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The Revised Two Factor Study Process Questionnaire-Short Version: A Psychometric Analysis in College Students

Versión breve del Cuestionario Revisado de Proceso de Estudio-2 Factores: Un análisis psicométrico en estudiantes universitarios

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Resumen

El trabajo presenta una versión breve del inventario R-SPQ-2F, específicamente desarrollada para evaluar enfoques de aprendizaje en estudiantes universitarios de Argentina y Perú. Participaron 1511 estudiantes universitarios (52.2% argentinos; 47.8% peruanos). Se seleccionaron los ocho ítems de la versión original, inicialmente compuesta por 20 elementos, que resultaron más representativos de los enfoques de aprendizaje superficial y profundo. Luego, se realizó un juicio experto, análisis factorial exploratorio y análisis del funcionamiento diferencial de los ítems. El modelo obtenido verificó un adecuado ajuste para la muestra total y submuestras —análisis factorial confirmatorio—, adecuada invarianza factorial según país, trayecto académico, género y equivalencia entre las versiones original y breve. Los índices de consistencia interna fueron adecuados, con pequeñas diferencias entre países. Estos hallazgos poseen importantes implicancias metodológicas y prácticas. Por un lado, se trata del primer estudio que analiza evidencia intercultural directa sobre la validez del R-SPQ-2F, mediante una selección los ítems más representativos de las dimensiones medidas que, asimismo, son equivalentes para grupos culturalmente distintos. Por otro lado,

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se aporta una versión breve del instrumento original, con adecuadas propiedades psicométricas, apropiada para su aplicación en estudiantes universitarios de Argentina y Perú.

Palabras claves: Transcultural, versión breve, R-SPQ-2F, enfoques de aprendizaje, características psicométricas.

Abstract

The study introduces the new R-SPQ-2F short version, especially developed to assess learning approaches in college students from Argentina and Peru. The sample was composed of 1511 undergraduates (52.2% Argentinean and 47.8%, Peruvian). The eight more representative items regarding the Surface and Deep approaches were selected from the original version, initially composed of 20 items. To do so, a content validity analysis was conducted by experts as a first step. The resulting model achieved adequate fit indices for the whole sample and for each country subsample as well —confirmatory factor analysis. Its invariance by country, class standing, and gender was also verified. The original and the short versions were proven equivalent. Internal consistency coefficients were adequate, with slight differences between countries. Findings entail important methodological and practical implications. On the one hand, the study is the first analyzing direct intercultural validity evidence from the R-SPQ-2F´s most representative items of the learning approaches dimensions, proven equivalent for culturally different groups. On the other hand, this short version verified adequate psychometric features, making it suitable to be used with Argentinean and Peruvian undergraduates.

Keywords: Cross-cultural, short version, R-SPQ-2F, learning approaches, psychometric features

INTRODUCTION

Learning approaches are defined as the strategies and motives which students employ when they deal with learning activities (Biggs, 1989; Entwistle, 2021; Takase *et al.,* 2019). The two approaches most frequently analyzed are named *Deep* and *Surface*. The Deep one corresponds to students interested in understanding academic contents. It entails strategies linking new information with previous knowledge, as well as an intrinsic motivation, which is guided by curiosity. Conversely, the Surface approach describes students who only want to pass exams without the proper understanding of different notions. This approach involves strategies related to a narrow information selection and retrieval as well as an extrinsic motivation (Biggs, Kember & Leung, 2001).

There is also a third approach, known as *Achieving* or *Strategic,* linked to strategies associated to academic success —time management, concentration, organization, etc.—, along with motives which lead to pursue good academic results (Biggs, 1989). Unlike the two previous approaches, this third one arises as a matter of debate, since it has not collected enough empirical evidence across cultures (Biggs, 1987; Biggs *et al.,* 2001). Given that studies reported overlaps in the Strategic approach, sometimes with the Deep one and some others with the Surface, joining the three factors into two combined dimensions has been suggested; nevertheless, such two-factor structure would differ according to each study report: the model would include either a Strategic-Deep on the one hand and a Surface on the other, or the combination of Strategic-Surface with the Deep approach as an independent dimension (Entwistle, McCune & Tait, 2013; Kember & Leung, 1998; Romero-Medina *et al.,* 2013). Therefore, two models were hypothesized: a *two-dimension* (Biggs *et al.,* 2001), and a *three-dimension* one (Tait, Entwistle, & McCune, 1998). This study focused on the first —Deep and Surface—, which obtained widely verified robust evidence.

According to this theoretical approach and the compiled findings, the strategies and motives employed by students in learning situations are explained, to a great extent, by the teaching-learning context where they participate (Biggs & Tang, 2011; Takase & Yoshida, 2021). Thus, teaching contexts promoting deep strategies and deep motives attain high quality learning outcomes (Biggs, 1988; Cetin, 2016; Guo, Yang, & Shi, 2017; Janeiro *et al.,* 2017). The assessment of learning approaches draws teachers´ attention to the students' needs, adapting teaching methods accordingly (Biggs & Tang, 2011).

