Grasha–Riechmann student learning style scales: an Argentinian version

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Abstract

Purpose – The study analyses psychometric features of the Grasha–Riechmann student learning style scale. It measures the instructional preferences of students attending different educational stages.

Design/methodology/approach – The scale was translated from English to Spanish. Content and face validity evidences were analysed. After that, construct validity evidences – exploratory factor analysis, confirmatory factor analysis, factorial invariance analysis – and internal consistency were examined. Data were collected from samples composed of high school and college students from Argentina.

Findings – The adapted version, a four-factor 12-item scale, suitable to be used in local students, measures four learning styles – competitive, independent, dependent and collaborative. The model showed a better fit when compared to rival models – three-factor and six-factor. Besides, the four-factor model verified its factorial invariance in high school and college students' groups composing the sample. The internal consistency indices were adequate for every dimension (ordinal $\alpha > 0.70$).

Research limitations/implications – Despite satisfactory results of the internal validity evidences and the internal consistency analysis, further studies should analyse external validity evidences – criterion and predictive evidences.

Practical implications – The adapted version of the scale is suitable to be used by teachers in order to examine learning preferences in their students. Such information will allow the adaptation of teaching methods regarding the actual students' needs.

Originality/value – The Grasha–Riechmann student learning style scale's Argentinian adaptation is presented. It is a valid and reliable measure of learning styles suitable to be used in high school and college.

Keywords Psychometrics, Reliability, Assessment, Validity, Scales, Higher education, College students

Paper type Research paper

Introduction

Several studies have been focussed on issues related to learning, as well as on the obstacles preventing students from reaching a good academic achievement. Therefore, researchers from different fields (education, medicine, epidemiology, nursing, among others) analysed a wide variety of variables likely to be linked to academic achievement (Bolin *et al.*, 2017; Burrows *et al.*, 2017; Doyle *et al.*, 2017; Lemma *et al.*, 2014; Lepp *et al.*, 2015; Ng *et al.*, 2019; Schachner *et al.*, 2019).

Psychology examines learning by analysing variables such as academic motivation, self-efficacy, learning strategies, learning approaches and learning styles (Çetin, 2015; Gargallo *et al.*, 2012; Illahi and Khandai, 2015; McLaughlin and Durrant, 2016; Pérez *et al.*, 2013; Pexoto *et al.*, 2012; Rodríguez *et al.*, 2019; Warden and Myers, 2017). This study addresses the matter of *learning styles*. They describe the way students interact with and respond to academic activities, regarding cognitive, affective and physiological preferences (Keefe, 1982). Such notion has been extensively examined in view of its link with academic success and failure (e.g. İlçin *et al.*, 2018; Magulod, 2019; Martínez-Bernal *et al.*, 2016).

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Learning styles

As mentioned earlier, learning styles describe the individual preferences for learning in terms of personality and skills (Curry, 1983). Several studies analysed how styles vary according to the influence of different academic and sociodemographic variables. Variations in learning styles according to the high school branch students attended were found (Kalantari *et al.*, 2016). Moreover, senior high school students and freshmen college students differed from college sophomores (Freiberg-Hoffmann *et al.*, 2017). College students attending different majors exhibited different styles (Rezaeinejad *et al.*, 2015; Viloriab *et al.*, 2019). Differences by gender, age, working status and father's occupation were also reported (Alducin-Ochoa and Vázquez-Martínez, 2017; Bayrak, 2012; Corbin, 2017).

The fit between learning styles and the specific learning context enhances learning and therefore, academic success. This implies less time and effort to complete the process productively (Acevedo-Pierart and Rocha-Pavés, 2011; Kolb, 1984; Richardson *et al.*, 2012). It was found that when teaching methods match the individual learning style, better academic results are achieved (Singh *et al.*, 2016; Vizeshfar and Torabizadeh, 2018). Recent studies on learning styles were aimed at identifying variables able to predict academic success (Kahn *et al.*, 2019; Shirazi and Heidari, 2019). Consequently, assessing learning styles is relevant since such information allows students to adapt their own styles to specific learning contexts. Teachers can also modify their methods accordingly (Stirling, 2017).

