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Validation of the Satisfaction Scale of Basic Psychological Needs in Physical Education with the Incorporation of the Novelty in the Spanish Context

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Abstract: The purpose of the study was to validate to the physical education context, the Spanish version of the Scale of the Satisfaction of Psychological Needs toward the Physical Education classes of Menéndez and Fernández-Rio, with the incorporation of the novelty, since they contemplated its inclusion. In this study, 1444 students participated (mean = 15.34, standard deviation = 1.12) from several schools in Almeria. To analyze the psychometric properties of the scale, several analyses were carried out. The results offered support for both the four-factor structure and the higher-order model called satisfaction. The analysis of invariance with respect to gender showed that the factor structure of the questionnaire was invariant. The Cronbach alpha values were higher than 0.70 in the subscales. The results of this study demonstrated the reliability and validity of the Scale of the Satisfaction of Psychological Needs, with the incorporation of novelty in the Spanish context of Physical Education.

Keywords: self-determination; satisfaction of psychological needs; physical education; novelty

1. Introduction

According to various studies, physical education (PE) classes have a very notable influence on the psychosocial, emotional, and physical development of students [1]; in addition, due to the characteristics of the subject, PE has a great influence on the development of body expression and the adoption of healthy habits [2,3]. However, for all of this to take place, during PE classes, students must experience a climate where a series of positive emotional and psychological experiences are generated [4], encourage personal self-concept [5], and promote self-knowledge and internal motivation [6]. In this sense, the Self-Determination Theory (SDT) is a principal theoretical framework that studies the motivational processes inherent to each individual and how this is influenced by the social, personal, and experiential context [7,8].

SDT states the existence of three psychological needs that are basic, universal, and inherent to every human being, which are competence, autonomy, and relatedness [9]. In this way, autonomy is defined as the feeling that the action carried out has its origin in oneself, without any kind of external pressure [9]. Competence is the perception of the individual's effectiveness in performing any type of action in a particular context [9]. Relatedness refers to the feeling one has of belonging to a particular social group [9]. These psychological needs tend to combine with each other, so that one influences the others; in this way, if one increases, the others will as well [10]. Thus, if these three basic psychological needs are satisfied, they will contribute to the personal well-being of the person, facilitating an increase

in intrinsic motivation [8]. In this sense, these psychological needs function as mediators between socio-contextual factors and the internal motivation of the subjects [3,11,12]. The satisfaction of psychological needs has also been related to various emotional factors (e.g., amusement, anxiety, etc.), which have been related to internal motivation [13]. In addition, they have been positively related to self-perceptions regarding initiative and personal identity, which are related to internal motivation [14].

Due to this relevant role of psychological needs in personal development and motivation, Vlachopoulos [15] developed the Basic Psychological Needs in Exercise Scale (BPNES), to measure the three psychological needs in the context of physical exercise, showing adequate reliability and validity. This scale was validated to the Spanish context by Sánchez and Núñez [16], who translated this scale into Spanish. To validate it, they used a sample of 233 subjects, with an average age of 28.7 years, reflecting Cronbach alpha values above 0.70 for each of the factors and good fit indices for the model. Subsequently, this validated questionnaire, adapted to the context of physical exercise, was adapted to the context of the PE by Moreno, González-Cutre, Chillón, and Parra [17], for which they previously modified the heading to “In Physical Education...” to subsequently validate the questionnaire with a sample of 370 secondary students, reflecting appropriate adjustment indices and Cronbach alpha values above 0.70 for each of the factors.

Recently, González-Cutre et al. [10] proposed the incorporation of a fourth psychological need, “novelty”. This factor is related to the need to experience something that was not previously experienced or that deviates from daily routine, being key to the development of internal motivation of people [18]. González-Cutre et al. [10] decided to incorporate six items corresponding to this new factor, novelty, to the basic psychological-needs scale toward the PE classes of Moreno et al. [17], forming a scale of 18 items. To validate this new scale, they used a sample of 1035 secondary students, with an average age of 16.20, obtaining the new scale-acceptable adjustment indices and Cronbach alpha values above 0.70 for each of the four factors that make it up.

