

STRUCTURAL VALIDITY OF THE LEARNING SELF-REGULATION QUESTIONNAIRE FOR UNIVERSITY STUDENTS

VALIDEZ ESTRUCTURAL DE LA ESCALA DE AUTORREGULACIÓN DEL APRENDIZAJE PARA ESTUDIANTES UNIVERSITARIOS

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ABSTRACT

The study's aim was to obtain evidence of validity of the Learning Self-Regulation Questionnaire (LSRQ) internal structure and to verify metric invariance compared with a previous research study. The participants were 237 university students from the first three academic semesters of a private university in three Peruvian cities (two in the North of Peru, and one in Lima). The analysis was performed by a semi-confirmatory factor analysis, specifying as comparison matrix: a) the configuration derived from a previous study, and b) the free estimation loadings factors. The results indicate that two dimensions represent the instrument structure satisfactorily; but the metric invariance compared to a previous study was not satisfactory. The re-specification of the model, by removing two items with factorial complexity problems and the free estimation of the items, was successful. These results are discussed so as to the interpretation of their scores and the lack of metric invariance.

Keywords: self-regulated learning, psychometric properties, structural validity, university students.

RESUMEN

El objetivo del estudio fue obtener evidencias de validez de la estructura interna del Cuestionario de Autorregulación del Aprendizaje (Learning Self-Regulation Questionnaire; LSRQ) y verificar la invarianza métrica comparada con un estudio previo. Los participantes fueron 237 estudiantes universitarios de los tres primeros ciclos académicos de una universidad privada, procedentes de tres ciudades del Perú (dos del norte y una de Lima). El análisis se realizó

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mediante un análisis factorial semiconfirmatorio, especificando como matriz de comparación (a) la configuración derivada de un estudio previo, y (b) la estimación libre de las cargas factoriales. Los resultados indican que dos dimensiones representan satisfactoriamente la estructura del instrumento; pero la invarianza métrica respecto a un estudio previo no fue satisfactoria. La re-especificación del modelo, mediante la eliminación de dos ítems con problemas de complejidad factorial y la estimación libre de los ítems, obtuvieron resultados satisfactorios. Se discuten estos resultados en el marco de la interpretación de sus puntajes y la falta de invarianza métrica.

Palabras clave: autorregulación del aprendizaje, propiedades psicométricas, validez estructural, universitarios.

INTRODUCTION

Massification of higher education in different contexts during the last decades (Rama, 2008) has lead school students, who have not yet achieved maturity, to decide what program o study, as part of their tertiary education. Thus, adolescents between 16 and 17 years old, when being admitted to the university, shall adapt to the new educational demands (Chau y Saravia, 2015). The university freshman usually discovers that he or she must modify several organizational aspects, such as study methods, time devoted to academic activities and the effort to obtain success and guarantee a professional future (Gutiérrez et al., 2010).

For this to be possible, their learning process will need to be self-regulated, based on their individual liberty and responsibility. Students who self-regulate tend to be more proactive and make a bigger effort to learn (Rosario et al., 2014). They become cognitively, emotionally and behaviorally conscious (Rosario, et al., 2009); they are aware of their capabilities and limitations (Rosario et al., 2014); their behavior when approaching education is based on their personal goals and strategies (Rosario et al., 2014; Rosario et al., 2009); they contemplate about their progress (Rosario et al., 2014), and improve on how they measure

their learning achievements (Lopez, Hederich-Martinez and Camargo, 2012; Hernandez Pina, De Fonseca and De Tejada, 2010; Rosario et al., 2012). Also, self-regulated learning benefits from the self-worth perception one has, as well as from the developed self-efficacy that can come in handy in the future (Rosario, et al., 2012), and the teaching strategies carried out by educators (Chaves, Trujillo and Lopez, 2015; Gaeta, 2014; Santelices, Williams, Soto and Dougnac, 2014) in learning environments, both individually and collectively (Jarvela, 2015).

One of the many viewpoints there is on self-regulation in learning is the one proposed by Deci and Ryan (2002). According to them, in their presented model about self-determination, people's conduct is based on their self-management and empowerment; in other words, their own motivation will lead them to commit to learning. Ryan and Deci (2000) also emphasize the importance of inherent resources and innate psychological needs of autonomy, competitiveness and relationships in order to produce self-motivation and mental health. Something that is also examined is how certain social environments work against the development of the aforementioned learning tendencies.