Learning styles

Since different theoretical models were aimed at explaining learning styles, various scales have also been developed. They can be classified into three categories according to the way they assess learning styles (Curry, 1983). The first one includes tests focussed on information processing styles. The second category comprises cognitive personality styles measures, and the third one encompasses scales which emphasise instructional preferences. Among these three categories, only the first two have scales adequate to be used with local population (Casullo *et al.*, 2000; Freiberg-Hoffmann and Fernández Liporace, 2013). Consequently, adapting scales focussed on the instructional preference arises as a matter of interest since it regards the specific learning context. Based on that previous assessment, teachers become able to change their methods in order to indirectly train students to fit their own styles to the major's requirements (Díaz and Cartnal, 1999).

Riechmann and Grasha (1974) gathered information from interviews with teachers and students to develope their model, which is one of the most frequently analysed in different educational stages (e.g. Babadogan and Kilic, 2012; Ford, Robinson and Wise, 2016; Bayrak, 2012; Rojas-Jara *et al.*, 2016). As a result, they were able to identify attitudes and behaviours, which led them to define six learning styles: *dependent, independent, participative*, *avoidant, competitive* and *collaborative*.

Independent students prefer to work on their own, following their own pace, choosing which contents are important to be learnt.

Dependent students rely on both teachers and peers to be guided. They prefer to follow instructions rather than making their own decisions. They are only interested in learning mandatory contents.

Competitive individuals feel the class environment as a win–lose arena. They constantly look for acknowledgement.

Collaborative learning is the way collaborative persons prefer. Group assignments and discussions are their strength.

Avoidant students show little interest in learning course contents. They remain passive in class.

Participative persons are highly responsible and eager to learn. They enjoy debates and every sort of class activity, mandatory and optional.

Riechmann and Grasha (1974) developed the *Grasha–Riechmann student learning style scale* (GRSLSS) in order to measure the six styles comprised in their model. It offers useful information about the students' learning needs in order to allow teachers to plan their classes accordingly. The scale's original version obtained adequate content and criterion validity evidences, as well as test–retest reliability (stability reliability). The GRSLSS was adapted to various countries, reaching reliability indices like the ones obtained by Riechmann and Grasha (1974). However, as a result of such adaptations, different factorial structures were found. On the one hand, evidences supporting the six-factor model (dependent, independent, participative, avoidant, competitive and collaborative) were reported (Baneshi *et al.*, 2013; Fathaigh, 2000; Saritaş and Süral, 2010). On the other, a three-factor model conceiving styles as bipolarities was obtained (dependent/independent, participative/avoidant and competitive/collaborative) (Ferrari *et al.*, 1996; Ferrell, 1983; Snyder, 1997).

The GRSLSS is unique since it is one of the few scales developed to be used with both high school and college students (Díaz and Cartnal, 1999). Moreover, it is also helpful to explain academic achievement by regression models (Bayrak, 2012; Cimermanová, 2018; Corbin, 2017; İlçin *et al.*, 2018; Javadi *et al.*, 2017; Lang *et al.*, 1999).

In view of the importance of learning styles for the educational environment, this study is aimed at adapting the GRSLSS to make it suitable to be used with Argentinian students (high school and college). The goals are as follows: (1) performing the linguistic adaptation, (2) examining content and face validity evidences, (3) analysing construct validity evidences (exploratory factor analysis, confirmatory factor analysis, comparison of the confirmed model with alternative models and factorial invariance analysis) and (4) examining internal consistency of the confirmed factors.

Method

Design

A psychometric and cross-sectional design, conducted with several groups of participants, was employed to translate and adapt the GRSLSS (Ato *et al.*, 2013).

Participants

Linguistic adaptation: Four academic translators with expertise in the educational field participated in this first stage.

Content and face validity evidences analysis: Five researchers from the psycho-educational field contributed to the content validity study. Forty students (20 high schoolers and 20 college students) participated in the face validity study.