Although the basic psychological-needs scale of Moreno et al. [17], and, later, that of González-Cutre et al. [10], show acceptable adjustment indices and have been used in numerous successful studies in the field of PE classes [19–21], these continue to use the BPNES designed for the context of physical exercise. However, the context of the PE classes shows a different functioning than that which can be observed or felt when practicing PE [22]. In addition, the fact that the exercise types that the students perform are chosen by the teacher during PE classes cannot be ignored [23].

Thus, Vlachopoulos et al. [23] decided to modify the original BPNES scale of Vlachopoulos [17] to create a new scale, the Basic Psychological Needs in Physical Education (BPN-PE) Scale, since, as Vlachopoulos et al. [23] point out, studies starting from concrete contexts must use specific scales; the lack of specific instrumentation to measure the degree to which the three basic psychological needs are satisfied in PE prevents the systematic evaluation of the motivational and behavioral processes of students in that specific context. To validate and adapt the BPN-PE, they conducted a study with three different groups of students where they showed that the scale had an internal consistency greater than 0.70 for a structure of three factors (competence, relationship with others, and autonomy). This scale has recently been adapted and validated to the Spanish context of PE by Menéndez and Fernández-Río [22], for which 624 secondary school students with an average age of 14.6 years took part in the study. The scale showed acceptable adjustment indices and internal consistency values greater than 0.70 for the three-factor structure (competence, relationship with others, and autonomy). However, both the scale of Vlachopoulos et al. [23] and the Menéndez and Fernández-Río scale [22] did not consider the incorporation of novelty as the fourth factor of basic psychological needs.

Therefore, the purpose of this study was to validate and adapt the Basic Psychological Needs Scale to Menéndez and Fernández-Río [22] PE classes, incorporating the items corresponding to novelty developed by González-Cutre et al. [10]. To this end, it is expected that the CFA (confirmatory factorial analysis) of the proposed instrument, Scale of Satisfaction of Psychological Needs in Physical Education (SPN-PE), will offer appropriate adjustment indices both for the four-factor correlated model (i.e., satisfaction of the needs of autonomy, competence, novelty, and relatedness) and for the

higher-order model, and that both models will be invariant with respect to gender. In addition, it is expected that the internal consistency and temporal stability of the factors will be adequate. Finally, a linear regression analysis will be performed to show evidence of criterion validity for the SPN-PE Scale by analyzing differences in subscale scores, with respect to the level of intrinsic motivation experienced during classes.

2. Method

2.1. Participants

This study involved 728 males and 716 females from various educational institutions in the province of Almeria, for a total of 1444 adolescents. The mean age of the participants was 15.34 y (SD = 1.12 y), between age 13 and 19. With the purpose of analyze the temporal stability of the scale (SPN-EF), a second independent sample of 568 secondary school students was used. The mean age of the participants was 16.11 y (SD = 0.89 y), between age 13 and 18 years. This group completed the scale twice, with a time interval of two weeks between the first and second data collection.

Based on those schools and students to which access was obtained, the sampling used was incidental non-probabilistic. Parents or legal guardians had to provide informed advice in order for their children to be able to participate in the study, this being an inclusion criterion. Finally, to encourage participation in the study, the teacher rewarded the student body with 0.20 points in the final grade of the subject.

2.2. Instruments

Satisfaction of Basic Psychological Needs: We used the validated and adapted version of the Basic Psychological Needs Scale in Physical Education (BPN-PE; [23]) to the Spanish context of PE by Menéndez and Fernández-Río [22], whose factors are autonomy, competence, and relatedness. The items corresponding to the novelty dimension developed by González-Cutre, et al. [10] were added to this scale. The final scale comprises a total of 18 items distributed among the four factors that make up the scale: four items correspond to autonomy, four correspond to competence, four correspond to relatedness, and six correspond to novelty. It uses a Likert scale, from totally disagree (1) to totally agree (7).

Intrinsic Motivation: We selected a factor with the same name from the Perceived Causality Locus Revised Scale (PLOC-R) by Vlachopoulos et al. [24], which was adapted and validated by Trigueros et al. [25] in the PE context of Spain. The scale was headed by the heading, "During Physical Education (PE) classes...", and the intrinsic motivation factor consists of 4 items. It uses a Likert scale, from strongly disagree (1) to strongly agree (7).

