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Adaptation and validation of the Preferences of Learning Styles (Index of Learning Styles, ILS, 1997) questionnaire to the cultural and cognitive characteristics of Spanish students aged 11-15 years[1]

Maríaluz Diago-Egaña[2]; Ana Isabel Manzanal-Martínez[3]; Patricia González-González[4]; Susana Quirós-Alpera[5] and Paola Perochena-González[6].

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Abstract. Introduction. The Index of Learning Styles (ILS) is a questionnaire created to assess students' preferences regarding how they learn. It was originally designed in English for university students. The objective of the present work is to adapt the ILS questionnaire to Spanish and validate this adapted version, taking into account the cultural characteristics and cognitive level of the recipients, namely Spanish students aged 11–15. Method. We used the Delphi method involving expert opinions for content validation and the Brown and Maydeu-Olivares model, an approach from the Item Response Theory, for construct validation (this model is recommended for forced-choice items). Results. We located new items in the data scrubbing process, which in previous research were missed using classical factor analysis. The results for the global fit of the model show that 32 of the 44 items in the original questionnaire, display optimal values in various indices (RMSEA, CFI, X2, among others), and so this instrument can be used to identify learning style preferences in Spanish adolescents. Discussion. The Brown and Maydeu-Olivares model takes into account the nature of forced-choice items and this is the first the first time it has been applied to the ILS questionnaire. This validation procedure is novel and proves to be an optimal validation method for questionnaires with this type of items. The interest in the ILS questionnaire is due to the dimensions it assesses, which provide teachers and students with information about learning preferences for better psycho-pedagogical orientation and for the design of more personalized educational interventions.
Keywords: learning theory; questionnaire; learning process; primary education; secondary education.

[es] Adaptación y validación del cuestionario de Preferencias de Estilos de Aprendizaje (Index of Learning Styles, ILS, 1997) a las características culturales y cognitivas de estudiantes españoles de entre 11-15 años

Resumen. Introducción. El Index of Learning Styles (ILS) es un cuestionario creado para evaluar las preferencias de los estudiantes respecto a la forma en la que aprenden y fue diseñado originalmente en inglés para universitarios. El objetivo del presente trabajo fue adaptarlo al castellano y validarlo, considerando las características culturales y la edad cognitiva de los destinatarios; siendo en esta ocasión el alumnado español de 11-15 años. Método. Se utilizaron el método Delphi mediante juicios de expertos para la validación del contenido y el modelo de Brown y Maydeu-Olivares, como aproximación desde la Teoría de Respuesta al Ítem, para la validación de constructo (modelo aconsejado cuando los ítems son de respuesta forzada). Resultados. Se han podido localizar nuevos ítems en el proceso de depuración

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[2] Universidad Internacional de La Rioja (España)
E-mail: marialuz.diago@unir.net
ORCID: https://orcid.org/0000-0002-0446-3120

[3] Universidad Internacional de La Rioja (España)
E-mail: ana.manzanal@unir.net
ORCID: https://orcid.org/0000-0003-0610-0451

[4] Universidad Cardenal Herrera-CEU (España)
E-mail: patricia.gonzalez4@uchceu.es
ORCID: https://orcid.org/0000-0002-6970-1134

[5] Universidad Internacional de La Rioja (España)
E-mail: susana.quiros@unir.net
ORCID: https://orcid.org/0000-0002-9438-2366

[6] Universidad Nacional de Educación a Distancia (España)
e-mail: paola.perochena@edu.uned.es
ORCID: https://orcid.org/0000-0001-7287-9040

que, en investigaciones anteriores, se escapaban con el análisis factorial clásico. El ajuste global del modelo demuestra que 32 ítems, de los 44 en el cuestionario original, muestran valores óptimos en diversos índices (RMSEA, CFI, X2, entre otros) por lo que este instrumento puede ser aplicado para identificar las preferencias de estilos de aprendizaje en adolescentes españoles. Discusión. El modelo de Brown y Maydeu-Olivares tiene en cuenta la naturaleza de los ítems de respuesta forzada y es la primera vez que se aplica al cuestionario ILS. Este procedimiento de validación resulta novedoso y demuestra ser un método óptimo de validación de instrumentos con este tipo de ítems. El interés por el cuestionario ILS se debe a las dimensiones que evalúa, que aportan información al profesor y al estudiante sobre las preferencias de aprendizaje para realizar una mejor orientación psicopedagógica y para el diseño de intervenciones educativas más personalizadas.
Palabras clave: teoría del aprendizaje; cuestionario; proceso de aprendizaje; educación primaria; educación secundaria.