The *Revised Two Factor Study Process Questionnaire* (R-SPQ-2F; Biggs *et al.,* 2001) is the most widely used scale assessing the two-dimension learning approaches model. It is composed of 20 items, which lead to obtain two independent scores: one, representing the Deep approach and another, the Surface. It is worth mentioning that these two subscales were developed regarding two facets each, in view of the hypothesis stating that learning approaches are defined as the strategies and motives employed to deal with learning. Such facets were Surface Motive, Surface Strategy, Deep Motive, Deep Strategy (Biggs, 1987).

Students exhibiting Surface Motives are extrinsically motivated: their goal relies in meeting the minimal requirements investing the less possible effort. The ones guided by the Deep Strategy focus on what appear to be the essential topics, reproducing them by heart. Deep Motive students possess an intrinsic motivation, linked to curiosity, initiative, self-improvement, and proactivity. Those who use a Deep Strategy are drawn to understand ideas by means of strategies which integrate contents to personally meaningful situations or prior knowledge.

The R-SPQ-2F two-factor structure was independently verified in different countries —Argentina, Colombia, Ghana, Iran, Malta, Norway, Peru, United Arab Emirates—,

obtaining good psychometric indicators (Freiberg-Hoffmann & Fernández-Liporace, 2016; Khine & Afari, 2018; Martinelli & Raykov, 2017; Merino-Soto & Kumar-Pradhan, 2013; Sohrabi, 2016; Vergara-Hernández, Simancas-Pallares, & Carbonell-Muñoz, 2019; Zakariya, Bjørkestøl, Nilsen, Goodchild, & Lorås, 2020). Furthermore, Leung (2006) replicated the two-dimension structure in five samples of students from different countries —USA, Australia, Hong Kong, Macao, and the United Kingdom. Nevertheless, two important weaknesses were pointed out. First, the two-dimension model has been criticized on the grounds of its sensitivity to cultural differences (Immekus & Imbrie, 2009; Stes, De Maeyer, & Van Petegem, 2013). Second, even though the questionnaire includes only 20 items, its extension makes it unsuitable to be employed in class, where time is scarce, and it is usually applied along with other scales. Extensive examination procedures generate fatigue in examinees, as well as a lack of interest and random responses (Robinson, 2017). Therefore, shorter scales are currently preferable, selecting the most robust items in terms of content and metric quality. If psychometric features result as good as the ones verified for longer scales, shorter versions become a superior substitute (Koğar, 2020). Accordingly, this study aimed at: 1) analyzing psychometric features of the original R-SPQ-2F in order to develop a shorter version, 2) examining the psychometric features of such short version, 3) testing the equivalence between the short and the original versions. These analyses were conducted on a sample composed of Argentinean and Peruvian college students.

METHOD

Participants

Employing a convenience sampling, 1511 undergraduates from public universities and different faculties were selected (32.9% males; 60.8% females). They were between 16 and 48 years old (M_{age} = 21.76; *SD* = 3.62). Peruvians represented 47.8% of the sample (*n* = 722; 28.9% males, 71.1% females), with ages from 16 to 48 years old (M_{age} = 20.44; *SD* = 3.06). The distribution by faculty was as follows: 63.2% Psychology, 18.8% Philosophy, 6% Economics, 3.2% Engineering, 3% Law, 2.6% Medicine, 1.7% Social Sciences, 1% Math and Computer Sciences, .6% Architecture.

The Argentinean group (*n* = 789; 52.2% of the sample) was composed of 48.7% males and 51.3% females from 17 to 36 years old (M_{age} = 22.96; *SD* = 3.68). Participating faculties were Psychology (40.6%), Engineering (27.9%), Math and Computer Sciences (15.2%), Law (8.9%), Medicine, (7.5%).

Students refusing participation or leaving two or more items unanswered were excluded. Two educational psychologists from Peru and Argentina participated as experts.

Instruments

Revised Two Factor Study Process Questionnaire (R-SPQ-2F) (Biggs *et al.,* 2001). Its 20 items enable to calculate two scores: one measuring the Deep approach (1, 2, 5, 6, 9, 10, 13, 14, 17, 18) and another, assessing the Surface approach (3, 4, 7, 8, 11, 12, 15, 16, 19, 20), as well as additional scores representing the facets: Deep Strategy (2, 6, 10, 14, 18), Deep Motive (1, 5, 9, 13, 17), Surface Strategy (4, 8, 12, 16, 20), and Surface Motive (3, 7, 11, 15, 19). Instructions to respond allude to general or standard learning situations. This study employed two versions of the questionnaire, with the same items linguistically adapted to each country (Freiberg-Hoffmann & Fernández-Liporace, 2016; Merino-Soto & Kumar-Pradhan, 2013), both obtaining similar psychometric results.