2.3. Procedure

Once in possession of the final scale (SPN-PE; Appendix A), a member of the research group contacted school principals who wanted to participate in the study. Later, the principals of the participating schools contacted their physical education teachers, who were informed about the objectives of this research and asked for their full cooperation. The parents or legal guardians of the underage students were contacted to sign an authorization document before applying the scales.

A surveyor from the research group was present when the students completed the questionnaire, explaining how they should complete it (i.e., the questionnaires are individual, cannot be copied from peers, and must respond to items in order) and answering any questions that arose during the process. The questionnaires were completed by the students at the beginning of the physical education classes, at different times, depending on their school hours. The questionnaires completed by the students were completely anonymous. The entire experiment was conducted in accordance with the Declaration of Helsinki. This study was approved by the Research Ethics Committee of the University

of Almeria, Spain (Reference UALBIO 2019/014). In addition, all the recommendations of the American Psychological Association were carried out.

The questionnaires were administered during the academic year 2018/2019. The estimated time to complete the questionnaires was around 10 min.

2.4. Data Analysis

In order to be able to analyze the psychometric properties of the new SPN-PE Scale with the incorporation of the eight novelty items, a series of analysis was conducted in order to determine the reliability and validity of SPN-PE Scale. First, the structure of the model was tested by conducting a confirmatory factorial analysis (CFA). Second, the invariability of the questionnaire in relation to gender was evaluated through a multigroup analysis. This analysis was used in order to establish if the questionnaire is interpreted by male and female students in the same way. Then, all descriptive statistics and bivariate correlations were examined, and, through Cronbach's alpha statistic, the internal consistency of the subscale was analyzed. Intraclass correlations (ICC) were used to evaluate temporal stability. Finally, we developed a linear regression analysis of the four factors that compose the SPN-PE Scale, with respect to the intrinsic motivation toward the PE classes, in order to know the instrument predictability. In order to carry out these analyses, the statistical packages SPSS 25.0 and AMOS 20.0 were used.

The bootstrapping procedure was used in combination with the maximum likelihood estimation method in the CFA, given that the value of the Mardia coefficient (317.20). In this case, the estimators were considered robust despite the lack of normality [26]. The fit indexes followed to accept or reject the proposed models are as follows [27]: The ratio between the chi-square value and the degrees of freedom (χ^2/df), whose value must be less than 3; the comparative fit index and incremental fit index, whose value must be equal to or greater than 0.9; the standardized root mean square residual, whose value must be equal to or less than 0.06; finally, the root mean square error of approximation plus confidence interval (CI), whose value must be equal to or less than 0.06.

3. Results

3.1. Confirmatory Factorial Analysis

The model (Figure 1) showed appropriate fit indexes: χ^2 (129. N = 1444) = 391.82, $p < 0.001$; $\chi^2/df = 3.04$; comparative fit index = 0.97; incremental fit index = 0.97; root mean square error of approximation = 0.058 (IC = 0.052 – 0.065); standardized root mean square residual = 0.037. Standardized factorial loading was statistically significant ($p < 0.001$) and ranged from 0.88 to 0.93. As for the correlations between the factors, it was 0.66 between competence and relatedness, 0.75 between competence and autonomy, 0.69 between relatedness and autonomy, 0.48 between relatedness and novelty, 0.62 between autonomy and novelty, and 0.65 between competence and novelty ($p < 0.001$).

The fit indices of the higher order model were similar to the previous model and were therefore acceptable: χ^2 (131. N = 1444) = 382.69, $p < 0.001$; $\chi^2/df = 2.92$; CFI = 0.97; IFI = 0.97; RMSEA = 0.061 (IC 90% = 0.056 – 0.067); SRMR = 0.038. The standardized factorial loads were 0.83 for competition, 0.84 for autonomy, 0.75 for ratio and 0.71 for novelty, which were significant ($p < 0.001$).