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1. Introduction

Within learning styles theories, there are a number of models, which provide a varied conceptual framework for identifying personal orientations towards learning. Table 1 summarises some of these models and shows how each one considers different aspects: cognitive styles, learning strategies and preferences.

Table 1. Diversity in the concept of learning styles

Models	Construct measured
Field-dependency and field-independency, Witkin and Goodenough	Way of perceiving reality. Two potential profiles identified
Learning styles, Dunn and Dunn	Ways of perceiving information
Kolb	Learning style preferences (experiential)
Honey and Mumford	Learning style preferences
Hermann's Brain Quadrants	Thinking styles. Ways of operating, thinking, creating, learning and living with the world
Vermunt	Learning strategies
Allison and Hayes	Cognitive styles
Neuro-linguistic programming (NLP), Bandler and Grinder	Systems for representing information
Gardner's Multiple Intelligences	Ways learners perceive, process and store information

Source: Produced by the authors of this study adapted from Diago et al. (2018) and Sprock (2018).

For example, Felder (2020) defines learning styles (LS) as students' common patterns of preferences for certain forms of instruction, which vary in intensity and change over time according to the context, the topic, individual education and life experience. A variety of detection instruments have been developed to identify LS, and many of them, such as the questionnaires by Kolb or Honey and Mumford, have not been validated (Álvarez-Montero et al*.,* 2018; Diago et al., 2018) with regard to content, construct and criterion validity. Content validity is generally evaluated through a panel of experts or expert judgement (Bernal-García et al., 2018), this being, according to Escobar-Pérez and Cuervo-Martínez (2008): "an informed opinion from people with a track record in the subject who are recognised by others as qualified experts and who can provide information, evidence, opinions and evaluations" (p. 29, own translation). For its part, factor analysis is often used to determine construct validity (López et al., 2019).

The ILS questionnaire (Felder & Soloman, 1997) is a widely used tool for identifying LS, which according to Diago et al. (2018) matches the original meaning of the term (Gibson, 1969). It was originally designed in English for university students and has been validated by a range of authors (Al-Azawei et al., 2015; Hosford & Siders, 2010; Seneler & Petrie, 2018; Wang & Mendori, 2015). However, according to Marhuenda et al. (2015), if a measurement instrument is to be applied to a population other than the one for which it was designed, translation and transcultural adaptation are necessary to eliminate any disparity in the use of the language.

There are several versions of the ILS questionnaire in Spanish (Ramírez & Araiza, 2016; Rodríguez, 2002), but

Rodríguez's version (2002) is the only one that has been validated for reliability and construct validity (Gamero, 2012; Ocampo et al., 2014) and content validity (Gamero, 2012), always at university levels. Therefore, in order to apply the original ILS questionnaire to non-university students in Spain, it is necessary to translate and adapt the language to the student's cultural characteristics (Çardak & Selvi, 2016) and cognitive and social level.

1.1. Characteristics of the ILS questionnaire

The ILS questionnaire is currently used in various disciplines, such as anatomy (Quinn et al., 2018), medicine (Rahim et al., 2019), engineering (Jamali & Mohamad 2018; Supangat & MohZainuri, 2020), educational sciences (Raash & Baljinnyam, 2020), accounting (Marques et al., 2019) and computer science (Ngatirin & Zainol, 2020). It comprises 44 items, which use dichotomous answers in order to force a decision between two exclusive alternatives, so that LS preferences can be identified (Litzinger et al., 2005). Table 2 shows that the questionnaire is organised in 4 cognitive dimensions – perception, input, understanding and processing – and that each dimension is linked to two opposing LS on a dichotomous scale: sensing–intuitive; visual–verbal; sequential–global and active–reflective. Table 2 provides a description of these LS, and the work of Felder and Spurlin (2005) covers them in more detail. There are 11 items for each of the scales and dimensions listed. Each individual is classified in accordance with 8 styles, where his or her preferred style in each dimension is identified, and a magnitude for this preference is provided.