As pointed out by Moreno and Martinez (2006), self-regulated learning synthesizes theories about cognitive evolution, organic integration, and orientation in purpose and in basic needs. It also incorporates theories about: innate motivation, self-control, personal competence, motivation from certain tasks, positive feedback, and the perception of effectiveness, self-orientation and self-government.

Based on their theory, Williams and Deci (1996) elaborated the Learning Self-Regulation Questionnaire (LSRQ), which measured people's regulation and motivation within the academic context. It focused on two factors: autonomy and self-control. The first factor is characterized by self-determination and intrinsic motivation; while the second is defined by extrinsic motivation. This instrument was adapted by Matos (2009) in a university population in Lima, Peru. Through an exploratory strategy, both factors were determined as reasonable; nevertheless, the internal structure evaluation by means of the structural equation modeling was unsatisfactory. The Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA) did not meet the standards usually required to define an acceptable fit: > 0.95 and < 0.05 respectively (Hooper, Coughlan and Mullen, 2008; Hu and Bentler, 1999). Apparently, some structural aspects were not resolved, such as the possible factorial complexity of some items, or the existing relationship between an item and two or more irrelevant latent variables (Merino and Grimaldo, 2010, 2011). Lack of specificity of this characteristic can have an impact on decreasing fit indexes because the source of variability of the items is not modeled (Brown, 2006).

The results of validation from the LSRQ, however, aren't conclusive given the fact that validity is not an inherent characteristic of the measuring instrument; it depends on

various aspects such as the characteristics of the evaluated samples and the context they are in (Martinez Arias, 2005). In that sense, it is necessary to verify how replicable are the validity and reliability of the LSRQ when applied to a wide range of students in other contexts. This will help to establish the test's theoretical bases, and to corroborate its psychometric properties generalizations. The preliminary objective of this research is to prove the structural validity and reliability of the LSRQ in a more diverse sample of Peruvian university students. Given that there are contextually relevant preliminary reports (Mateo, 2009), the current study will also examine the invariance of previous discoveries and how replicable they are.

METHOD

Participants

A non-probabilistic sample, made up of 237 first- and third-term students from private universities in Trujillo, Lima and Cajamarca, enrolled in the second semester of 2013, was used. The estimated socioeconomic level of the students is middle and upper middle class; 52% were males; the average age being 19.98; 98% single and 70% not yet working. The sample is made up from students in Engineering (41%), Accounting and Finance (21%), Business Management (19%), Law (16%), Psychology (2%), and Communications (1%).

Measures

Learning Self-Regulation Questionnaire (LSRQ; Williams and Deci, 1996). It's made up of 14 items and its objective is to determine if university students are controlled (Control scale, 8 items) or autonomous (Autonomy scale, 6 items) within the educational context. The answer format is an ordinal 5-point format (just as designed in the original study), ranging

from *Not at all True* to *Completely True*. The answer instructions demand that the test subject provide a general perspective about the accuracy of each item.

Procedure

It's an instrumental-type research (Montero and Leon, 2002). Its execution was authorized by the university's board of directors on behalf of one of their areas interested in getting to know their students' psychological characteristics. The research was coordinated with the head of a psychological department to plan out the evaluation process in the hands of psychologists and interns. The instrument was applied in the middle of the semester. It was done collectively and in the classroom, with an estimated number of 35 students in each test. The participants were informed about the objectives of the research and their participation was voluntary. The approximate time was 15 minutes.

As for the analysis, it consisted of examining the internal structure of the LSRQ through a semi-confirmatory procedure. This method prevents the identification of the dimensional structure from being oriented from the data, as is the case in the exploratory factor analysis (Nunnally and Bernstein, 1995). It also prevents the modeling from being highly restrictive, as is the case in a confirmatory factor analysis/structural equation modeling (Nunnally and Bernstein, 1995). The basic procedure for this semi-confirmatory methodology demands the establishment of a matrix that serves as a hypothesis (target matrix) towards which the factorial solution of the data is rotated to. The rotation's adjustment, regarding the data, is evaluated through the congruence coefficient (ϕ ; Tucker, 1951); congruence coefficients greater than 0.95 indicate that both solutions can be considered identical (Lorenzo-Seva and Ten Berge, 2006).