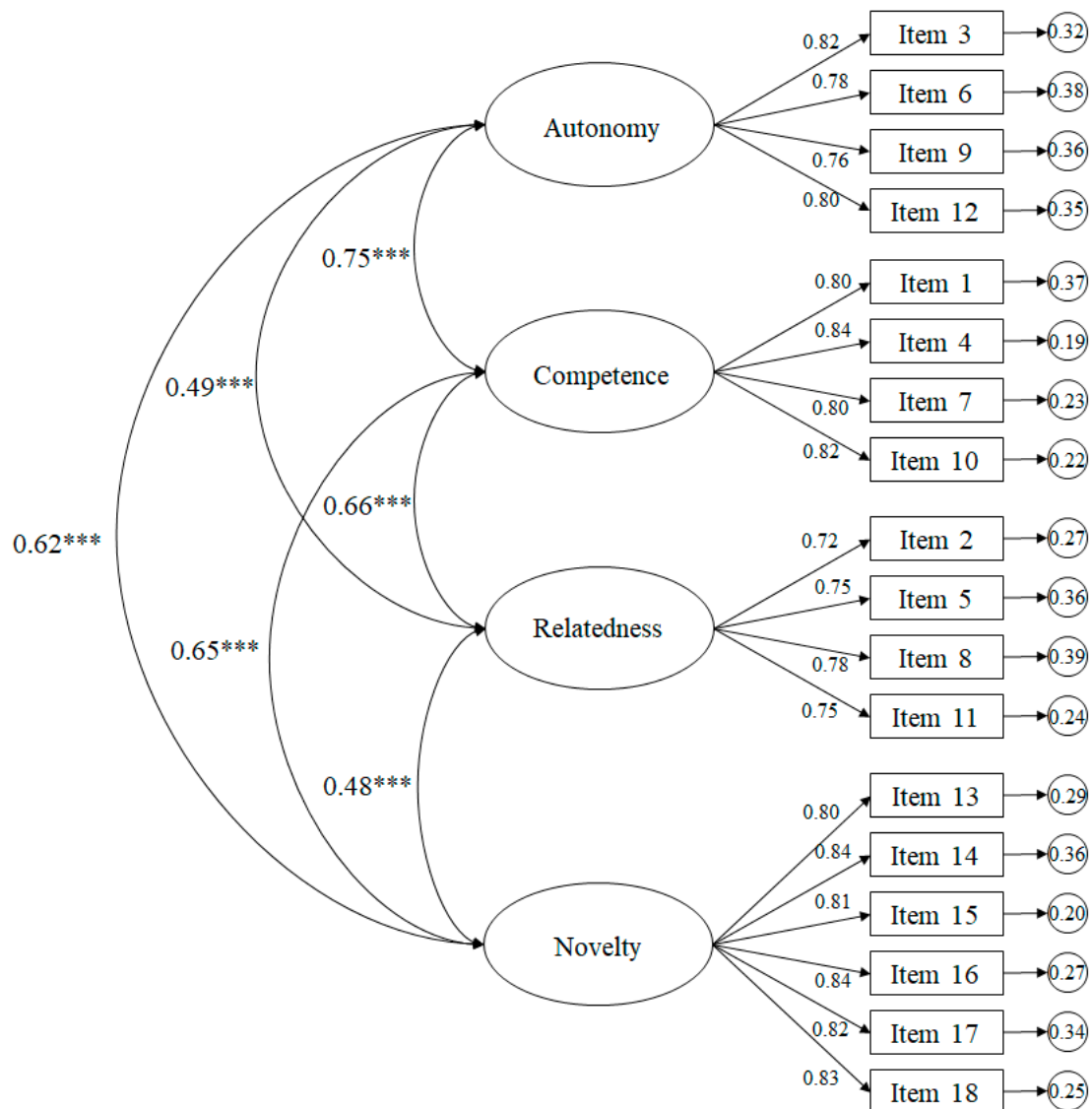


Figure 1. CFA of the Satisfaction of Psychological Needs in Physical Education (SPN-PE) Scale. The factors are presented in the ellipses and the items in the rectangles, finally, in the small circles the Residual variances are presented. Note: *** $p < 0.001$.