Table 2. Structure of the ILS questionnaire, dimensions and description of the scales.

Dimensions	Scales	Items	Number of factors	Description
Perception (preference of the student for the type of information perceived)	Sensing	38; 6; 18;14; 2	1 factor (preference for the type of information received)	Concrete information. Practical person, oriented towards facts and procedures
	Intuitive	10; 34; 26; 22; 42; 30		Abstract information. Conceptual person, innovative, oriented towards theories, models
Input (predominant sensory route for entry of information, memory and recall)	Visual	7; 31; 23; 11; 15	2 factors (predominant sensory route for entry of information, and for memory and recall)	Visual representations (images, diagrams, flow charts)
	Verbal	27; 19; 3; 35; 43; 39		Written and verbal explanations
Understanding (the student's preference for the method of processing information)	Sequential	20; 36; 44; 8; 12; 32; 24	1 factor (Preference for the process of thinking)	Linear, sequential (by steps)
	Global	28; 4; 16; 40		Holistic (learns in large leaps)
Processing (the predominant process through which information is understood)	Active	25; 1; 29; 5; 17	3 factors (What they do first: act or reflect; outgoing or reserved; favourable or unfavourable attitude towards group work)	Learns by acting first then thinking, outgoing; enjoys working in groups
	Reflective	37; 13; 9; 21; 33; 41		Learns by thinking first then acting; reserved; prefers working alone or with 1 or 2 people

Source: Produced by the authors of this study based on Litzinger et al. (2005).

Previous studied to validate the ILS questionnaire have covered adaptations to the structure of the questionnaire (Felder & Spurlin, 2005; Litzinger et al., 2007) or adaptations for other geographic settings or other types of participants (Brito-Orta & Espinosa-Taguma, 2015; Çardak & Selvi, 2016; Platsidou & Metallidou, 2009; Seneler & Petrie, 2018) and their subsequent validation. These works share the use of conventional factor analysis and Cronbach's alpha. Nonetheless, when examining https://doi.org/10.21547/jss.256723 the ILS closely it is apparent that the items are deliberately designed as mutually exclusive dichotomous responses, to force respondents to make a decision (Calderón & Ximénez, 2014). Consequently, there is a fixed number of points in each block of questions, and so the total number of points in the test is the same for each individual. This structure, along with the analytic properties of its items, such as the residual variance being shared and having to be split between the two extremes of each scale (an aspect not considered in a conventional factor analysis), mean that using classical factorisation procedures is not advisable, as these lead to erroneous conclusions about the internal structure of the data (Meade, 2004; Calderón & Ximénez, 2014).

To rectify this, Brown and Maydeu-Olivares (2011) apply Thurstone's law of comparative judgement, suggesting the item response theory (IRT), which focuses on the responses to each of the items to recode these forced choices as binary outcomes of pairwise comparisons, which is more effective for calculating the scores of the traits of the individuals. This model could be applied for validation of the ILS questionnaire, as it would resolve the problems caused by forced-choice items. In this study, learners aged between 11 and 15 have been chosen as there is no validated translation into Spanish of the ILS questionnaire for this age group. Furthermore, this age involves a change in educational cycle (they complete primary education and start secondary education) and changes in their psychological development (Stassen, 2007).

1.2. Objectives

The objectives of this work are to adapt the ILS questionnaire (Felder & Soloman, 1997) into Spanish at the cognitive and social level of students aged from 11 to 15 and to validate the instrument so that it can be used to identify learning style preferences and can be used for designing educational interventions in the classroom.

2. Method

The steps followed to carry out the process of validating the instrument and its content are described below.

