regression weights of .71 for

autonomy frustration, .90 for competence frustration, and .76 for relatedness frustration were observed on the hierarchical need frustration factor.

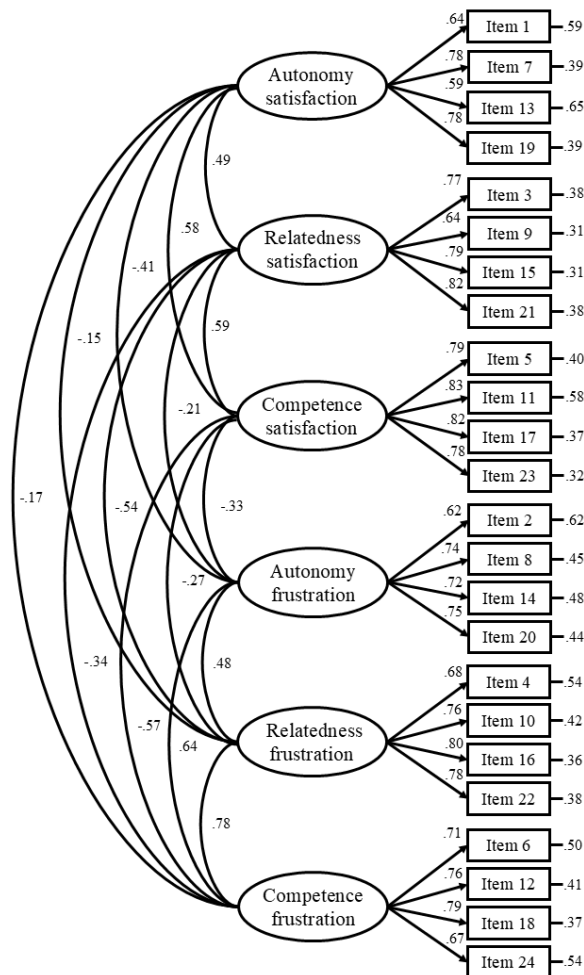


Figure 1. Confirmatory factor analysis for the Spanish physical education version of the Basic Psychological Need Satisfaction and Frustration Scale

Gender and age invariance

Regarding gender invariance, Table 1 shows differences in CFI ranging from -.010 to .000 and in RMSEA from -.001 to .002 across the increasingly constrained models, for both the six-factor correlated model and for the second-order two-factor model. These findings supported the assumption of gender invariance.

Table 1. Gender invariance tests

Primary-order six-factor model							
	$\chi^2 (df)$	CFI	RMSEA(90%CI)	Models' comparison	$\chi^2 (df)$	CFI	RMSEA
1. Configural invariance	1505.583(474)	.945	.037(.035–.039)	–	–	–	–
2. Weak invariance	1530.003(492)	.945	.036(.034–.039)	2 versus 1	24.420(18)	.000	-.001
3. Strong invariance	1728.782(516)	.935	.038(.036–.040)	3 versus 2	198.779(24)***	- .010	.002
4. Strict invariance	1779.496(540)	.934	.038(.036–.040)	4 versus 3	50.713(24)***	- .001	.000
Hierarchical two-factor model							
	$\chi^2 (df)$	CFI	RMSEA (90%CI)	Models' comparison	$\chi^2 (df)$	CFI	RMSEA
1. Configural invariance	1913.083(486)	.924	.043(.041–.045)	–	–	–	–
2. Weak invariance	1938.614(504)	.924	.042(.040–.044)	2 versus 1	25.531(18)	.000	-.001
3. Strong invariance	2133.989(528)	.914	.044(.042–.046)	3 versus 2	195.374(24)***	- .010	.002
4. Strict invariance	2133.508(552)	.913	.043(.041–.045)	4 versus 3	51.(51924)***	- .001	-.001
5. Structural weights invariance	2215.911(556)	.912	.043(.041–.045)	5 versus 4	30.403(4)***	- .001	.000
6. Structural residuals invariance	2265.666(562)	.909	.044(.042–.046)	6 versus 5	49.759(6)***	- .003	.001

Note. *** $p < .001$, ** $p < .01$, * $p < .05$

Concerning age invariance, Table 2 presents changes in CFI from -.002 to .000 and in RMSEA from -.002 to .001 among the progressively constrained models for both the six-factor correlated model and the second-order two-factor model. Accordingly, the assumption of age invariance was supported.