3.2. Analysis of Gender and Age Invariance

Tables 1 and 2 show the different fit indices for each of the models. The minimum criterion for acceptance of invariability in relation to gender is the absence of significant differences between model 1 and model 2 [28]. In this sense, in the four-factor model, differences were found between model 1 and model 3–4. For the higher-order model, differences were found between model 1 and model 5–6.

Table 1. Multigroup invariance model across gender.

Four-factor first-order model									
Models	χ^2	df	χ^2/df	$\Delta\chi^2$	Δdf	CFI	IFI	SRMR	RMSEA (CI 90%)
Model 1	572.67	258	2.22	-	-	0.94	0.94	0.047	0.053 (0.047–0.058)
Model 2	581.30	272	2.14	8.62	14	0.94	0.94	0.049	0.051 (0.045–0.056)
Model 3	639.41	282	2.27	66.73 ***	24	0.94	0.94	0.051	0.054 (0.048–0.059)
Model 4	665.48	300	2.22	92.80 ***	42	0.93	0.93	0.052	0.052 (0.048–0.058)
One-factor higher-order model									
Models	χ^2	df	χ^2/df	$\Delta\chi^2$	Δdf	CFI	IFI	SRMR	RMSEA (CI 90%)
Model 1	582.21	262	2.22	-	-	0.94	0.94	0.048	0.053 (0.047–0.058)
Model 2	590.62	276	2.14	8.41	14	0.94	0.94	0.049	0.051 (0.045–0.056)
Model 3	595.58	279	2.13	13.36	17	0.94	0.94	0.050	0.051 (0.045–0.056)
Model 4	597.27	280	2.13	15.05	18	0.94	0.94	0.052	0.051 (0.045–0.056)
Model 5	645.02	284	2.27	62.80 ***	22	0.94	0.94	0.053	0.051 (0.048–0.059)
Model 6	671.09	302	2.22	88.88 ***	40	0.94	0.94	0.058	0.051 (0.047–0.058)

*** $p < 0.001$ Note: Model 1 = unrestricted model; Model 2 = the weighted mean invariance model; Model 3 = the invariant structural covariance model; Model 4 = mean residual invariant model; Model 5 = invariant structural residual model; Model 6 = invariant residual measures model.

Table 2. Multigroup invariance model across age.

Four-factor first-order model									
Models	χ^2	df	χ^2/df	$\Delta\chi^2$	Δdf	CFI	IFI	SRMR	RMSEA (CI 90%)
Model 1	562.03	258	2.28	-	-	0.94	0.94	0.050	0.060 (0.053–0.067)
Model 2	577.99	272	2.13	15.97	14	0.94	0.94	0.051	0.058 (0.052–0.065)
Model 3	583.77	282	2.07	21.75 *	24	0.94	0.94	0.051	0.057 (0.050–0.064)
Model 4	649.05	300	2.16	87.03 ***	42	0.93	0.93	0.053	0.059 (0.053–0.066)
One factor higher order model									
Models	χ^2	df	χ^2/df	$\Delta\chi^2$	Δdf	CFI	IFI	SRMR	RMSEA (CI 90%)
Model 1	581.89	262	2.22	-	-	0.94	0.94	0.046	0.061 (0.054–0.068)
Model 2	598.18	276	2.17	16.28	14	0.94	0.94	0.048	0.060 (0.053–0.066)
Model 3	600.28	279	2.15	18.38	17	0.94	0.94	0.051	0.059 (0.053–0.066)
Model 4	600.30	280	2.14	18.41	18	0.94	0.94	0.054	0.059 (0.052–0.065)
Model 5	601.79	284	2.12	34.90 **	22	0.94	0.94	0.057	0.058 (0.052–0.065)
Model 6	668.15	302	2.21	86.26 ***	40	0.93	0.93	0.055	0.061 (0.055–0.067)

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ Note: Model 1 = unrestricted model; Model 2 = the weighted mean invariance model; Model 3 = the invariant structural covariance model; Model 4 = mean residual invariant model; Model 5 = invariant structural residual model; Model 6 = invariant residual measures model.

3.3. Descriptive Statistics and Reliability Analysis

Table 3 shows the descriptive statistics, reliability analysis (Cronbach's alpha), and bivariate correlations.