2.1. Content validity

The content validation process comprises three steps:

2.1.1. Validation of the translation

The questionnaire was translated into Spanish and was then submitted for expert judgement to ensure semantic equivalence with the items from the original ILS. The team of experts comprised five English graduates, including three with doctorates, with extensive teaching experience. The number of experts chosen is in line with what Corral de Franco (2009) specifies regarding requirements for validation and reliability. This procedure was carried out using the Delphi method (Helmer & Rescher, 1959). To do so, we sent the original version of the instrument and the translation to the panel of experts and asked them to indicate whether the translation was correct and whether it transmitted the same information in both languages. The response to this question was dichotomous (yes/no), and a section for making comments on each item was included. The criterion chosen for accepting or rejecting items was the degree of positive agreement. If the agreement was 100%, the item was automatically included in the questionnaire. Items with partial agreement were revised and reformulated in accordance with the recommendations of the experts and were subjected to a new round of validation. Three rounds of validation were necessary to increase the agreement, finally achieving a level of agreement of between 80% and 100% between all of the experts and for all of the items. The agreement between the experts was also analysed using the Fleiss' kappa statistic. Following completion of this validation process, 28 items were modified (4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 19, 20, 22, 23, 24, 26, 28, 29, 31, 34, 35, 38, 39, 41, 42, 44).

2.1.2. Validation of language

To verify whether students aged 11–15 would find it easy to understand the items translated into Spanish, a new expert judgement was carried out involving seven teachers from these educational levels with more than 20 years' experience. They were asked whether the language in the wording of each item would be comprehensible for their students, and an ordinal evaluation scale (from 1 to 4) was used (Escobar-Pérez & Cuervo-Martínez, 2008). Achieving a degree of positive agreement of 80–100% was taken as the criterion for accepting or rejecting items. Furthermore, we calculated Kendall's W statistic to analyse the degree of agreement between the experts. After completion of this validation process, 14 items were modified (2, 4, 6, 8, 10, 13, 18, 21, 28, 32, 34, 37, 38, 44).

The final questionnaire to be subjected to construct validation can be found in Appendix 1.

2.2. Validation of the instrument

The characteristics of the sample participating in this validation study are described below, as is the procedure followed.

2.2.1. Description of the sample

We used non-probability convenience sampling. The translated and adapted questionnaire was applied in educational centres distributed across Spain, with the initial participation of 1032 learners aged from 11 to 15. Participation was voluntary and anonymous, and the only incentive provided was feedback to the centres about the learning preferences of their students. Prior authorisation was acquired from the parents or legal guardians, from the educational centres, and from regional ministries of education that required it. After a first round, 56 questionnaires were excluded as they had not been completed correctly (questions left blank or with more than one answer selected), reducing the number of participants to 976. Of these, 54.9% were male, 24.3% were in year 6 of primary school, 32.7% in year one of secondary school, 19% in year two of secondary school and 24% in year three of secondary school. Of the students, 62.3% attend public centres and 37.7% state-

funded independent schools, and they had a medium social level. With regards to sample size, Morales (2012) recommends having around 10 times as many answers as the number of items in the questionnaire. In this case, knowing that each item would count double owing to the polarity in the items (44 × 2 = 88; 88 × 10 = 880) a sufficiently large sample was obtained.

2.2.2. Construct validation process

For this validation, we used the technique of analysis of forced-choice items based on Thurstone's law of comparative judgement, combined with IRT, using Mplus software. The final psychometric properties of the instrument, the global functioning of the model (of the 4 dimensions and their corresponding associated scales of styles) and the scrubbing of items were determined.

To evaluate the quality of the model, we followed the guidelines of Brown and Maydeu-Olivares (2012) for forced-choice items, which consist of estimating the parameters using as an algorithm the mean-weighted-least squares and residual variance of the residuals. Theta parametrisation is used to test whether there is a latent implicit trait that makes it possible to locate the subject at one extreme or another, depending on the cut-off point. The root mean square error of approximation (RMSEA) index, the standardised root mean squared residual (SRMR) and the comparative fit index (CFI) are calculated and for the comparative indices with the null model, the standardised root mean squared residual (SRMR) is calculated. The values considered as optimal, based on RMSEA, must be less than .08. For CFI, the values must be greater than .9 (Byrne, 2009).

To develop the models, we completed two rounds. As a first approach, the empirical data obtained by Litzinger et al. (2007), were taken into account. These show that there are items that are not well positioned in the scales (intuitive: items 22, 30, 42; verbal: item 39 and global: item 40). The process of scrubbing the items was done on the basis of analysis of the output tables from the program and the decision on whether to eliminate items was based on fulfilling two criteria established to respect the theoretical structure of the instrument: whether the item has insignificant weight and whether eliminating it improves the fit of the model.