Table 2. Age invariance tests

Primary-order six-factor model							
	$\chi^2 (df)$	CFI	RMSEA(90%CI)	Models' comparison	$\chi^2 (df)$	CFI	RMSEA
1. Configural invariance	1601.358(474)	.941	.039(.035–.039)	–	–	–	–
2. Weak invariance	1616.169(492)	.941	.038(.036–.040)	2 versus 1	14.811(18)	.000	-.001
3. Strong invariance	1676.999(516)	.939	.037(.035–.039)	3 versus 2	60.831(24)***	- .002	-.001
4. Strict	1737.854(540)	.937	.037(.035–.039)	4 versus 3	60.855(24)***	-	.000

invariance	.002						
Hierarchical two-factor model							
	$\chi^2 (df)$	CFI	RMSEA(90%CI)	Models' comparison	$\chi^2 (df)$	CFI	RMSEA
1. Configural invariance	2028.765(486)	.919	.045(.043–.047)	–	–	–	–
2. Weak invariance	2046.060(504)	.919	.044(.042–.046)	2 versus 1	17.296(18)	.000	-.001
3. Strong invariance	2101.622(528)	.918	.043(.041–.045)	3 versus 2	55.561(24)***	- .001	-.001
4. Strict invariance	2161.914(552)	.916	.043(.041–.045)	4 versus 3	60.292(24)***	- .002	.000
5. Structural weights invariance	2171.238(556)	.916	.043(.041–.044)	5 versus 4	9.324(4)	.000	.000
6. Structural residuals invariance	2178.440(562)	.915	.042(.041–.044)	6 versus 5	7.202(6)	- .001	-.001

Convergent validity, discriminant validity, and reliability

Table 3 reports the AVE scores ranging from .50 to .65, indicating an acceptable level of convergent validity. In addition, HTMT scores ranged from -.53 to .82, and Figure 1 displays correlations among the six latent factors between -.54 and .78, gathering evidence for the instrument's discriminant validity. Moreover, the correlation between the hierarchical factors of need satisfaction and need frustration was -.35.

Table 3. Internal consistency, convergent validity, and discriminant validity

	α	ω	ρ	AVE	1	2	3	4	5	6
1. Autonomy satisfaction	.79	.80	.80	.50	–	.49	.55	-.39	-.18	-.13
2. Relatedness satisfaction	.84	.84	.84	.58		–	.60	-.21	-.53	-.33
3. Competence satisfaction	.88	.88	.88	.65			–	-.33	-.26	-.53
4. Autonomy frustration	.80	.80	.80	.51				–	.48	.64
5. Relatedness frustration	.83	.84	.84	.57					–	.82
6. Competence frustration	.82	.82	.82	.54						–

Note. Numbers above the diagonal report the heterotrait–monotrait ratio of correlations