Cronbach's alpha values were 0.85 for relatedness, 0.81 for novelty, 0.91 for competence, 0.87 for autonomy, and 0.82 for intrinsic motivation. For the global factor called satisfaction, Cronbach's alpha was 0.93.

Intraclass correlation coefficients (ICCs) and confidence intervals (CIs) were used to conduct the temporal stability analysis. These analyses were performed with an independent sample that completed the questionnaire on two separate occasions. Temporal stability was supported for each of the SPN-PE Scale factors, including competence = ICC of 0.93 (CI = 0.90 – 0.89); autonomy = ICC of 0.92 (CI = 0.91 – 0.93); relatedness = ICC of 0.91 (CI = 0.90 – 0.92); and novelty = ICC of 0.85 (CI = 0.82 – 0.87).

Table 3. Descriptive statistics and correlations.

Factors	M	SD	Range	1	2	3	4	5	6
1. Autonomy	5.34	1.19	1–7		0.60 **	0.61 **	0.41 **	0.45 **	0.62 **
2. Competence	4.61	1.45	1–7			0.68 **	0.52 **	0.58 **	0.50 **
3. Relatedness	4.60	1.26	1–7				0.48 **	0.54 **	0.54 **
4. Novelty	4.74	0.95	1–7					0.70 **	0.39 **
5. Satisfaction	4.84	1.55	1–7						0.70 **
6. Intrinsic Motivation	4.88	1.76	1–7						

Note: ** $p < 0.01$.

3.4. Criteria Validity Analysis

A linear regression analysis was performed in order to assess the criteria validity of the SPN-PE Scale in PE classes (see Table 4). In this way, the dependent variable was the intrinsic motivation, and autonomy, competence, relatedness, novelty, and global factor (satisfaction) as an independent variable. The results showed that factors significantly predicted intrinsic motivation with a positive regression weight and provided an explained variance of 51%.

Table 4. Linear regression analysis.

Variables	F	R ²	β	t
	123.73	0.51 ***		
1. Autonomy			0.77	1.21 *
2. Competence			0.90	2.63 **
3. Relatedness			0.68	1.72
4. Novelty			0.30	1.34 **
5. Satisfaction			1.61	4.201 ***

Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

4. Discussion

The objective of the present study was to examine the psychometric properties of SPN-PE Scale. Based on the established cut-off points [27], the results suggested that SPN-PE Scale has an appropriate factorial structure. Furthermore, Cronbach's alpha analysis revealed that all factors are reliable, given that his score was above 0.70, this being the lowest criterion [29]. Thus, there is an effective tool to help researchers understand and analyze the predictive effects of psychological needs on the positive and negative consequences for the overall development of adolescents at the physical, psychological, and emotional level [23].

The CFA revealed that the factor structure of the SPN-PE Scale had adequate adjustment indices, both for the four-factor model and for the higher-order model. These results are in concordance with the postulates of SDT, since the sub-theory of basic psychological needs defends the existence of a group of psychological needs that are interrelated with each other, which also has the incorporation of novelty as a psychological need, continuing the line of previous studies (e.g., [10,23,30,31]). As for the reliability analyses and temporal stability analysis, they revealed acceptable adjustment indices for the four subscales (i.e., autonomy, competition, relationship with others, and novelty). In addition, the present study revealed a high correlation between the factors that make up the scale, but without achieving overlap between the factors.

In relation to the higher-order model, satisfaction, the factorial structure was supported through a CFA. This model is interesting because it suggests the use of a global value composed by the mean of the four factors, which allows researchers to use it in order to simplify models where several constructs are present. Furthermore, its use is justified since the study conducted by Gagné, Ryan and Bargmann [32] suggested that needs tend to function as a single "factor" in different situations. Multigroup analyses showed that the structure of the four-factor and higher-order model of the SPN-PE Scale was invariant

with respect to gender and age. These results support the use of the questionnaire in future research where it is intended to compare the means between boys and girls by understanding both groups in a similar way to the axioms of the questionnaire.