To check whether the four dimensions of the questionnaire are independent or measure associated characteristics, we analysed the correlations obtained using MPlus. In the second round, we used correlations between dimensions to make modifications to the parameters of the model, setting at zero those that theoretically should not be correlated, and testing the changes in the fit of the model.

3. Results

The results obtained following the content and construct validation are shown below.

3.1. Content validation

The validation tests displayed agreement between the expert judges of 80–100% for all of the items. The Fleiss' kappa value was .052, with agreement between categories of .88; and the Kendall's W value was .212, with the α value being less than .05, confirming that there is statistically significant concordance.

2.2. Construct validation

The results obtained during the process of construct validation are described in detail below.

2.2.1. Evaluation of the global fit of the model

With regards to the global fit of the model (Table 3), the statistics recognised as being most informative are based on the Chi squared test, owing to its usefulness for detecting the existence of independence between two variables, displaying after the second round a value of 1.23 (1055.743 with df = 860, *p*-value = .000) and RMSEA achieving a value of .022 (CI 90% .017–.026). Regarding indices that compare with the null model, the SRMR stands out with a value of .085, which indicates a good fit, as does the CFI with a value of .728, which is a slightly low value.

With the original structure of the questionnaire, fitting the model was not possible and the process of scrubbing items was started. After various attempts at scrubbing items, described in section 2.2.2, a small improvement was obtained when the parameters of the correlations between the estimated dimensions were left free, and not fixed between pairs (between 2 styles from a same scale), thus conserving more items within the model.

Table 3. Indices obtained to evaluate the goodness-of-fit model and list of items excluded in each validation round.

	Statistical tests	RMSEA	SRMR	CFI	Items eliminated
First round	1.45 X^2 = 1272.952 df = 876 *p*-value = .000	.030 (CI 90% .027–.024)	.103	.334	33 (reflective) 10, 42 (intuitive) 15 (visual), 39 (verbal) 32, 36, 44 (sequential)
Second round	1.23 X^2=1055.743 df = 860 *p*-value = .000	.022 (CI 90% .017–.026)	.085	.728	17 (active) 35 (verbal) 40 (global)

Source: Authors' own research.

Eleven items were rejected (Appendix 1) owing to their factor weighting in the values for each dimension.

3.2.2. Correlations between the dimensions and the styles (scales)

Table 4 shows the statistically significant correlations obtained between the scales on the questionnaire. There are correlations greater than .7 between both opposing styles associated with each dimension. Furthermore, significant correlations are observed between different dimensions, but with values lower than .5 in almost all cases. In the processing dimension, the active style correlates positively with the intuitive style and negatively with the sensing and global styles. The reflective style has a negative correlation with the sensing and visual styles, and a positive correlation with the sequential one; this is the highest correlation between scales with an estimation value of .606. However, in the perception dimension, the sensing style correlates positively with the verbal and global styles, with values of less than .3. In the input dimension, the visual style only correlates positively with the sequential style, and finally, the verbal style only with the global.

Table 4. Values of the statistics that show the correlations between the different styles.

		Estimation	Standard error	Standardised standard error	p-value
Active	Reflective	.976	.017	57.543	.000
	Sensing	-.292	.115	-2.528	.011
	Intuitive	.158	.061	2.586	.010
	Global	-.576	.122	-4.717	.000
Reflective	Sensing	-.429	.096	-4.460	.000
	Visual	-.077	.038	-2.007	.045
	Sequential	.606	.119	5.107	.000
Sensing	Intuitive	.872	.045	19.311	.000
	Verbal	.298	.073	-4.103	.000
	Global	.218	.061	3.589	.000
Intuitive	Visual	.322	.062	5.217	.000
Visual	Verbal	.842	.056	15.090	.000
	Sequential	.331	.105	3.162	.002
Verbal	Global	-.217	.104	-2.088	.037
Sequential	Global	.753	.087	8.699	.000

Source: Authors' own research.

The correlation study of the four dimensions that the questionnaire measures, in order to establish whether they are really independent or measure associated characteristics, found that the items from the sequential scale are implicitly in more than one dimension. These items relate to the preferred forms for the process of thinking and could require a deeper revision as indicators within the scale.