Construct validity evidences and internal consistency analyses: A convenience sample composed of high school and college students was selected. Such sample was split into two groups (each one including students attending both educational stages). Exploratory factor analysis and internal consistency analysis were conducted on the first group whilst confirmatory factor analysis and factorial invariance analysis were performed on the second.

Exploratory factor analysis and internal consistency analysis: 300 students (150 high school and 150 college) composed the sample (51% males, 49% females in high school; 45.3% males, 54.7% females in college). High school students' ages varied from 13 to 19 years old ($\overline{X}$ = 15.07; *SD* = 1.59). College students' ages ranged between 18 and 47 years old ($\overline{X}$ = 24.73; *SD* = 4.23).

Confirmatory factor analysis and factorial invariance study: 856 students participated (367 high school, 489 college). High school students (60.5% males, 39.5% females) were between 13

and 19 years old ($\overline{X} = 15.39$; $SD = 1.62$). College students (48.9% males, 51.1% females) were between 18 and 48 years old ($\overline{X} = 24.36$; $SD = 4.95$).

Instruments

Sociodemographic and academic survey: It collects data regarding gender and age.

GRSLSS (Riechmann and Grasha, 1974): It is composed of 60 items responded by means of a 5-point likert scale – 1 strongly disagree, 2 moderately disagree, 3 undecided, 4 moderately agree, 5 strongly agree. It assesses six learning styles as follows: independent, avoidant, collaborative, dependent, competitive, participative.

Procedures

Data were gathered by a trained psychologist. An informed consent was given to college students and to parents in the case of high school students. Participants were informed about the study's goals, as well as about the voluntary and anonymous status of their participation. No economic or academic reward was given. The study was endorsed by an ethics committee form the University of Buenos Aires.

Procedures related to translation and the scale's psychometric features are detailed further.

Linguistic adaptation: The instructions, response options and items were translated by means of a collaborative procedure named team approach (Ali, 2016).

Content and face validity evidences: Experts reviewed the items content according to the theoretical description of the model's dimensions. Each expert received a file containing items randomly displayed, along with the theoretical description of each dimension. They were requested to ponder each item according to how well they met the dimensions' descriptions. They were also asked to indicate each item's quality in terms of how well they represented each dimension, following a 5-option likert scale (1, not adequate at all to 5, highly adequate). This way, as a first step, only items classified in the same dimension by all the experts remained. After that, the V Aiken coefficient was estimated for each item. Indices were interpreted using a conservative criterion, leaving out those which obtained V coefficients under 0.70 (Merino-Soto and Livia-Segovia, 2009). The resulting version was tested in a pilot study – high school and college students – to make the instructions and items linguistically suitable for these two groups. Alterations suggested by at least 70% of the participants were performed (Snape *et al.*, 2014).

Since data were ordinal, a polychoric correlations matrix was calculated in order to conduct the factor analysis, the internal consistency indices calculation and the factorial invariance study.

Exploratory factor analysis and internal consistency analysis: A parallel analysis established the number of factors to be retained. Results were interpreted from percentile 95th and higher (Timmerman and Lorenzo-Seva, 2011). Later, the exploratory factor analysis was conducted, using the *minimum rank factor analysis* method with direct oblimin rotation and Kaiser normalisation criterion. Items with loadings higher than 0.50 on a unique factor also obtaining simplicity indices over 0.50 were retained (Fleming and Merino-Soto, 2005). Internal consistency expressed by the ordinal alpha coefficient was estimated for each dimension.

Confirmatory factor analysis: The model was interpreted by means of the *goodness of fit index* (GFI), the *adjusted goodness of fit index* (AGFI) and the *comparative fit index* (CFI), all of them with suggested acceptable values over 0.90. The *root mean square error of approximation* index (RMSEA) was also analysed. Values lower than 0.06 are recommended. The model parsimony was examined by the *parsimony goodness of fit index* (PGFI), where accepted values should be between 0.50 and 0.70 (Mulaik *et al.*, 1989; Schumacker and Lomax, 2016). The *diagonally weighted least squares* (DWLS) estimation

method was employed since it is advisable for ordinal variables and large samples (Li, 2015).