For linear regression analysis, evidence of predictive validity of SPN-PE Scale was found. The analysis suggested that PE students with high levels of intrinsic motivation rated higher in the overall value of satisfaction, as well as in the factors linked to competence, autonomy, and relatedness, with no predictive evidence with the relatedness. These results are shown in line with several previous studies in which intrinsic motivation was positively predicted by the satisfaction of psychological needs [33,34]. In addition, these results support the postulates of SDT proposed by Deci and Ryan [35], where the satisfaction of psychological needs can result in the development of positive adaptive behaviors that result in the promotion of personal well-being.

Finally, the results obtained in the present study, through the various analyses carried out, have shown that the SPN-PE Scale is in line with the original scale of Menéndez and Fernández-Río [22], incorporating into the scale a fourth psychological need called novelty. Therefore, the present scale procures conceptual validity (see, Menéndez and Fernández-Río [22]; Vlachopoulos, Katartzi, and Kontou [23]) to the detriment of the scale traditionally used in the Spanish context (see, Moreno, González-Cutre, Chillón, and Parra [17]; Vlachopoulos and Michailidou [36]). Furthermore, the present scale gives the Menéndez and Fernández-Río scale as an instrument of greater applicability, to investigate the three psychological needs, together with the fourth psychological need (novelty), so that these results comply with a greater adaptability and reproduction to other educational and sociodemographic environments worldwide.

5. Conclusions

The SPN Scale toward the context of PE in Spain has shown evidence of reliability and validity. In this way, education professionals have an effective instrument to measure the satisfaction of students' psychological needs during PE classes.

However, future researchers should analyze the factor structure of the questionnaire with different student populations, with the aim of improving the tool available and analyzing with the psychological processes present toward PE, using greater criteria. In addition, future studies should analyze the structure of invariance with respect to other variables, academic level, or type of center (e.g., private, concerted, or public). Finally, the predictability of the scale should be explored with respect to other variables, for example, body mass index and self-esteem.

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Appendix A

Satisfaction of Psychological Needs Scale in physical education (scale was validated in Spanish)

La escala está precedida por el siguiente epígrafe: “En mis clases de EF...”

1. Siento que mejoro incluso en las tareas consideradas difíciles por la mayoría de mis compañeros.
2. Las relaciones con mis compañeros de clase son buenas.
3. Hacemos cosas que son de mí interés.
4. Siento que realizo bien incluso las tareas consideradas difíciles por la mayoría mis compañeros.
5. Siento que tengo una estrecha relación con mis compañeros de clase.
6. Siento que las clases son enseñadas en la forma en que me gustaría que fueran enseñadas.

7. Siento que hago muy bien incluso las tareas consideradas difíciles para la mayoría de mis compañeros.
8. Me siento una persona apreciada/valorada dentro del grupo de mis amigos.
9. Estoy totalmente de acuerdo con la forma en que las clases son enseñadas.
10. Soy capaz de hacer eficazmente incluso las tareas consideradas difíciles por la mayoría de mis compañeros.
11. Me siento integrado en el grupo de los compañeros de clase.
12. Siento que las actividades que estamos haciendo han sido elegidas por mí.
13. Siento que hago cosas nuevas.
14. Con frecuencia siento que hay novedades para mí.
15. Siento nuevas sensaciones.
16. Creo que vienen nuevas situaciones para mí.
17. Tengo la oportunidad de innovar.
18. Creo que descubro cosas nuevas con frecuencia.

The scale is preceded by the following heading: "In my PE classes..."

1. I feel that I improve even on tasks considered difficult by most of my peers.
2. Relationships with my classmates are good.
3. We do things that are of interest to me.
4. I feel that I do well even on the tasks considered difficult by most of my peers.
5. I feel like I have a close relationship with my classmates.
6. I feel that classes are taught the way I would like them to be taught.
7. I feel that I do very well even on the tasks considered difficult for most of my classmates.
8. I feel like a valued/appreciated person in my friends' group.
9. I totally agree with the way the classes are taught.
10. I am able to do effectively even the tasks considered difficult by most of my peers.
11. I feel integrated into the group of my classmates.
12. I feel that the activities we are doing have been chosen by me.
13. I feel like I'm doing new things.
14. I often feel that there is something new for me.
15. I feel new sensations.
16. I think new situations are coming for me.
17. I have the opportunity to innovate.
18. I think I often discover new things.

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