2.1.3. Correlations of each item

With regards to the R^2 value, 27 of the 88 possible combinations returned statistically significant values (Table 5) and in all cases, values lower than .6 were observed. In fact, the items with the lowest estimation value were item 10 in

its intuitive extreme (R^2 = .084 and p = .049), item 36 in global (R^2 = .092 and p = .078) and item 20 in sequential (R^2 = .110 and p = .032). In turn, the items with the greatest value would be 27 in verbal (R^2 = .533 and p = .000) and 23 in visual (R^2 = .396 and p = .000), both in the reception of information dimension. Items 4, 7, 12, 13, 16 and 23, with values greater than .3, are kept because they do not make the proposed model worse.

In contrast, the items whose variance considerably improves the indices of reliability when set at zero are 24, 32, 39, 40 and 44, which are candidates to be reformulated in the questionnaire. The items validated as definitive are shown in Appendix 1 marked with an asterisk. It would be necessary to reformulate items in all of the scales, except in the sensitive scale.

Table 5. R^2 observed in a two-tailed test by dimension of the questionnaire.

Dimension	Item[#]	R^2	p-value
Processing	17 A	.173	.007
	25 A	.279	.001
	29 A	.217	.004
	13 R	.376	.001
	21 R	.134	.018
	37 R	.162	.007
	41 R	.200	.005
Input of information	03 Vi	.241	.000
	07 Vi	.365	.000
	15 Vi	.255	.008
	23 Vi	.396	.000
	27 Ve	.533	.000
Perception	02 S	.204	.000
	06 S	.128	.011
	18 S	.276	.000
	10 I	.084	.049
	22 I	.120	.025
	30 I	.228	.001
	34 I	.149	.010
	42 I	.222	.027
Understanding	04 Seq	.330	.000
	12 Seq	.321	.000
	16 Seq	.319	.000
	20 Seq	.110	.032
	28 G	.197	.003
	36 G	.092	.078
	38 G	.184	.008

[#]A=active, R=Reflective, S=Sensing, I=Intuitive, Vi=Visual, Ve=Verbal, Seq=Sequential, G=Global.

Source: Authors' own research

3. Discussion

To validate our translated version and adapt it to Spanish students aged from 11 to 15, we used the Delphi method with expert evaluation. Items were included in the questionnaire when the degree of consensus among the experts reached 80–100%. Nonetheless, the values of the statistics for the translation (Fleiss' kappa) and for the semantic equivalence (Kendall's W) observed are lower than those indicated by Viera and Garrett (2005) and Márquez and Márquez (2018), even though we performed additional tests by dimensions and scales for Kendall's W, which, although they slightly improved the values, did not reach the optimal value of .6. This could be because of the lack of variability in the responses. For example, for Kendall's W, almost all of the answers to the questionnaire have values of 3 and 4, and in some dimensions the agreement is total (everyone gave these items valuations of 4).

As for the construct validation, it is confirmed that the goodness-of-fit model is good, as the indicators of goodness-of-fit are within what is specified by Hu and Bentler (1999). The analysis of the effect of the items on the construct validity makes it possible to suggest that 32 of the 44 initial items display an appropriate value for the factor

loading on the scale assigned to them. The rejection of items 10, 17, 35, 39 and 44 agrees with what was found by Çardak and Selvi (2016).

Eliminating item 17 is also indicated in the work of Samanci and Keskin (2007). Equally, the elimination of items 15, 24, 39, 42 and 44 coincides with what was found by Mirza et al. (2021) and that of items 39, 40 and 44 coincides with the results of Litzinger et al. (2007). According to them, items 22 and 30 should also be eliminated, but our results do not confirm this. For the elimination of items 32, 33 and 36, we did not find agreement with any author. In this regard, the population in our study is different from that of these authors. It has a different educational level and different culture and age.

Furthermore, the method used for analysing forced-choice items has made it possible to identify new items that were previously missed with factor analysis. It is necessary to take into account the errors committed when applying conventional factor analysis techniques to forced-choice items, referring to non-compliance with the basic assumptions of precision tests (consistent coding and independence of errors), it also makes it impossible to use conventional analysis of reliability, such as Cronbach's alpha coefficient, as it distorts the individual profiles, the construct validity and the criterion validity (Brown & Maydeu-Olivares, 2013). Calderón and Ximénez (2014) indicate that: "conventional techniques designed for normative data without ipsative restrictions are currently still being used to analyse and validate this type of test" (p. 33, own translation).