Factorial invariance analysis: The factorial invariance for high school and college students' groups was tested. The DWLS estimation method was used, and different models with different restriction levels were examined. First, a configural model without any restriction; second, a metric model restricting regression coefficients; third, a structural model restricting covariances among factors. Results from the invariance study were interpreted by means of the CFI, the RMSEA and the Satorra–Bentler indices.

Data analysis

The content validity evidences analysis was performed using an app developed in Visual Basic (Merino-Soto and Livia-Segovia, 2009). Exploratory factor analysis was calculated employing Factor 10.9 (Lorenzo-Seva and Ferrando, 2019) and SIMLOAD (Fleming and Merino-Soto, 2005). Confirmatory factor analysis and factorial invariance analysis were conducted with LISREL 8.8 (Scientific Software International, 2006).

Results

Linguistic adaptation

The translation was performed using a team approach. Four academic experts independently translated the scale from English to Spanish. The four resulting translations were discussed by the translators, who finally reached consensus on the preliminary version of the scale.

Content and face validity evidences analysis

The scale resulting from the previous step was analysed by experts in terms of the items content. Thirty-four out of the 60 original items remained (Table 1).

A new numeration of the 34 remaining items was randomly assigned to proceed with the adaptation and the next psychometric analyses. The version obtained up to the moment was tested in a pilot study conducted on a sample composed of high school and college students. Participants did not report any issue. Hence, no linguistic alterations were performed on the items, the response scale or the instructions.

Exploratory factor analysis and internal consistency analysis

Firstly, the parallel analysis calculated suggested the extraction of four factors (Table 2).

Secondly, the exploratory factor analysis was conducted following suggestions from the parallel analysis. Therefore, a four-factor solution retaining 12 out of the 34 items explaining a common variance of 79.3% was isolated (Table 3). The factors were labelled as competitive, independent, dependent and collaborative in view of the content of the items which loaded on them. Participative and avoidant styles did not remain in the structure.

Confirmatory factor analysis

A confirmatory factor analysis of the four-factor model resulting from the exploratory factor analysis was conducted (Figure 1). It was also compared with a three-factor and a six-factor model (Figures 2 and 3).

Only the four-factor model achieved adequate fit indices (Table 4).

Factorial invariance analysis

The four-factor model invariance was tested. To do so, indices for both groups (high school versus college) were compared. The model was analysed using different levels of

Item	*V*	CI [90%]	
GRSLSS01	0.90	0.74	0.97
GRSLSS02	0.80	0.62	0.91
GRSLSS05	0.75	0.57	0.87
GRSLSS08	0.80	0.62	0.91
GRSLSS10	0.90	0.74	0.97
GRSLSS11	0.90	0.74	0.97
GRSLSS13	1	0.88	1
GRSLSS14	0.90	0.74	0.97
GRSLSS16	0.80	0.62	0.91
GRSLSS19	0.90	0.74	0.97
GRSLSS21	0.80	0.62	0.91
GRSLSS22	0.75	0.57	0.87
GRSLSS25	0.75	0.57	0.87
GRSLSS26	0.75	0.57	0.87
GRSLSS29	0.80	0.62	0.91
GRSLSS30	0.70	0.52	0.84
GRSLSS31	0.80	0.62	0.91
GRSLSS34	0.85	0.68	0.94
GRSLSS35	0.95	0.80	0.99
GRSLSS36	0.90	0.74	0.97
GRSLSS37	0.80	0.62	0.90
GRSLSS40	0.70	0.51	0.83
GRSLSS41	0.85	0.68	0.94
GRSLSS43	0.85	0.68	0.94
GRSLSS45	0.75	0.57	0.87
GRSLSS46	0.70	0.52	0.84
GRSLSS47	0.90	0.74	0.97
GRSLSS49	0.95	0.80	0.99
GRSLSS50	0.80	0.62	0.91
GRSLSS51	0.70	0.52	0.84
GRSLSS53	0.75	0.57	0.87
GRSLSS55	0.90	0.74	0.97
GRSLSS58	0.70	0.52	0.84
GRSLSS59	0.80	0.62	0.90