Evaluation of the LSRQ measuring model was done in various phases: first, the measurement invariance differences between the present data and Matos' results (2009) were verified. This consisted of seeing if the items' factorial loads remained the same; something also known as "metric invariance" (Elosua, 2005). The specific procedure was done through the rotation of the factorial solution of the present data towards the reported configuration in Table 2 of Matos' (2009) research. The second step was to evaluate the dimensionality with a new specification about the model, which consisted in identifying each item in their own expected latent variable (without restricting any specific value), and specifying the zero value in the other variable. For this factorial procedure, the Factor 9.2 program computer was used (Lorenzo-Seva and Fernando, 2006).

RESULTS

Preliminary Analysis

The items showed a clear pattern in the answer trend, since those representing the autonomous behavior were more frequent, while the control ones were fewer and slightly more dispersed (see Table 1). On the other hand, the non-rotated factorial solution seems to show a pattern which is different in its convergent factorial loads between the items and their constructs.

Evidence of the Internal Structure

Completely Specified Model. In the complete specification (based on the work done by Matos, 2009), the congruence of the obtained solution was of 0.605, a similar result to the one obtained on the factors level, since that one was also under 0.70. These levels indicate poor congruence in what concerns the obtained factorial solution, between the factorial loads of Matos' (2009) study and the current sample. On the item level, 3 items

Table 1
Descriptive statistics and polychoric correlation matrix

	au1	au2	au3	au4	au5	au6	au7	au8	au9	au10	au11	au12	au13	au14	F1	F2
au1	1.000														0.515	-0.097
au2	0.556	1.000													-0.225	0.656
au3	0.291	0.357	1.000												0.637	0.031
au4	0.244	0.410	0.550	1.000											0.146	0.423
au5	0.364	0.501	0.487	0.538	1.000										0.455	0.246
au6	0.254	0.317	0.215	0.348	0.431	1.000									0.621	0.117
au7	-0.123	-0.101	-0.126	-0.149	-0.256	0.019	1.000								-0.158	0.796
au8	0.144	0.256	0.010	0.095	0.074	0.140	0.309	1.000							-0.105	0.591
au9	0.177	0.221	0.564	0.401	0.295	0.197	0.067	0.078	1.000						0.694	0.05
au10	-0.131	-0.074	0.037	-0.120	-0.181	0.015	0.544	0.320	0.112	1.000					0.000	0.729
au11	-0.223	-0.164	0.050	0.006	-0.168	0.079	0.459	0.088	0.204	0.507	1.000				0.779	-0.125
au12	-0.128	0.062	0.155	0.071	-0.167	0.065	0.456	0.393	0.215	0.548	0.405	1.000			0.552	0.164
au13	0.206	0.221	0.174	0.326	0.373	0.690	0.008	0.142	0.186	0.076	0.175	0.147	1.000		0.488	0.239
au14	-0.071	0.054	0.037	-0.003	-0.101	0.066	0.468	0.349	0.102	0.641	0.387	0.533	0.186	1.000	-0.034	0.731
M	3.743	3.954	4.312	4.177	4.451	4.139	1.578	2.835	3.916	2.089	2.283	2.114	3.928	2.274	-	-
SD	0.992	1.040	0.925	0.951	0.849	0.977	0.927	1.357	1.064	1.203	1.249	1.205	1.136	1.367	-	-
g_1	-0.168	-0.562	-1.301	-0.892	-1.594	-0.963	1.38	0.037	-0.57	0.763	0.599	0.696	-0.986	0.679	-	-
g_2	-0.659	-0.489	1.307	0.091	2.161	0.337	0.869	-1.079	-0.461	-0.474	-0.591	-0.615	0.349	-0.801	-	-

Note: g_1 : skewness; g_2 : kurtosis; F1 y F2: non-rotated factorial results

(50%) from F1 (Autonomy) and 5 items (71%) from F2 (Control) were in the range between 0.85 and 0.94, which, according to the criteria, is deemed acceptable. Lastly, the RMSR value for the adjustment according to the Matos' (2009) results was 0.08, greater than the suggested minimum according to Kelley's criteria (as cited in Harman, 1962). On balance, these results indicate that the metric configuration from Matos' (2009) results do not adjust well to the data in the current study.