The model of Brown and Maydeu-Olivares (2011) solves these problems as it fits the forced-choice items by using the Mplus general modelling software program. This software recoded the forced choices as binary results of pairwise comparisons, thus calculating the scores of the traits of the individuals effectively.

This validation of the ILS questionnaire is novel, as it is the first time it is applied and it takes into account the characteristics of the forced-choice items.

The results obtained make it practical to use the ILS owing to its adequate psychometric characteristics, but it is necessary to reformulate or eliminate from the questionnaire items 10, 15, 17, 24, 32, 33, 35, 36, 39, 40, 42 and 44. The understanding dimension (sequential/global scale) has more items affected that score in more than one dimension and should be revised.

The limitations of this work are that not all of the educational centres contacted were willing to carry out the study, and that the ILS questionnaire collected self-reported data (which can be potential sources of bias). Finally, assuming that the validation of an instrument is never completed, it would be desirable to continue working on the optimal conditions for the application of the factorisation procedures for forced-response items, making new fits to try to improve the CFI, and carrying out interviews with spoken response techniques according to Brizuela et al. (2016). The interest in the ILS questionnaire is because of the dimensions it evaluates, which provide information about the learning preferences of each learner for better educational psychology guidance and design of personalised educational interventions.

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Appendix 1.

ILS questionnaire adapted to the cognitive and cultural characteristics of Spanish students aged between 11 and 15, which is subjected to the construct validation process.

Item number. Wording and responses
*1. Entiendo algo mejor después de: a. probarlo. b. pensar sobre ello.
*2. Prefiero que me consideren una persona: a. realista (sé perfectamente cuáles son mis posibilidades y realizo las cosas según mis posibilidades). b. de ideas novedosas (capaz de realizar cosas nuevas).
*3. Cuando pienso en lo que hice ayer, es más probable que me vengan a la mente: a. imágenes. b. palabras.
*4. En un tema tiendo a: a. entender los detalles, pero no el tema en general. b. entender el tema, pero no los detalles.
*5. Cuando estoy aprendiendo algo nuevo, me ayuda: a. hablar de ello. b. pensar en ello.
*6. Si yo fuera profesor, preferiría enseñar un tema: a. que tratase sobre hechos y situaciones de la vida real. b. que tratase sobre ideas y pensamientos.
*7. Prefiero recibir la información nueva en forma de: a. imágenes, esquemas, gráficos o mapas. b. instrucciones escritas o información verbal.
*8. Una vez que entiendo: a. los diferentes apartados de un tema, entiendo el tema completo. b. el tema completo, entiendo cómo encajan los diferentes apartados.
*9. En un grupo de estudio que trabaja con un tema difícil, es más probable que yo: a. intervenga y aporte ideas. b. me siente y escuche.
10. Me resulta más fácil: a. aprender hechos. b. aprender ideas.
*11. En un libro con muchas imágenes y gráficos, es más probable que: a. mire las imágenes y gráficos cuidadosamente. b. me concentre en el texto escrito.
*12. Cuando resuelvo problemas de matemáticas: a. por lo general, llego a las soluciones paso a paso. b. a menudo, veo solo las soluciones, pero luego tengo que esforzarme en encontrar los pasos que me llevan a las soluciones.
*13. En las clases a las que he asistido: a. por lo general, he llegado a conocer a muchos de los otros estudiantes. b. pocas veces he llegado a conocer a muchos de los otros estudiantes.
*14. En una lectura que no es de ficción, prefiero la que: a. me enseña cosas nuevas o me dice cómo hacer algo. b. me ofrece nuevas ideas en las que pensar.
15. Me gustan los profesores: a. que hacen gran cantidad de esquemas en la pizarra. b. que pasan mucho tiempo explicando.
*16. Cuando estoy analizando un cuento o una novela: a. pienso en los acontecimientos y trato de unirlos para averiguar las ideas principales. b. sólo sé cuáles son las ideas principales cuando termino de leer, pero luego tengo que volver a leer y encontrar los acontecimientos que los demuestran.
17. Cuando comienzo un problema de los deberes, es más probable que: a. empiece a trabajar en la solución inmediatamente. b. primero trate de entender completamente el problema.