Table 1.
GRSLSS. *V* Aiken coefficients

Variable	Real data % of variance	Mean of random % of variance	95th percentile of random % of variance
1	16.0970	6.4604	6.9487
2	13.3159	5.9974	6.4176
3	8.1369	5.6723	6.0014
4	6.9530	5.3821	5.6870

Table 2.
GRSLSS. Parallel analysis

restriction (configural, metric, structural). The model invariance was verified in both groups (Table 5).

Discussion

The study was aimed at performing the linguistic, conceptual and metric adaptation of the GRSLSS to Argentinian high school and college students.

Firstly, four independent experts translated the scale from English to Spanish and reached an agreement on the preliminary version (team approach). After that, a content

Item	Competitive	Independent	Dependent	Collaborative	Index of factorial simplicity
GRSLSS03	*0.609*	0.079	0.176	0.024	0.879
GRSLSS06	*0.762*	0.215	−0.352	0.114	0.691
GRSLSS19	*0.695*	−0.140	0.022	−0.044	0.942
GRSLSS10	0.194	*0.577*	0.158	−0.162	0.720
GRSLSS17	0.011	*0.555*	0.176	0.141	0.814
GRSLSS21	−0.033	*0.539*	0.191	−0.155	0.771
GRSLSS24	−0.102	*0.576*	0.034	0.321	0.689
GRSLSS11	0.077	0.096	*0.921*	−0.089	0.965
GRSLSS25	−0.049	0.131	*0.509*	0.178	0.784
GRSLSS22	−0.175	0.130	−0.119	*0.600*	0.806
GRSLSS26	0.116	−0.146	0.189	*0.583*	0.772
GRSLSS33	0.062	−0.021	−0.001	*0.603*	0.985
Σ	21.4	20	19.9	18	
Ordinal alpha	0.849	0.771	0.967	0.751	
Factor scale fit index	0.931	0.902	0.787	0.823	Total = 0.863 (mean = 0.902)
Total index of factorial simplicity					Total = 0.839 (mean = 0.806)
Hyperplane Kaiser-Cerny	0.176	0.224	0.179	0.208	
Loadings in the hyperplane [−0.15, +0.15]					23 (47.9%)
Kaiser-Cerny hyperplane count					31 (64.6%)
Ideal hyperplane count					36 (75%)
Bentler's scale-free matrix measure					0.912
Interfactorial correlations	Competitive	Independent	Dependent	Collaborative	
Competitive	1				
Independent	0.080	1			
Dependent	−0.038	0.165	1		
Collaborative	−0.106	0.077	0.176	1	

Table 3.
GRSLSS. Exploratory factor analysis

validity analysis was conducted. In order to do so, experts were requested to select those items able to describe the dimensions composing the notion of learning styles in local students (Bengtsson, 2016). Thirty-four items remained in the scale based on their adequacy to the dimensions' description.

Items were subsequently tested in a pilot study conducted in samples composed of high school and college students. Such procedures allowed the scale's linguistic and conceptual adaptation.

In order to complete the conceptual adaptation, the internal structure of the scale resulting from the previous steps was examined by an exploratory factor analysis. A four-factor model was obtained, leaving out the avoidant and participative styles: the items composing such dimensions did not converge in a common factor nor loaded on any other factor which was retained in the exploratory factor analysis. In view of these results, further studies should analyse whether the factors left out (participant and avoidant) were eliminated because of translation issues or because these factors depict styles which are rarely exhibited by local students. Moreover, including two educational groups in the sample (high school and college)

