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Assessment of learning strategies with the ACRA and the Brief-ACRA scales: Competitive models, measurement invariance, and prediction of academic achievement in secondary elementary students from the Dominican Republic☆

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ABSTRACT

Learning strategies have been widely studied, and they have been related to academic achievement in several studies. Among the measurement instruments developed, the 44-item version of the Learning Strategies Scale (ACRA) is, by far, one of the most widely used questionnaires in the Spanish speaking context. This instrument has been recently shortened to a 17-item version. Neither the 44-item nor the 17-item version have been tested in the Dominican Republic. The aim of this study is to study the psychometric properties of the 44-item and 17-item versions of the ACRA. Participants were 1712 Dominican secondary school students. Both structures of the ACRA were tested via CFA; alpha and CRI Index were calculated for internal consistency; and, to obtain evidence of the relations with other variables, two models of academic achievement prediction were tested. Results pointed adequate internal structure of both versions, but higher consistency estimates for the former. Both versions of the scale were invariant across gender and age, and no latent mean differences were found. In the prediction model of the 44-item, cognitive strategies was the only significant predictor of achievement; in the 17-item ACRA, it was emotional-social support. These predictive models were, again, invariant across gender and age. Taking into account these results, the 44-item version has shown better properties to asses LS in the Dominican Republic. However, when our aim is to predict academic achievement, a mixed version of the 44- and the 17-item versions could be used.

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Evaluación de las estrategias de aprendizaje con las escalas ACRA y ACRA-Breve: Modelos competitivos, invarianza de medida, y predicción del rendimiento académico en estudiantes de secundaria de la República Dominicana

RESUMEN

Las estrategias de aprendizaje (EA) han sido ampliamente estudiadas, y se han relacionado con el éxito académico en diversos estudios. Entre las medidas desarrolladas, la versión de 44 ítems de la Escala de Estrategias de Aprendizaje (ACRA) es, de lejos, una de las más utilizadas en el contexto de habla hispana. Este instrumento ha sido recientemente reducido en una versión de 17 ítems. Ni la versión de 44 ítems ni la de 17 han sido puestas a prueba en la República Dominicana. La muestra se compone de 1712 estudiantes dominicanos de secundaria. Ambas estructuras del ACRA son evaluadas mediante CFA; alfa

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y el índice CRI es calculado para la consistencia interna; y, para obtener evidencia de las relaciones con otras variables, se prueba dos modelos de predicción del rendimiento académico. Los resultados muestran una estructura interna adecuada para ambas versiones, pero mayores estimaciones de consistencia para la primera. Ambas versiones de la escala resultan invariantes a través de sexo y edad, y no hay diferencias en las medias latentes. En el modelo de predicción con la versión de 44 ítems, las estrategias cognitivas son el único predictor significativo de rendimiento; con la de 17 ítems, lo es el apoyo emocional-social. Estos modelos predictivos son, de nuevo, invariantes a través de sexo y edad. Teniendo en cuenta estos resultados, la versión de 44 ítems muestra mejores propiedades para evaluar las EA en la República Dominicana. Sin embargo, si el objetivo es predecir el rendimiento académico, podría utilizarse una versión mixta de las versiones de 44 y 17 ítems.

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Introduction

In order to provide resources to students to face academic tasks, one of the main commitments of educational institutions is to implement new systems to improve learning while considering students' individual differences and interests (Abad et al., 2002). When aiming to improve learning, a clear conceptualization and accurate measurement of learning strategies (LS) is essential.

In cognitive psychology, LS can be understood as the process in which students purposely choose to recover their knowledge in order to achieve their desired educational objectives (Monereo et al., 2001). They differ from learning techniques because LS are processes and action plans with the objective of fulfilling intellectual tasks, for example, creating debates or role-playing (Valle et al., 1999), whereas learning techniques refer to the procedures itself. Indeed, they can be defined as decision making processes about the most appropriate procedures to achieve the objectives in a specific situation (López-Aguado, 2010). LS have been mostly studied as predictors of academic success (Añez, 2016; Guapacha & Benavidez, 2017), although they have also been found to predict other constructs, as creativity (Mall-Amiri & Fekrazad, 2015), critical thinking (Olivares & Heredia, 2012), satisfaction with life (Bustos et al., 2017), self-efficacy or metacognitive awareness (Nosratinia et al., 2014).

The Learning Strategies Scale (ACRA, Román & Gallego, 1994), is one of the most widely used questionnaires in the Spanish speaking context according to a recent systematic review performed by Bahamón et al. (2012). The purpose of Román and Gallego (1994) was to develop a measure of learning strategies for secondary school students, based on the basic cognitive processes of information processing and retrieval. The acronym ACRA states for Acquisition, Codification, Retrieval and Support Strategies in Spanish (*Adquisición, Codificación, Recuperación and Apoyo al estudio*). The ACRA scale is composed by 119 items, divided in 32 strategies which are grouped in four factors: 7 subscales evaluating acquisition strategies, 13 subscales evaluating codification strategies, 4 subscales for retrieval strategies, and 9 subscales for support strategies. Acquisition Strategies are the ones which allow students to incorporate new information by selecting and organizing stimuli coming from their environment in order to incorporate into their short-term memory (STM), codification strategies are the ones in charge of transforming information from the STM to the long-term memory (LTM), additionally, retrieval or recovery strategies' function is to retrieve and verify information, finally, the support strategies, strategies included are based on meta-cognitive processes aimed at improving learning by focusing on motivational and emotional processes. Although this scale has been widely validated with good psychometric properties (De la Fuente & Justicia, 2003; Juárez-Lugo, Pichardo-Silva, & Rodríguez-Hernández, 2015), there is still some pending questions about its dimensionality. Some authors as Gutiérrez-Braojos et al. (2013) validated the four factors scale by confirmatory factor analysis (CFA), with satisfactory

results. However, some other researchers obtained a three factorial solution, applying principal components analysis with varimax rotation (Juárez-Lugo et al., 2015). All in all, it seems that there is more literature supporting the three-factor structure (Ángel-González et al., 2017; De la Fuente & Justicia, 2003; Jiménez et al., 2018; Juárez-Lugo et al., 2015).