Procedures

Data gathering. It was conducted in class by trained psychologists. Examinees received a consent form —informing the study goals as well as the voluntary and anonymous status of the participation—, a personal data survey and the R-SPQ-2F. The sequence of application was replicated in each class group. The study was endorsed by the Ethics Committee of the University of the Buenos Aires and the University of San Martin de Porres.

Data analysis

R-SPQ-2F's short version

The items selection was decided according to the content and the construct validity evidence analyses of the scale's original version.

Content validity. Two experts examined the items content regarding both the Peruvian and Argentinean educational contexts on the grounds of the theoretical model, selecting those representing the dimensions properly. Each item's quality was assessed by a 4-point Likert-type scale —not adequate, partially adequate, adequate, completely adequate. Redundant items were also identified. Such assessments allowed to calculate the content validity index (CVI), suitable when two experts participate (Grant & Davis, 1997). Items with a CVI ≥ .50 were retained (Eskandari, Simbar, Vadadhir, & Baghestani, 2016). CVI was calculated using the following formula: CVI= Number of raters choosing points 3 and 4/Total number of raters. Though redundant items were identified they were not yet eliminated, setting special attention on them during the decision-making process involved in the construct validity analysis performed afterwards.

Construct validity. The items selection required: a) high factorial loadings (> .40), b) high factorial simplicity indices (> .60), c) the items invariance and the covariation between learning approaches by gender and class standing within each sample —intra-country

invariance. Such criteria were established in order to get a short version suitable to be used in both countries and stable in terms of internal structure. To accomplish points a and b, the dimensionality of the R-SPQ-2F was independently analyzed in both subsamples (Argentinean and Peruvian) in the first place. To do so, a parallel analysis and an exploratory factor analysis were calculated. The FACTOR 10.9 software was employed. Polychoric matrices and the direct oblimin rotation method were used. SIMLOAD was employed to analyze factorial simplicity. To accomplish point c, a non-parametric differential item functioning analysis (DIF) based on contingency tables was calculated to test the items invariance by gender —males/females— and class standing —freshmen-sophomores/juniors-seniors— within each country. Such decision was made on the grounds of the sample size and the moderate skewness of the distributions (Güller, & Penfield, 2009; Lai, Teresi, & Gershon, 2005). The null hypothesis stating the absence of DIF was tested by: a) the analysis based on the X^2 (M-X^2, df = 1; Mantel, 1963), and b) *cumulative common log odds ratio* in the standardized normal distribution ($Z_{LA\text{-}LOR}$; Penfield & Algina, 2003). A two-step criterion to identify DIF was applied: first, a conservative significance level was assumed, p < .001 (M-X^2 > 6.63; $Z_{LA\text{-}LOR}$ >|3.29|) to control Type I error; second, when an item with a statistically significant DIF was identified, its effect size was analyzed by the LA-LOR estimator (Penfield, 2007). Three levels were identified: small ($Z_{LA\text{-}LOR}$ < .43), medium ($Z_{LA\text{-}LOR}$ < .63), and large ($Z_{LA\text{-}LOR}$ ³ .64). The positive value —item favoring the reference group— or negative value —item favoring the focal group — were extracted from $LOR_{L\text{-}A}$. The DIF analysis was conducted with DIFAS (Penfield, 2005).

Psychometric analyses

Confirmatory factor analysis. The new short version of the scale was analyzed calculating polychoric correlations matrices. The *robust maximum likelihood* method —RML—, recommended for medium samples with ordinal response scales was employed. It also lessens the Type I error and improves the results statistical power (Freiberg-Hoffmann, Stover, de la Iglesia, & Fernández-Liporace, 2013; Holgado-Tello, Morata-Ramírez, & Barbero-García, 2018). The model fit was interpreted by the comparative fit (CFI), the normed fit (NFI), the non-normed fit (NNFI), the goodness-of-fit (GFI), and the adjusted goodness-of-fit indices (AGFI); values higher than .90 indicate a good fit. The root mean square error of approximation (RMSEA) and the standardized root mean squared residual (SRMR) were also calculated. Results under .08 are acceptable (Lozano-Lozano, Chacón-Moscoso, Sanduvete-Chaves, & Holgado-Tello, 2021). After verifying the internal structure, the item parameters were estimated for the whole sample and by country (Viladrich, Angulo-Brunet, & Doval, 2017).

Factorial invariance analysis. The model's factorial invariance was tested, using country, gender and class standing —freshmen-sophomores/juniors-seniors— as segmentation

variables. Different and increasing restriction levels were applied (Putnick & Bornstein, 2016): configural —model invariance—, metric —factorial loadings equivalence —, and scalar —intercepts equivalence. LISREL 8.8 was employed to run such analyses.

Internal consistency. Internal consistency coefficients and their confidence intervals were estimated using *ad hoc* software regarding the results obtained by structural equations modelling. The omega (McDonald, 1999), H (Hammer, 2016), and ordinal Alpha indices (Zumbo, Gadermann, & Zeisser, 2007) were calculated for the whole sample and also by country. The internal consistency coefficients were compared using *AlphaTest* (Merino-Soto & Lautenschlager, 2003).