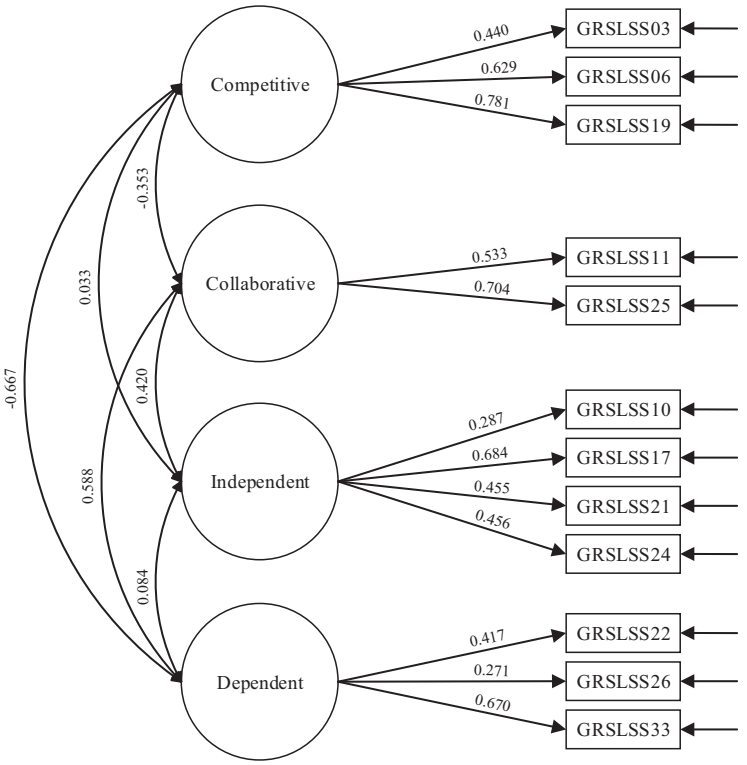

Figure 1.
GRSLSS. four-factor model resulting from the exploratory factor analysis

without splitting it to analyse differences between educational stages could imply an issue. It seems reasonable to think that one or both eliminated styles could have been present only in one of the two groups. However, after merging high school and college, such styles' effect could have been diluted in the whole sample because of the influence of a larger sample size.

As for the confirmation of a four-factor model, even though it did not replicate the six-factor model, it did replicate previous findings related to the independence of the styles, which were not grouped in terms of bipolarities (Baneshi *et al.*, 2013; Fathaigh, 2000; Saritaş and Süral, 2010).

Regarding the confirmatory factor analysis, the parsimony involved in the four-factor 12-item model explaining 80% of the variance is worth to be mentioned. Thus, a plain structure with a high explicative power retaining only items with high factor loadings and high factorial simplicity indices (>0.50) was achieved (Bentler, 1977; Boateng *et al.*, 2018; Fleming and Merino-Soto, 2005). Such adequate parsimony was also found in the interfactor correlations (<0.30). A low common variance between factors indicates their conceptual independence, guaranteeing they do not overlap (Lloret-Segura *et al.*, 2014).

The four-factor model was compared to two alternative models: a three-factor model (Ferrari *et al.*, 1996; Ferrell, 1983; Snyder, 1997) and a six-factor model (Baneshi *et al.*, 2013; Fathaigh, 2000; Saritaş and Süral, 2010). The four-factor model showed a better fit and therefore, more adequacy to explain learning styles in local students.