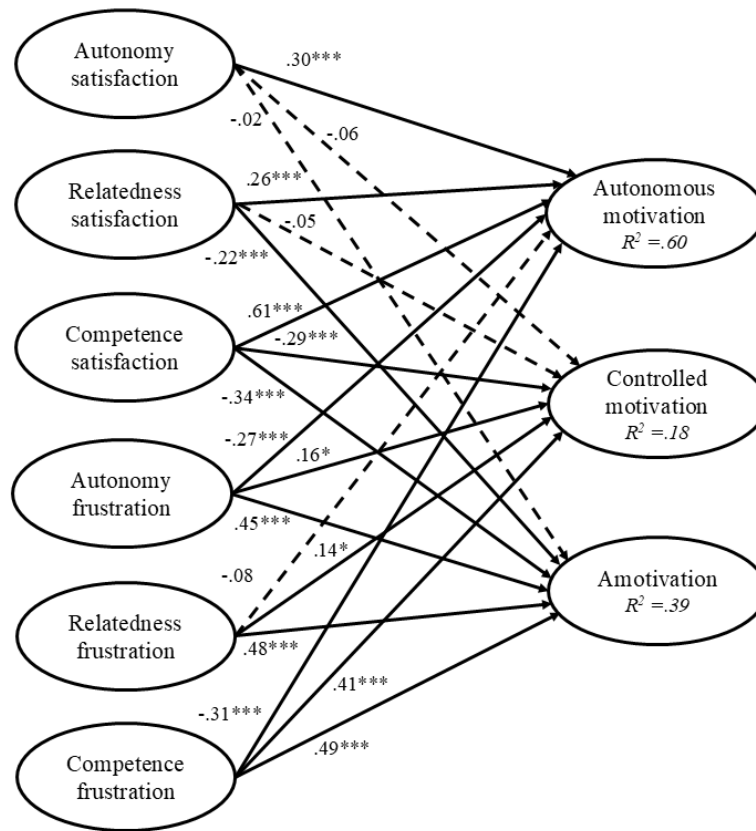
On the other hand, Table 3 shows Cronbach's alpha values ranging from .79 to .88, while McDonald's omega and Raykov's rho coefficients were between .80 and .88 for the six dimensions of need-based experiences. For the two second-order factors, coefficient H was .95 for need satisfaction and .94 for need frustration. Regarding temporal stability, ICC reported values of .72 (95%CI=.60–.85) for autonomy satisfaction, .77 (95% CI=.65–.86) for competence satisfaction, .85

(95%CI=.77–.91), .70 (95%CI=.56–.84) for autonomy frustration, .75 (95%CI=.64–.89) for competence frustration, and .73 (95%CI=.62–.87) for relatedness frustration.

Structural equation modelling

A first SEM analysis was run to test the paths from the six primary-order factors to the quality of motivation. The measurement model and the structural model showed a similar fit: $\chi^2=2503.842$, $df=506$, $p<.001$, $\chi^2/df=4.948$; CFI=.928; TLI=.915; SRMR=.064; RMSEA=.050 (90%CI=.048–.052, $p\text{-close}<=.373$) given that the latter was based on the same measurement specification and no additional modifications were introduced. Figure 2 shows that, after controlling for gender and age, positive relationships were found between autonomy, relatedness, and competence satisfaction with autonomous motivation ($\beta=.30$, $p<.001$; $\beta=.26$, $p<.001$; $\beta=.61$, $p<.001$). Similarly, there were negative associations between competence satisfaction and controlled motivation ($\beta=-.29$, $p<.001$), and between relatedness and competence satisfaction with amotivation ($\beta=-.22$, $p<.001$; $\beta=-.34$, $p<.001$). In addition, positive relationships were found between autonomy, relatedness, and competence frustration with controlled motivation ($\beta=.16$, $p=.016$; $\beta=.14$, $p=.033$; $\beta=.41$, $p<.001$) and amotivation ($\beta=.45$, $p<.001$; $\beta=.48$, $p<.001$, $\beta=.49$, $p<.001$), while negative associations were observed between autonomy and competence frustration with autonomous motivation ($\beta=-.27$, $p<.001$, $\beta=-.31$, $p<.001$).