Equivalence between versions

First, a corrected Pearson's correlation was estimated (Levy, 1967). These spurious correlations should be high enough (≥ .70) to verify the linear dependence between the short and the original versions (Petrides, Jackson, Furnham, & Levine, 2003; Putnam & Rothbart, 2006; Smith et al., 2000). Second, the agreement between scores from the new and the original versions were compared by the AC coefficient (Gwet, 2014). Scores were classified into tertiles, quartiles and quintiles.

RESULTS

The short version development

CVI coefficients for items 3, 5, and 7 reached values under .50. Redundant content was identified in items from the Deep Strategy (14, 18), Deep Motive (5, 13), and Surface Strategy (3, 7) facets.

As for the construct validity evidence, the items´ descriptive statistics were calculated. A parallel analysis to determine the number of dimensions to be retained in the exploratory factor analysis —run separately by country— was also conducted. As a result, two dimensions were extracted (Table 1).

Table 1.

Items and dimensionality statistical descriptives

	Whole Sample				Peru				Argentina			
Items	M	SD	Skewness	Kurtosis	M	SD	Skewness	Kurtosis	M	SD	Skewness	Kurtosis
Deep												
RSPQ1	3.717	1.003	-.487	-.437	3.587	1.023	-.463	-.471	3.836	.970	-.495	-.463
RSPQ2	3.457	.968	-.232	-.491	3.336	1.028	-.201	-.604	3.569	.897	-.166	-.532
RSPQ5	3.330	1.000	-.061	-.567	3.637	1.012	-.417	-.517	3.049	.902	.131	-.054
RSPQ6	2.845	1.079	.186	-.668	3.265	1.067	-.175	-.697	2.461	.939	.403	-.110
RSPQ9	3.441	1.123	-.317	-.694	3.325	1.042	-.277	-.582	3.547	1.182	-.407	-.750
RSPQ10	3.466	1.017	-.386	-.415	3.447	1.011	-.395	-.410	3.482	1.022	-.379	-.415
RSPQ13	3.830	.944	-.573	-.124	3.536	.939	-.326	-.320	4.100	.866	-.876	.640
RSPQ14	2.565	1.065	.340	-.551	2.932	1.024	.012	-.542	2.230	.990	.722	.167
RSPQ17	2.771	1.063	.296	-.496	2.991	1.093	.151	-.697	2.570	.993	.381	-.221
RSPQ18	3.337	1.073	-.189	-.661	3.321	1.022	-.135	-.615	3.351	1.118	-.232	-.713
Surface												
RSPQ3	2.469	1.280	.568	-.743	2.513	1.327	.468	-.971	2.429	1.236	.666	-.480
RSPQ4	2.682	1.147	.178	-.830	2.858	1.089	.063	-.740	2.520	1.174	.329	-.815
RSPQ7	2.602	1.103	.303	-.600	2.699	1.123	.164	-.774	2.513	1.078	.432	-.352
RSPQ8	2.396	1.143	.426	-.744	2.608	1.137	.209	-.836	2.202	1.115	.657	-.442
RSPQ11	2.150	1.096	.713	-.318	2.533	1.132	.309	-.776	1.799	.933	1.169	1.050
RSPQ12	2.434	1.067	.337	-.615	2.494	1.105	.268	-.784	2.380	1.029	.394	-.428
RSPQ15	1.933	1.070	.993	.183	2.296	1.189	.505	-.769	1.600	.820	1.477	2.322
RSPQ16	2.573	1.176	.292	-.819	2.634	1.155	.166	-.858	2.518	1.194	.407	-749
RSPQ19	2.199	1.101	.651	-.374	2.444	1.111	.383	-.660	1.974	1.042	.955	.298
RSPQ20	1.976	1.162	.995	-.048	2.481	1.250	.394	-.936	1.513	.842	1.816	3.136

Parallel analysis

	Dimensions		Dimensions		Dimensions	
	1	2	1	2	1	2
Real data % of variance	27.840	18.797	25.788	23.268	32.623	14.318
Mean of random % of variance	10.173	9.551	10.035	9.329	10.077	9.397
95 Percentile of random % of variance	11.914	11.027	11.626	10.499	11.425	9.721

Table 2 shows results for Peruvian undergraduates. A low inter-factor correlation, high factorial loadings, and high factorial simplicity indices were obtained. Furthermore, the estimated internal consistency indices for both factors achieved optimal values.

As for the items invariance across groups split by gender and class standing, Table 2 exhibits results regarding three significance levels. The M-X^2 and Z_{LA} indices were statistically significant. Three items achieved significant levels lower than .05 in the groups split by gender and class standing. Item 4 — from Surface factor— was the unique accomplishing the $p < .001$ criterion; the $LOR_{L\text{-}A}$ effect size was large. The positive value indicated higher scores for males.