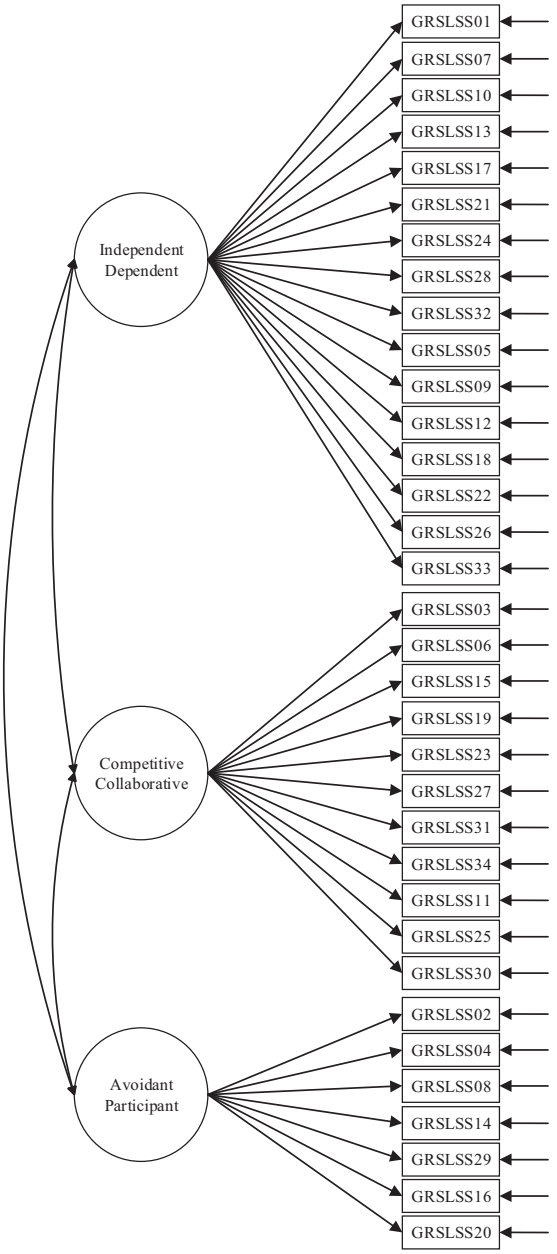

Figure 2.
GRSLSS. Three-factor model

The factorial invariance analysis was performed to test whether the four-factor model remained identical in the two groups to guarantee an unbiased comparison of factor means (Nolte and Elsworth, 2014). Significant differences were not verified when comparing Satorra–Bentler's ($p > 0.01$), CFI (<0.01) and RMSEA indices (<0.015) (Davidov *et al.* 2018).