Partially Specified Model. On the other hand, the partial specification in which the items places were identified in their hypothetical dimensions, reached congruence ratios in a range between 0.85 and 0.94 (ϕ_i) for the items, factors (ϕ_p) and the total solution (0.903). All F1 items reached a high congruence level (≥ 0.95); and all but two F2 items (5 and 13), the rest are around 0.95 or higher. These adjustment levels are good, although they are opposite to the RMSR (0.0809), which was greater than the standard proposed by Kelley. Apparently, this inconsistency in the adjusted was due to the factorial complexity of items 5 and 13, the same who showed congruence problems. The SFI simplicity ratios for these items, 5 and 13, also were very low (0.65 <); item 2 also showed low factorial simplicity, but not as low as the previous items.

Modified Model. In this evaluation of the factorial structure, items 5 and 13 were removed in order to verify their effects on the overall factorial solution. The results appear in Table 3, in which the items' and factors' adjustment are shown. Except for item 4, the congruence levels on the items (ϕ_i), factors (ϕ_p) and total solution (0.970) level where superior to 0.95, which indicates that the adjustment can be considered complete. On the other hand, the item factorial simplicity

indicators were also elevated, and essentially ≥ 0.95 . The overall solution factorial simplicity was of 0.98. Lastly, the RMSR was 0.0615, a number lower than what is established for this sample (0.0651), which along with the other indicators points out that this modified model displays the best fit.

Correlation among Factors. Using Matos' (2009) specification, the interfactorial correlation was moderate and negative (see Table 2), while in the partial specification and the modified model correlation was zero (see Table 3) and practically the same as observed in Mato's (2009) study.

Reliability Evidence. The internal consistency (α ; Cronbach, 1951), estimated with the usual covariance matrix, was of .702 and .744 on the Autonomy (F1) and Control (F2) scales, respectively. The corresponding confidence intervals (Romano, Kromrey and Hibbard, 2010) based on the Fisher method (to have better coverage on the context of ordinal items; Romano, Kromrey, Owens and Scott, 2011) were CI 95%: 0.63, 0.76 and CI 95%: 0.68, 0.79, for F1 and F2, respectively. Given the content of the analysis, which was based on a polychoric matrix, the previous estimates are attenuated (Elosua and Zumbo, 2008), because that they were calculated based on a different matrix. Based on the matrix of polychoric correlations, the ordinal internal consistency (α) (α_o ; Elosua and Zumbo, 2008) was calculated through an *ad hoc* program (Domínguez, 2012). It was found that for F1 ($\alpha_o = .91$) and F2 ($\alpha_o = .87$) reliability was higher so they can be considered more appropriate estimates. The calculated α_o was done without the two items that were removed (5 and 13) from F2. In this analysis same context, the estimated reliability from a congeneric model (ω) was inferior in relation to α_o (see Table 3).

Tabla 2
Complete and partially specified factorial solution

	Matos Specification (2009)			Partial Specification			
	F1	F2	ϕ_i	F1	F2	ϕ_i	SFI_i
au1	0.501	-0.051	0.995	0.518	-0.126	0.972	0.888
au3	0.671	0.101	0.149	0.638	-0.004	1.000	1.000
au6	0.684	0.193	0.962	0.620	0.083	0.991	0.965
au9	0.737	0.128	0.171	0.694	0.013	1.000	0.999
au11	0.766	-0.054	-0.070	0.784	-0.168	0.978	0.912
au12	0.628	0.237	0.936	0.549	0.134	0.971	0.888
au2	-0.012	0.689	1.000	-0.240	0.669	0.941	0.772
au4	0.294	0.475	0.850	0.137	0.415	0.950	0.803
au5	0.555	0.315	0.870	0.451	0.221	0.441	0.613
au7	0.105	0.848	0.992	-0.176	0.806	0.977	0.909
au8	0.091	0.631	0.143	-0.118	0.598	0.981	0.925
au10	0.247	0.792	0.298	-0.015	0.730	1.000	0.999
au13	0.587	0.311	0.468	0.484	0.212	0.402	0.678
au14	0.213	0.791	0.966	-0.049	0.734	0.998	0.991
ϕ_F	0.560	0.653		0.894	0.917	-	-
SFI_F	-	-		0.956	0.943	-	-
ω	0.828	0.833		0.803	0.787	-	-
φ							
F1	-	-0.40			0.076	-	-