Table 3 contains findings for Argentinean undergraduates. The obtained structure showed a low inter-factor correlation. Moreover, factorial loadings and factor simplicity indices reached adequate values, except for item 18, whose index of factorial simplicity was low. The internal consistency coefficients achieved optimal values.

Regarding the items invariance by gender and class standing, the M-X^2 and Z_{LA} indices were statistically significant, except for item 5. Ten items achieved statistical significance lower than .05, and a substantially lower number of items reached the $p < .001$ criterion. As for gender, items 6 —favoring males—, and 18 —favoring females— were significant, both loading on the Deep approach. They verified a large effect size ($LOR_{LA} > .70$). Item 4 with DIF loaded on the Surface approach, with a medium effect size, favoring males. About class standing, items 13, 17, and 18 —Deep approach—, as well as 4 and 7 —Surface approach— verified a medium effect size.

Table 2.

R-SPQ-2F original version: Exploratory factor analysis and DIF (Peruvian undergraduates)

		Exploratory factor analysis				DIF analysis					
		Approaches				Gender			Class standing		
Item	Subscale	Deep	Surface	h^2	ISF	M-X^2	LOR_{L-A}	Z_{LOR}	M-X^2	LOR_{L-A}	Z_{LOR}
Deep											
RSPQ1	Motive	**.602**	-.151	.534	.882	.677	-.129	-.811	.286	-.082	-.55
RSPQ2	Strategy	**.519**	-.020	.455	.997	.307	.085	.545	.215	-.069	-.473
RSPQ5	Motive	**.497**	-.137	.477	.859	.142	-.06	-.377	9.2	.463	3.107
RSPQ6	Strategy	**.614**	.007	.524	1	.003	-.008	-.052	7.235**	-.396	-2.694**
RSPQ9	Motive	**.632**	.010	.568	.999	5.467*	-.373	-2.331*	.798	.136	.913
RSPQ10	Strategy	**.657**	-.055	.613	.986	1.009	-.16	-.976	.53	.113	.748
RSPQ13	Motive	**.652**	-.027	.654	.997	.07	-.042	-.262	.017	-.02	-.131
RSPQ14	Strategy	.657	.178	.716	.863	.874	.144	.935	.408	-.092	-.634
RSPQ17	Motive	**.604**	.181	.681	.835	2.295	.235	1.526	.625	-.113	-.79
RSPQ18	Strategy	**.603**	-.057	.611	.982	1.074	.162	1.012	3.812*	.291	1.993*
Surface											
RSPQ3	Motive	-.020	**.570**	.605	.998	.243	.075	.497	.054	.114	.236
RSPQ4	Strategy	-.032	**.504**	.706	.992	19.183***	$.65^{L}$	4.483***	6.53**	-1.413	-2.56*
RSPQ7	Motive	-.052	**.503**	.403	.979	.04	-.029	-.201	.324	-.322	-.606
RSPQ8	Strategy	.041	**.658**	.564	.992	.07	-.039	-.267	.084	-.173	-.334
RSPQ11	Motive	.058	**.727**	.711	.987	.265	.078	.51	.196	-.21	-.436
RSPQ12	Strategy	-.086	**.630**	.526	.963	1.254	-.168	-1.128	.425	.363	.706
RSPQ15	Motive	.007	**.717**	.695	1	.344	-.091	-.58	2.963	1.055	1.81
RSPQ16	Strategy	.046	**.634**	.695	.990	4.411*	-.311	-2.116*	.000	-.008	-.016
RSPQ19	Motive	-.037	**.658**	.635	.994	.063	.038	.252	2.082	.79	1.434
RSPQ20	Strategy	.003	**.741**	.727	1	2.128	.221	1.483	.186	.209	.391
Reliability											
$Alpha_O$		.925	.904								
Omega		.852	.872								
Correlation											
Deep		-									
Surface		.004	-								
M		33.368	25.560								
SD		6.184	7.327								
Skewness		-.044	.212								
Kurtosis		-.039	-.484								

*Note. *p < .05 (X^2 = 3.64; z = 1.96). **p < .01 (X^2 = 6.64; z = 2.58). ***p < .001 (X^2 = 10.83; z = 3.29). Effect size = ^{S} small; ^{M} medium; ^{L} large. Gender: Reference Group = males; focal group = females. Class standing: Reference group = freshmen-sophomores; focal group= juniors-seniors.*

Table 3.