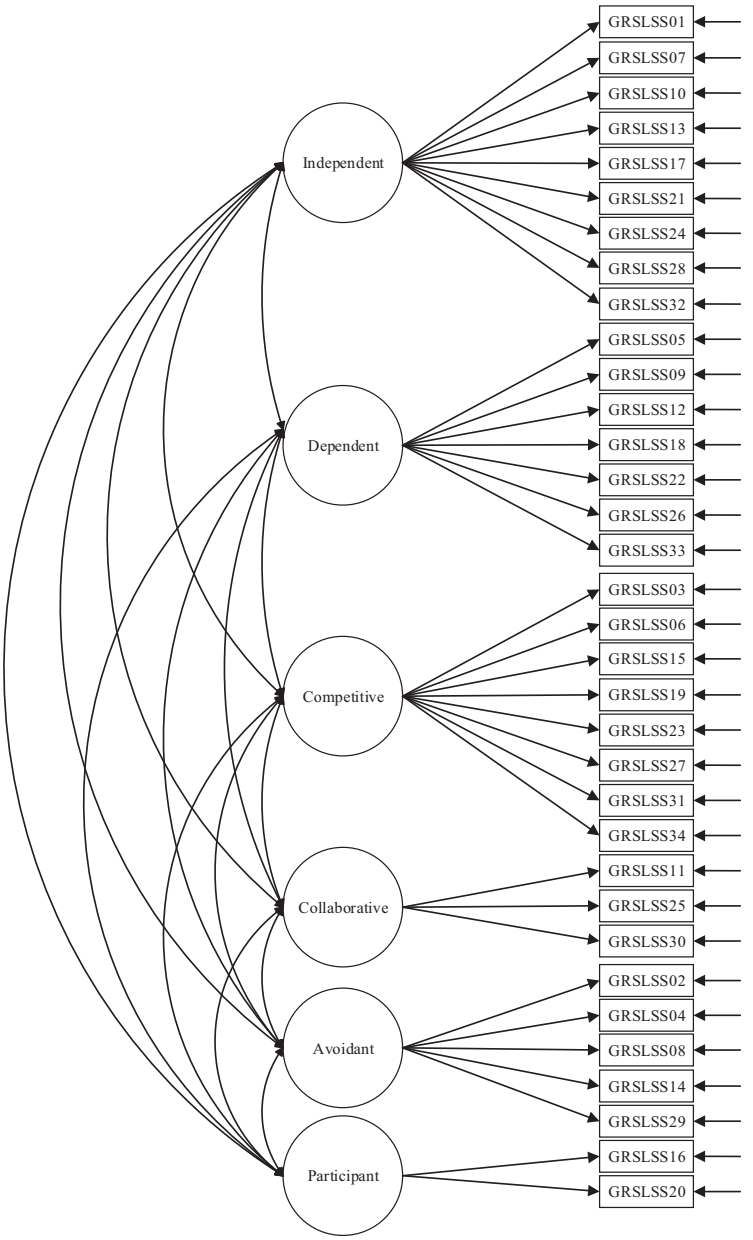

Figure 3.
GRSLSS. Six-factor model

Such evidences sustain the hypothesis stating the generalisation of the model, since it seems to be useful to explain learning styles in either high school or college students.

About the internal consistency analysis, all the factors extracted in the exploratory factor analysis exhibited acceptable values, higher than 0.70. It is worth mentioning that despite 48 items being eliminated as a result of the technical features analyses, reliability was not

affected. On the contrary, the indices obtained were higher than those reported in previous studies, where all the original items remained (Baneshi *et al.*, 2013; Fathaigh, 2000; Saritaş and Süral, 2010). This new result means that the content of the items composing each factor is the most appropriate to assess each dimension. Technically speaking, the decision of maintaining homogeneous items offers reliable measures with a low standard error (DeVellis, 2016).

Concerning the weaknesses of the study, it only analysed the scale's internal structure and its internal consistency. External validity evidences (convergent and predictive) and the stability reliability of the scores will be furtherly examined.

The replication of the study in samples from different regions of Argentina is another matter which should be considered. Even though Buenos Aires concentrates most of the population, broadening research throughout the country is imperative.

The difference in the number of items and dimensions of this version compared to the original one should also be mentioned. It complicates the comparison between these results and previous findings. However, such comparison regarding dimensions is possible once scores are standardised to a common metrics. Since that exceeds the goals of the study, it remains as a pending issue to be furtherly analysed in depth.

As for the practical implications of these results, the optimal psychometric features of the GRSLSS make it useful as an assessment resource in high school and college. Once the assessment of students' learning styles is performed, results will be helpful to change a certain *statu quo* if necessary. When individual learning styles and teaching methods do not match, learning quality could be seriously affected. Knowing the students' actual needs seems a sensible pathway to change a poor result. Bearing in mind the information provided by the scale, teachers could adapt their methods: planning tailored activities and assignments, monitoring classroom tasks more efficiently, encouraging a two-way communication as well as providing positive feedback. Hence, promoting huge changes in students' attitudes, motivation, comprehension or attachment to the class or the major would become possible (Grasha, 1994). Moreover, in case students would notice their *way of doing things* is not suitable enough for the class requirements, the GRSLSS can also be employed as a self-assessment in order to ask for tutors's guidance if necessary (Grasha, 1996).

Further studies should identify styles which are useful or detrimental for learning in different educational stages.

Table 4. GRSLSS. Model fit and model comparison

Model	X^2	df	Fit indices GFI	AGFI	CFI	PGFI	RMSEA [IC]
Four-factor (EFA)	70.531	48	0.972	0.954	0.968	0.598	0.036 [0.015−0.053]
Three-factor	3318.684	524	0.851	0.831	0.754	0.750	0.079 [0.076−0.081]
Six-factor	2846.283	512	0.867	0.846	0.795	0.746	0.073 [0.070−0.075]

Table 5. GRSLSS. Factorial invariance analysis

	S-B	df	ΔS-B	*p*	RMSEA	ΔRMSEA	CFI	Δ CFI
Configural	240.367	100	–	–	0.057	–	0.916	–
Metric	259.442	108	18.963	0.015	0.057	0.000	0.909	0.007
Structural	268.828	114	27.096	0.018	0.056	0.001	0.907	0.009

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