F1: Autonomy F2: Control. ϕ_F : congruence of factors. ϕ_i : congruence of items. SFI_i : factorial simplicity of item. SFI_F : factorial simplicity of factors. φ : inter-factorial correlation

Table 3
Modified factorial solution

	F1	F2	h^2	ϕ_i	SFI_i
au1	0.536	-0.110	0.299	0.980	0.919
au3	0.708	0.026	0.502	0.999	0.997
au6	0.600	0.076	0.366	0.992	0.968
au9	0.673	0.011	0.453	1.000	0.999
au11	0.767	-0.160	0.614	0.979	0.917
au12	0.481	0.106	0.243	0.977	0.907
au2	-0.177	0.668	0.478	0.967	0.869
au4	0.209	0.438	0.236	0.902	0.629
au5	-	-	-	-	-
au7	-0.097	0.809	0.664	0.993	0.972
au8	-0.115	0.567	0.335	0.980	0.921
au10	0.047	0.728	0.532	0.998	0.992
au13	-	-	-	-	-
au14	0.024	0.741	0.550	0.999	0.998
ϕ_F	0.968	0.973			
SFI_F	0.960	0.980			
ω	0.798	0.825			
φ					
F1	-	-0.017			

F1: Autonomy. F2: Control. ϕ_F : congruence of factors. ϕ_i : congruence of item. SFI_i : factorial simplicity of item. SFI_F : factorial simplicity of factors. φ : inter-factorial correlation

DISCUSSION

The results obtained indicate that the structure of two latent dimensions is reasonable for the current data, which allow to make sure that these two dimensions are empirically representative of the theoretical framework in which they were constructed. Nevertheless, one of the aspects of this validity was unsatisfactory, such as the invariance of factorial loads. This type of invariance is fundamental in moving forward to other types of more restricted invariance (Milfont and Fischer, 2010), such as the invariance of intercepts and residuals. Therefore, even though the items are dimensionally associated to theoretically identifiable constructs, the force or intensity with which the items are associated to them does not remain constant.

This discrepancy means that there is a different interpretation of the items content between both samples; between Matos' (2009) study and the current sample, and that the constructs' characterization varies according to the dissenting items. For now, the observation of these items does not allow us to infer how their content interacts with the participants' characteristics, therefore, there is an open question which must bring up hypotheses for future studies. In the context of the invariance analysis, the problematic items can be removed or adjusted if we wish to proceed with comparisons between groups, but there are problems with both solutions. The first is that the results would not be comparable with other studies, since the removing of items would seriously alter the factors interpretation. The second refers to the fact that this demands the use of an equational methodology, which was not applied in this study.

An aspect that seems to have been influenced by the lack of replicability is the

correlation between constructs. When adjusting the data to Matos' (2009) structural parameters, the association between factors was negative.

Some aspects were not evaluated and the same are part of the limitations in the current study. In first place, the invariance of all the items' parameters (intercepts and residuals) was not evaluated, which would have allowed the comparison between groups in various aspects, such as the means and variances between them (Elosua, 2005). This limitation is applied to the comparison between our data and Matos' (2009) study, and between the relevant groups in the current investigation, for example, men and women, or between semesters. The second unestimated aspect indicates that the sample size can have an effect on obtaining high stability and a higher sampling error within the gathered statistics, compared to larger samples. This means a bigger sample size is required in order to obtain more representative conclusions. Also, the similarity between the factorial loads within each factor was not verified. This is known as tau-equivalent (Meyer, 2010) and it helps in the interpretation of the factor and to back up the use of coefficient α as the appropriate estimator for internal consistency reliability.

Lastly, the interpretation of both constructs in the current sample indicates that these can coexist when the subject faces academic situations. The linear correlation between both, equivalent to zero in this study, suggests that control and autonomy do not have to be opposite behaviors, they can actually interact and adapt to each other in order to obtain successful learning results. Nevertheless, this last point needs to be looked into and research dedicated to it is guaranteed.

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