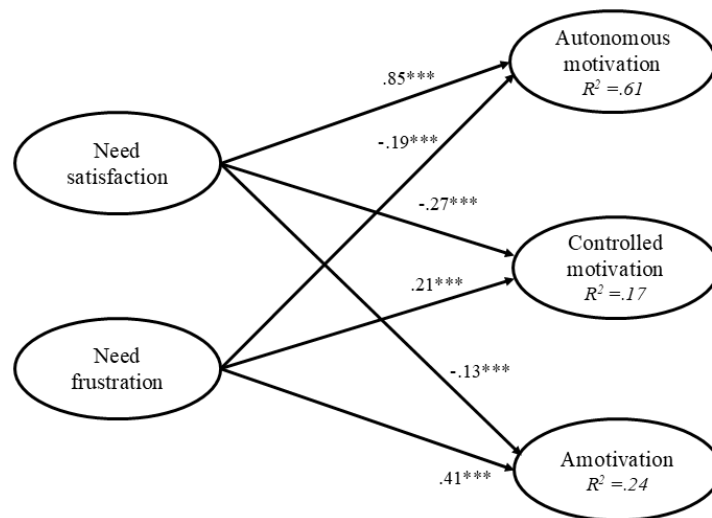
A second SEM analysis was performed to test the paths from the hierarchical factors of need satisfaction and need frustration to the three motivational qualities. The robustness of the measurement model was supported ($\chi^2=497.765$, $df=95$, $p<.001$, $\chi^2/df=4.987$; CFI=.912; TLI=.901; SRMR=.072; RMSEA=.079 (90%CI=.075–.082, $p\text{-close}<.001$). Then, the structural model was tested, obtaining an appropriate fit to the data: $\chi^2=459.606$, $df=93$, $p<.001$, $\chi^2/df=4.942$, CFI=.942; TLI=.916; SRMR=.053; RMSEA=.060 (90%CI=.056–.065, $p\text{-close}<.001$).



Note. Ellipses represent latent variables. Dotted arrows represent non-significant paths. *** $p < .001$, ** $p < .01$, * $p < .05$

Figure 2. Paths from the six primary-order factors of need-based experiences to the quality of motivation among students in physical education

Figure 3 shows that, after controlling for gender and age, there was a positive and significant relationship between need satisfaction and autonomous motivation ($\beta = .85$, $p < .001$), and negative and significant associations with controlled motivation ($\beta = -.27$, $p < .001$), and amotivation ($\beta = -.13$, $p < .001$). Conversely, there were positive and significant relationships between need frustration and controlled motivation ($\beta = .21$, $p < .001$), and amotivation ($\beta = .41$, $p < .001$), and a negative and significant association with autonomous motivation ($\beta = -.19$, $p < .001$).



Note. Ellipses represent latent variables. *** $p < .001$

Figure 3. Paths from the hierarchical factors of need satisfaction and need frustration to the quality of motivation among students in physical education

Table 4 presents mean scores above the midpoint of their measurement scale for the satisfaction of each need, autonomy frustration, autonomous motivation, and controlled motivation. By contrast, mean values below the midpoint of their measurement scale were reported for competence and relatedness frustration, overall need frustration, and amotivation.

Table 4. Descriptive statistics for the study's variables

	Range	<i>M</i> (<i>SD</i>)	γ_1	γ_2
Need satisfaction	1–5	2.60(0.56)	-0.46	0.03
Autonomy satisfaction	1–5	3.01(0.95)	-0.16	-0.48
Relatedness satisfaction	1–5	3.70(0.94)	-0.68	0.07
Competence satisfaction	1–5	3.71(0.93)	-0.61	-0.10
Need frustration	1–5	2.40(0.84)	0.48	-0.28
Autonomy frustration	1–5	2.82(1.01)	0.06	-0.70
Relatedness frustration	1–5	2.07(1.02)	0.82	-0.18
Competence frustration	1–5	2.31(1.02)	0.53	-0.55
Autonomous motivation	1–7	4.94(1.34)	-0.54	-0.23
Controlled motivation	1–7	4.09(1.22)	-0.11	-0.34
Amotivation	1–7	2.75(1.40)	0.63	-0.13

4. DISCUSSION

Our results gathered a robust basis of psychometric evidence to consider the Spanish PE version of the Basic Psychological Need Satisfaction and Frustration Scale as a valid and reliable measure of secondary school students' perceptions of need-based experiences in PE lessons.