R-SPQ-2F Original Version: Exploratory factor analysis and DIF analysis (Argentinean undergraduates)

Item	Exploratory factor analysis					DIF analysis					
	Facets	Approaches		h^2	ISF	Gender			Class standing		
		Deep	Surface			M-X^2	LOR_{L-A}	Z_{LOR}	M-X^2	LOR_{L-A}	Z_{LOR}
Deep											
RSPQ1	Motive	**.612**	-.389	.630	.424	.000	.003	.022	3.935*	-.275	-1.978*
RSPQ2	Strategy	**.485**	-.065	.554	.965	.016	.017	.121	.356	.081	.596
RSPQ5	Motive	**.454**	-.101	.526	.906	1.423	.454	3.29**	4.818*	.304	2.235*
RSPQ6	Strategy	**.652**	-.141	.745	.911	29.601***	$.79^{G}$	5.563***	7.557**	.385	2.77**
RSPQ9	Motive	**.519**	-.264	.501	.589	5.25*	-.319	-2.279*	2.55	-.219	-1.599
RSPQ10	Strategy	**.464**	-.190	.511	.713	1.051	-.141	-1.014	.561	.101	.743
RSPQ13	Motive	**.532**	-.237	.680	.669	5.002*	-.333	-2.235*	12.585***	$-.523^{M}$	-3.51***
RSPQ14	Strategy	**.655**	-.138	.721	.915	7.297**	.395	2.743**	.214	.066	.462
RSPQ17	Motive	**.476**	-.153	.483	.813	5.426*	.32	2.302*	13.657***	$.509^{M}$	3.743***
RSPQ18	Strategy	**.448**	-.372	.695	-184	38.679***	$-.863^{L}$	-6.209***	12.12***	$-.472^{M}$	-3.496**
Surface											
RSPQ3	Motive	-.274	**.490**	.643	.524	1.187	0.159	1.097	0.52	-0.102	-0.713
RSPQ4	Strategy	-.155	**.573**	.607	.864	20.693***	0.645^{M}	4.388***	14.948***	0.54^{M}	3.885***
RSPQ7	Motive	-.107	**.406**	.387	.870	0.85	0.131	0.929	13.29***	-0.501^{M}	-3.604***
RSPQ8	Strategy	-.145	**.615**	.649	.895	1.792	-0.194	-1.276	0.782	-0.124	-0.873
RSPQ11	Motive	-.130	**.751**	.933	.942	1.211	-0.177	-1.041	0.751	0.136	0.872
RSPQ12	Strategy	-.342	**.642**	.553	.558	0.353	-0.088	-0.603	3.372	-0.261	-1.838
RSPQ15	Motive	-.295	**.698**	.694	.697	5.096*	0.374	2.24*	5.255*	0.375	2.273*
RSPQ16	Strategy	-.241	**.620**	.582	.737	5.438*	-0.329	-2.35*	0.24	-0.067	-0.496
RSPQ19	Motive	-.281	**.672**	.698	.702	2.548	-0.25	-1.645	1.062	0.154	1.048
RSPQ20	Strategy	-.159	**.699**	.694	.902	4.312*	-0.386	-2.064*	4.212*	-0.367	-2.085*
Reliability											
$Alpha_O$		.892	.950								
Omega		.797	.862								
Correlation											
Deep		-									
Surface		-.309	-								
M		32.199	21.453								
SD		5.304	6.224								
Skewness		-.142	.523								
Kurtosis		.069	.136								

*Note. *p < .05 (X^2 = 3.64; z = 1.96). **p < .01 (X^2 = 6.64; z = 2.58). ***p < .001 (X^2 = 10.83; z = 3.29). Effect size = S small; M medium; L large. Gender: Reference Group = males; focal group = females. Class standing: Reference group = freshmen-sophomores; focal group= juniors-seniors.*

As a result of the above described, an 8-item-2-factor version was obtained: one factor named Deep approach (items 2 and 6 representing Deep Strategy; 9 and 17, Deep Motive), and the other factor, Surface approach (items 8 and 20 measuring Surface Strategy; 15 and 19, Surface Motive). Such model was achieved following the decision-making criteria including items content, items loadings, indices of factorial simplicity, invariance by gender

and class standing in both counties. Special attention was focused on avoiding redundancy in the selected items content, and on representing each dimension regarding their operative definitions.

Confirmatory factor analysis

The 8-item model resulting from the previous procedure was tested in terms of fit (Table 4). Every index reached the recommended values (Schumaker & Lomax, 2016). Although factorial loadings were higher in the Peruvian subsample, all of them were statistically significant for all the parameters in both subsamples.

Table 4.