*18. Respecto a una idea, prefiero: a. conocerla de forma segura y clara b. conocerla de forma teórica (sin tener seguridad).
*19. Recuerdo mejor: a. lo que veo. b. lo que oigo.
*20. Para mí es más importante que un profesor: a. exponga el material ordenado en pasos muy claros. b. me ofrezca una visión global y que relacione el material con otros temas.
*21. Prefiero estudiar: a. en grupo. b. solo.
*22. Es habitual que me consideren: a. cuidadoso con los detalles de mi trabajo. b. creativo acerca de cómo hago mi trabajo.
*23. Cuando me dan la dirección para llegar a un sitio nuevo, prefiero: a. un mapa. b. instrucciones escritas.
24. Aprendo: a. a un ritmo bastante regular: si estudio mucho lo acabo entendiendo todo. b. de forma irregular: de estar muy confundido, paso a entenderlo todo de pronto.
*25. Primero prefiero: a. probar las cosas. b. pensar en cómo voy a hacer las cosas.
*26. Cuando leo por gusto, me gusta que los escritores: a. expresen claramente lo que quieren decir. b. digan las cosas de forma creativa e interesante.
*27. Cuando veo un diagrama o esquema en una clase, es más probable que recuerde: a. la imagen. b. lo que el profesor dijo al respecto.
*28. Al considerar una información, es más probable que: a. me centre en los detalles y no comprenda la idea general. b. trate de entender la idea general antes de centrarme en los detalles.
*29. Recuerdo con mayor facilidad: a. algo que he hecho. b. algo sobre lo que he pensado mucho.
*30. Cuando tengo que realizar una tarea, prefiero: a. dominar una forma de hacerlo. b. encontrar nuevas maneras de hacerlo.
*31. Cuando alguien me está mostrando datos, prefiero: a. imágenes o gráficos. b. un texto que resuma los resultados.
32. Al escribir un trabajo, es probable que: a. Trabaje en el principio del trabajo y siga a partir de ahí. b. Trabaje en diferentes partes y después las ordene.
33. Cuando tengo que trabajar en un proyecto de grupo, primero quiero: a. tener una “lluvia de ideas” en grupo donde todos aportemos ideas. b. hacer una “lluvia de ideas” individualmente y después reunirnos en grupo para comparar las ideas.
*34. Considero un piropo llamar a alguien: a. sensato (que actúa con prudencia, con cuidado). b. imaginativo.
35. Cuando conozco gente en una fiesta, es más probable que me acuerde: a. de cómo eran físicamente. b. de lo que decían de sí mismos.
36. Cuando estoy aprendiendo un nuevo tema, prefiero: a. mantener la concentración en ese tema, aprendiendo tanto sobre él como pueda. b. tratar de establecer conexiones entre ese tema y otros temas relacionados.

*37. Es más probable que se me considere una persona: a. abierta (sociable). b. reservada (callada, que no cuenta sus cosas).
*38. Prefiero cursos que utilizan mucho: a. material concreto (hechos, datos). b. material abstracto (conceptos, teorías).
39. Para mi ocio, prefiero: a. ver la televisión. b. leer un libro.
40. Algunos profesores comienzan sus clases con un breve resumen de lo que van a cubrir. Esa información es: a. relativamente útil para mí. b. bastante útil para mí.
*41. La idea de hacer tareas en grupos, con una misma nota para todos: a. me parece bien. b. no me parece bien.
42. Cuando estoy haciendo cálculos largos: a. suelo seguir todos los pasos y comprobar mi trabajo con cuidado. b. encuentro pesado repasar mi trabajo, y tengo que obligarme a hacerlo.
*43. Tiendo a recordar lugares en los que he estado: a. con facilidad y con bastante precisión. b. con dificultad y sin mucho detalle.
44. Cuando resolvemos problemas en grupo, yo tiendo a: a. pensar en cómo encontrar la solución. b. pensar en la utilidad de la solución.
*The items that are confirmed when the construct validation process is completed are marked with an asterisk

Source: Authors' own research