The results from the first confirmatory factor analysis supported a 24-item six-factor correlated model, consistent with the original version of the instrument (Chen et al., 2015) and its Mexican PE version (Zamarripa et al., 2020). In contrast to Zamarripa et al. (2020) who detected item 1 as having a low standardised regression weight in the primary-order factor of autonomy satisfaction, our findings reported that all standardised regression weights were significantly and ranged from .59 to .83, indicating that the content of each of them well captured the characteristic experiences that define the satisfaction and frustration of the needs for autonomy, relatedness, and competence, respectively. In addition to this primary-order six-factor model, a second confirmatory factor provided support for a hierarchical two-factor model, which aligned with the Dutch (Haerens et al., 2015) and Estonian (Tilga et al., 2020) versions of the instrument. This result psychometrically underpinned the SDT premise that need satisfaction and need frustration are two distinguishable but moderately related variables (Cordeiro et al., 2016; Longo et al., 2016). In line with previous research (Longo et al., 2016; Tilga et al., 2020) and following the SDT assumptions (Vansteenkiste et al., 2020), this hierarchical model theoretically implies that the experiences of autonomy, relatedness, and competence satisfaction converged into a hierarchical experience of need satisfaction, just as the experiences of autonomy, relatedness, and competence shaped a hierarchical experience of need frustration. In practice, it might be advantageous to consider need satisfaction and need frustration as hierarchical variables within more complex models in association with other variables to shed light on their respective antecedents and specific learning-related outcomes in the PE lesson.

The findings from multi-group analyses provided evidence for gender and age invariance. These results regarding gender invariance aligned with the version of the Basic Psychological Need Satisfaction and Frustration Scale in the general life domain (Grubbs et al., 2025), and extended the instrument's evidence, from partial (Zamarripa et al., 2020) to full, for gender invariance in the PE context. In addition to gender invariance, this is, to our knowledge, the first study to add evidence for age in the PE context. These findings mean that boys and girls of different ages (from 13 to 18 years) interpret the instrument's item content in the same way. In other words, the instrument performs equally for students regardless of their gender and age. This has great practical value, as it enables

researchers to compare mean differences in need-based experiences across groups of students' gender and age in PE lessons.

The AVE scores, ranging from .50 to .65, provided convergent validity evidence for the Spanish PE version of the instrument. To our knowledge, this is the first study to expand evidence for the instrument's convergent validity in the PE context, pointing out that the content of each of the 24 items well retained the psychological experiences that operationalise the satisfaction and frustration of the needs for autonomy, competence, and relatedness in the eyes of secondary school students when participating in PE lessons. The results from correlations among latent factors and HTMT gathered discriminant validity evidence, consistent with the original version (Chen et al., 2015) of the instrument and its Mexican PE version (Zamarripa et al., 2020). In fact, the estimation of the HTMT with values below .85 offered new evidence in favour of the instrument's discriminant validity. These findings highlight that Spanish secondary school students can clearly and accurately distinguish between experiences of satisfaction and frustration of the needs for autonomy, relatedness, and competence in PE lessons.

The results from Cronbach's alpha, McDonald's omega, and Raykov's rho coefficient supported the instrument's internal consistency. Our Cronbach's alpha scores were similar to those reported in the Estonian PE version of the instrument (Tilga et al., 2020), yet contrasted with those reported in the Mexican PE version (Zamarripa et al., 2020), which showed reported marginal values for the six primary-order factors. Furthermore, the estimation of McDonald's omega and Raykov's rho coefficients with scores above .70 provided new evidence for the instrument's internal consistency. Moreover, coefficient *H* underpinned the reliability of the hierarchical factors of need satisfaction and need frustration, consistent with the Dutch PE version of the scale (Haerens et al., 2015). On the other hand, ICC scores supported the temporal stability of the Spanish PE version of the instrument.

The results from the two SEM analyses gathered criterion validity evidence for the Spanish PE version of the Basic Psychological Need Satisfaction and Frustration Scale among secondary school students. These results are consistent with our hypotheses and align with previous research in PE, as the satisfaction of each need was positively related to autonomous motivation and negatively associated with amotivation (Van den Berghe et al., 2014; Vasconcellos et al., 2020). This finding additionally supported the SDT tenet that need satisfaction energises autonomous motivation and protects against amotivation (Vansteenkiste et al., 2020). This is because when students perceive their autonomy, relatedness, and competence as satisfied, they are more likely not only to enjoy PE