R-SPQ-2F Short Version: Confirmatory factor analysis

Item	Facet	Whole Sample (n = 1511)					Argentina (n = 789)					Peru (n = 722)				
		Deep	Surface	STN	Ritc	Rii	Deep	Surface	STN	Ritc	Rii	Deep	Surface	STN	Ritc	Rii
Deep																
RSPQ2	Strategy	.362		.416	.092	.131	.381		.445	.143	.145	.502		.671	.176	.252
RSPQ6	Strategy	.602		.944	.277	.362	.553		.796	.093	.305	.595		.921	.238	.354
RSPQ9	Motive	.379		.442	.037	.144	.482		.627	.029	.233	.550		.788	.197	.302
RSPQ17	Motive	.570		.844	.265	.324	.447		.558	.068	.191	.545			.315	.297
Surface																
RSPQ8	Strategy		.578	.867	.315	.334		.519	.710	.166	.269		.582	.880	.358	.339
RSPQ20	Strategy		.816	2.442	.399	.666		.696	1.349	.183	.484		.806	2.300	.401	.650
RSPQ15	Motive		.731	1.569	.307	.535		.714	1.456	.137	.510		.664	1.187	.338	.440
RSPQ19	Motive		.666	1.196	.450	.444		.681	1.269	.274	.463		.652	1.134	.417	.426
Model fit																
CFI		.954					.969					.988				
NFI		.948					.956					.975				
NNFI		.932					.955					.983				
GFI		.962					.970					.982				
AGFI		.927					.943					.966				
SRMR		.073					.047					.042				
RMSEA [IC 90%]		.068 [.059-.079]					.051 [.036-.066]					.033 [.013-.051]				
Correlation																
Deep		-										-				
Surface		.071	-				-.384					.048	-			
M		12.514	8.505				12.148	7.291				12.915	9.831			
SD		2.710	3.351				2.513	2.700				2.858	3.491			
Skewness		.043	.604				.099	.871				-.093	.213			
Kurtosis		-.188	-.336				-.107	.432				-.234	-.686			

Note. STN: ratio sign-to-noise. Ritc: corrected correlation item-test. Rii: item reliability.

Factorial invariance analysis

Next, groups were split to be compared by country, class standing, and gender. The model's factorial invariance was verified in every case (Table 5).

Table 5.

R-SPQ-2F Short Version: Factorial invariance by country, gender and class standing.

	Model	RMSEA [CI 90%]	ΔRMSEA	CFI	Δ CFI
Country	Configural	.044 [.033-.055]	-	.979	-
	Metric	.043 [.033-.054]	.001	.978	.001
	Scalar	.044 [.034-.055]	.000	.976	.003
Gender	Configural	.063 [.053-.074]	-	.960	-
	Metric	.061 [.052-.072]	.002	.959	.001
	Scalar	.064 [.054-.074]	-.001	.953	.007
Class Standing	Configural	.063 [.053-.074]	-	.959	-
	Metric	.062 [.052-.072]	.001	.958	.001
	Scalar	.064 [.054-.073]	-.001	.952	.007

Internal consistency analysis

The dimensions' internal consistency —Deep and Surface approaches— was analyzed in the whole sample and by country. Such estimated indices for those three samples were compared: significant differences for each index regarding Deep approach were found. The Surface approach values were non-significant, except for the H index (Table 6).

Table 6.

R-SPQ-2F Short Version: Internal consistency indices comparison.

		Whole sample [CI 95%]	Argentina [CI 95%]	Peru [CI 95%]	X^2	*df*	*p*
Surface	$Alpha_o$	.789 [.771-.806]	.746 [.716-.774]	.769[.740-.795]	4.708	2	.095
	Omega	.794 [.777-.810]	.750 [.720-.777]	.773 [.745-.799]	5.131	2	.076
	H	.820 [.805-.834]	.760 [.731-.786]	.800 [.775-.823]	11.494	2	.003
Deep	$Alpha_o$	.537 [.498-.574]	.523 [.466-.575]	.631 [.585-.673]	10.804	2	.004
	Omega	.546 [.507-.582]	.527 [.471-.579]	.632 [.586-.674]	9.928	2	.007
	H	.580 [.544-.614]	.540 [.485.-.590]	.640 [.595-.681]	8.342	2	.015

Equivalence between the original and short versions

Table 7 shows coefficients by tertiles, quartiles and quintiles. AC_{Gwet} coefficients in the tertiles classification were higher than those obtained for the quartiles and quintiles segmentation. No overlaps in the confidence intervals were found, inferring that the differences between the tertiles partition on the one hand, and the quatiles and quintiles ones on the other, were significant.

Table 7

R-SPQ-2F Original and Short Versions: Classification agreement

	$\%_{Agreement}$	CI 95%	AC_{Gwet}	CI 95 %
Surface				
Tertiles	.743**	.721, .765	.614	.581, .647
Quartiles	.623**	.599, .647	.498	.465, .530
Quintiles	.561**	.536, 586	.451	.420, .483
Deep				
Tertiles	.721**	.698, .744	.582	.548, .616
Quartiles	.638**	.614, .662	.518	.486, .500
Quintiles	.550**	.524, .575	.438	.407, .470

Note. ** $p < .01$

As for the association between versions (Table 8), the non-corrected correlations were higher than .80. Corrected correlations were higher than .70, except for two of them (.672 and .667). The former did not statistically differ from the .70 criterion ($z = 1.484$, $p > .05$). The latter (.667) showed a small difference ($z = 2.407$, $p < .01$, $q = .061$). Both the Argentinean and Peruvian subsamples verified the same correlational pattern —sign and magnitude— between the original version and the shorter. The association between Deep and Surface approaches differed between countries, indicating the likelihood of the context variation.

Table 8.

R-SPQ-2F Original and Short Versions: Corrected and non-corrected correlations

	Peru (n = 722)		Argentina (n = 789)		Whole Sample (n = 1511)	
	Deep– original	Surface – original	Deep – original	Surface – original	Deep – original	Surface – original
Deep – original	-		-		-	
Surface – original	-.008	-	-.368**	-	-.130**	-
Deep – short	.893** (.723)	.056	.863** (.672)	-.257**	.881** (.667)	-.082
Surface – short	.001	.906** (.798)	-.314**	.854** (.745)	.082	.892** (.794)

*Note. **p < .01. In brackets: correction for spurious correlation.*

DISCUSSION

The study aimed at: 1) developing a short version of R-SPQ-2F, 2) analyzing its psychometric features, and 3) testing the equivalence between the original and the short versions.

As for Objective 1, a short 8-item2-factor-version of R-SPQ-2F assessing the Deep and Surface approaches taking their facets —motives and strategies— into consideration was developed. It derived from a content and a construct validity analysis which retained the less redundant and most representative items. They explained a high percentage of the common variance and achieved adequate psychometric indicators suggesting that, at least, in this exploratory stage the new version is suitable to be used with Peruvian and Argentinean undergraduates. That runs in line with previous studies verifying the model´s generalization hypothesis (Freiberg-Hoffmann & Fernández-Liporace, 2016; Khine & Afari, 2018; Martinelli & Raykov, 2017; Merino-Soto & Kumar-Pradhan, 2013; Sohrabi, 2016; Vergara-Hernández, Simancas-Pallares, & Carbonell-Muñoz, 2019; Zakariya *et al.,* 2020).

Nevertheless, the lack of control of demographic features could have generated different types of responses by subsample. That could explain the differences of the factorial simplicity indices by country, which usually affect the estimation of the factor loadings and the inter-factorial correlations (Marsh *et al.,* 2014; Robinson, 2017).

Objective 2 conducted a confirmatory factor analysis of the short version, verifying the model fit in the whole sample as well as in the subsamples split by country. The invariance analysis obtained similar parameters when groups were compared by gender, class standing

and country, thus adding evidence supporting the short version model´s generalization hypothesis (Dimitrov, 2010). In view of the lack of prior research, this study implies a first step to enable comparisons of the model stability within groups.

The dimensions' internal consistency analysis for the whole sample and by country achieved acceptable values regarding the number of items (4) composing each dimension (Tavakol & Dennick, 2011). Coefficients varied between .70 and .85 for the Surface approach, and between .50 and .70 for the Deep one. The reported lowest values for the Deep dimension seem reasonable since the items' selection prioritized two criteria: the construct´s wide coverage and the avoidance of redundant contents (Anselmi, Colledani, & Robusto, 2019).

When comparing the internal consistency indices in the whole sample and by country, significant differences were verified for the Deep approach in every case —Omega, ordinal Alpha, and H—, whereas the Surface approach showed a unique difference regarding the H index. Such differences could be attributed, again, to the lack of control in demographic and academic variables (Sideridis, Saddaawi & Al-Harbi, 2018). Further research should analyze and identify variables that may affect the scale's internal consistency.

Objective 3 verified the equivalence between the original and the short version since their scores verified a high linear relation. Moreover, the correlation pattern was similar in both versions, meaning that the items represent learning approaches in both countries accurately. The agreement between scores tended to be higher when they were classified into tertiles. Due to the moderate scores' reliability, tertiles could be suitable for less specific assessment processes, eventually attempting a screening. That, undoubtedly, requires further analyses.

The study involves weaknesses which deserve a special mention. First, the lack of a social desirability measure. Bearing in mind that socially desirable responses are likely to affect the scores interpretation, a part of the irrelevant systematic variance could be explained by that issue (Lavidas & Gialamas, 2019). The effect of social desirability on R-SPQ-2F was not analyzed so far. Further studies should take the matter into consideration. Second, the participants representativity regarding the populations they belong to was not guaranteed, requiring a new sampling of undergraduates with more heterogeneous features. Third, the short version's structure must be analyzed in other countries –English and Spanish speakers at least— in order to test the model's invariance. Four, external criteria were not included to add predictive validity evidence to the short version —i.e. academic achievement.

A methodological contribution and another, theoretical are worth mentioning. Evidence on the metric invariance of the parameters in two culturally different groups —Argentina and Peru— was added to the existing research. This invariance makes group comparisons possible and favors the generalization hypothesis of the Deep and Surface approaches model in undergraduates from both countries (Davidov *et al.,* 2018). Additionally, this short version enables follow-up assessments across different stages of academic pathways.

It will also be useful in studies where examination brevity plays a key role, maintaining the adequate psychometric features of the original version (Breitsohl & Steidelmüller, 2018; Huang, Liu, & Bowling, 2015).

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