and recognise the benefits that its participation brings (autonomous motivation), but also to minimise their experiences of futility and disengagement (amotivation) in PE lessons (García-González et al., 2023; Tilga et al., 2020). In contrast to García-González et al. (2023) and Vasconcellos et al. (2020), but in line with Tilga et al. (2020), our findings also revealed a negative relationship between need satisfaction, especially relatedness and competence satisfaction, with controlled motivation, suggesting that need satisfaction could additionally buffer against experiences of self-imposed and social pressures that define controlled motivation (Vansteenkiste et al., 2020). On the other hand, our results showed positive associations between need frustration and amotivation and negative associations, especially autonomy and competence frustration, with autonomous motivation, which were aligned with both our hypotheses and previous studies in PE (García-González et al., 2023; Vasconcellos et al., 2020). These results supported the SDT assumption that need frustration contributes to amotivation, while it undermines autonomous motivation (Vansteenkiste et al., 2020). Unlike Vasconcellos et al. (2020) and consistent with emerging research in PE (Abós et al., 2022; García-González et al., 2023; Tilga et al., 2020), need frustration was also positively associated with controlled motivation, indicating that it also leads to experiences of controlled motivation (Vansteenkiste et al., 2020). A possible explanation is that when students feel their autonomy, relatedness, and competence are being frustrated, they are not only more likely to participate in PE lessons due to feeling forced to obtain personal or social rewards, but they also tend to experience disengagement and a lack of interest in their learning (Abós et al., 2022; García-González et al., 2023; Tilga et al., 2020).

4.1. Implications for teaching practice

The availability of the Spanish PE version of the Basic Psychological Need Satisfaction and Frustration Scale opens up different applications for classroom practice. Firstly, the scale allows PE teachers and researchers to assess how students' experiences of need satisfaction and need frustration occur during the PE lesson in the Spanish setting. In this regard, PE teachers may use this information to identify not only students with low need satisfaction but also those at motivational risk due to experiencing higher need frustration. Secondly, this instrument can be used to map students' need-based experiences by examining how their perceptions of need satisfaction and need frustration change in PE over an academic year, from one year to the next, or transitioning from compulsory to post-compulsory secondary education. Thus, PE teachers can use this information to calibrate their instructional practices in the classroom to maximise students' perceptions of autonomy, competence, and relatedness satisfaction and to minimise their experiences of need frustration during PE lessons.

Thirdly, the scale can also be used in intervention studies aimed at examining how specific instructional practices, including pedagogical models, signature pedagogies, student-centred pedagogies (i.e., voice, democratic, activist, social justice), or (de)motivating teaching styles, contribute not only to promoting students' need satisfaction but also to diminishing their experiences of need frustration in the PE. In this way, PE teachers may design and enact a variety of instructional practices that are better aligned with students' motivational needs and, consequently, foster their autonomy, competence, and relatedness in the PE lesson.

5. LIMITATIONS

Given that the validation process for any instrument should be ongoing, the present study has some limitations despite providing strong evidence for the Spanish version of the Basic Psychological Need Satisfaction and Frustration Scale. Firstly, the purposive sampling method prevents us from generalising the results to the broader population. Future studies are therefore required to include samples of students with more heterogeneous characteristics across school levels (i.e., primary education, vocational education, or higher education), school types (e.g., private), and social and cultural backgrounds. Secondly, the use of a cross-sectional design cannot allow us to establish cause-and-effect relationships between students' need-based experiences and the quality of their motivation. Hence, new longitudinal and experimental studies are needed to clarify how students' need satisfaction and need frustration relate to the quality of motivation in the secondary school PE setting. Thirdly, although criterion validity was supported by examining associations with motivation, both antecedents and additional outcomes are required to shed light on the distinctive role that need-based experiences may have in PE and, consequently, to expand the nomological network of need-based experiences in the Spanish context of secondary school PE.

6. CONCLUSIONS

The current study established a strong basis of psychometric evidence for the use of the Basic Psychological Need Satisfaction and Frustration Scale with Spanish secondary school students in PE lessons. The results indicated that the validity and reliability of the scores from the Spanish PE version of the instrument were appropriate and psychometrically robust, suggesting it could be used in future research with Spanish secondary school students in PE.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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