De la Fuente and Justicia (2003) created an abbreviated version of the ACRA scale (De la Fuente & Justicia, 2003) for university students. The scale was reduced to 44 items grouped in three factors: cognitive strategies and learning control, support to learning strategies, and study habits. The first dimension, cognitive strategies and learning control was composed by 25 items and it encompasses seven learning strategies: selection and organization, highlighting, repetition of the material, elaboration of the material, consciousness about the use of strategies, and control of answers and planning. The second factor, support to learning strategies, was composed by 14 items and five subscales: scheduling and planning the progression of work, acting plans in contradictory conditions, control of anxiety, intrinsic motivation, and social support. The third factor, study habits, was composed by 5 items and by two subscales: comprehension and study habits. The psychometric properties of this version have been examined with good internal consistency indexes. For the total scale, estimates of internal consistency are excellent, ranging from .89 to .96 (Ángel-González et al., 2017; Juárez-Lugo et al., 2015). However, evidence of reliability for the different dimensions have been sometimes poor (Vega-Hernández et al., 2017). Regarding the internal structure, different results have been found. For example, Juárez-Lugo et al. (2015) defended a four-factor structure based on 14 out of the 44 items of the scale.

There is a recent version of this scale developed by Jiménez et al. (2018), which attempts to solve the dimensionality problem of the previous versions. They estimated a three-factor structure in a 17-item version of the scale, providing evidence for gender invariance across. This scale was obtained by a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), as well as a criterial validity assessment with learning, critical thinking, and satisfaction with life. The three factors were named micro-strategies, metacognition and memory keys, and emotional-social support. Criterion-related validity was assessed by correlating learning strategies with focuses on learning, critical thinking, and satisfaction with life: all correlations were statistically significant, moderate and positive. Regarding the internal consistency, these authors obtained an alpha of .78 for micro-strategies, .86 for keys for memory and metacognition, and .78 for emotional-social support.

In this same study, and using the 17-item version, Jiménez et al. (2018) found differences in the use of learning strategies across gender, although effect size was low ($d < 0.50$). In another study, Mashhady and Fallah (2014) found no significant differences among learning strategies in language learning in a sample of university students among different study fields. In addition, when

differences are found in the use of learning strategies, they tend to benefit women, although there are studies where they benefit men (Da Cuña et al., 2014; Navarro et al., 2018).

There is enough evidence supporting that training students in learning strategies may be a powerful tool for their development and success in their posterior career path since they are positively related to academic achievement (Ambreen et al., 2016; Ergen & Kanadli, 2017), creativity (Gutiérrez-Braojos et al., 2013; Mall-Amiri & Fekrazad, 2015), critical thinking (Olivares & Heredia, 2012), or satisfaction with life (Bustos et al., 2017). Specifically using the 44-item version ACRA scale, learning strategies have been related to academic performance. For example, Añez (2016) found out that all three factors of the ACRA scale were positively correlated to the grades on mathematics, language, social and natural sciences in a sample of middle school Colombian children. In the same line, Guapacha and Benavidez (2017) results indicated a positive relationship between improving learning strategies and English performance in a sample of Colombian university students. In sum, research up to date shows that improving learning strategies could lead students to have a greater academic and professional success in the future. For all these reasons, it is necessary to have valid and reliable scales to evaluate LS. The ACRA scale could be a useful instrument in providing information about students' learning process.

Specifically, in the Dominican Republic context, none of the ACRA versions have been validated. This country has repeatedly shown low levels of academic success when compared to other countries results (i.e., OECD, 2019). However, during the last years, the Dominican Republic has shown advances in education: higher investment for the pre-university level, improvement of the effective time of classes, universalization of primary education, improvement in teacher training, updating of the curricular proposal, among others (Acción Empresarial para la Educación, EDUCA, 2015; Iniciativa Dominicana por una Educación de Calidad, IDEC, 2014). Nonetheless, academic achievement it is still a major challenge. Learning results in national evaluations remain at low levels, according to the needs and expectations of the country (Fondo de las Naciones Unidas para el Desarrollo, UNICEF, 2017).

In this context, the aim of this study is to validate and compare the widely used 44-item version and the new shortened 17-item version of the ACRA in order to provide evidence about their reliability and validity in a sample of Dominican Republic. Specifically, this general aim can be divided into five, with their corresponding hypotheses: (1) To test the factorial validity of the 44- and the 17-item versions of the ACRA in Dominican Republic students; (2) To test the reliability of the 44- and the 17-item versions of the ACRA; (3) To test the measurement invariance across gender and age of the 44- and the 17-item versions of the ACRA; (4) To test gender and age differences in learning strategies, as measured with the 44- and the 17-item versions of the ACRA; and, (5) To test the power of the 44- and the 17-item versions of the ACRA to predict academic achievement.

Based on previous literature, hypotheses were that both scales would have an acceptable fit to the previously found three-factors structures (hypothesis 1) and will be reliable (hypothesis 2), that they would be invariant across age and gender (hypotheses 3), although, there would be differences across gender (hypothesis 4) (Jiménez et al., 2018; Juárez-Lugo et al., 2015). There was no hypothesis on the differences in predictive power of both scales on academic achievement (hypothesis 5) since there is no previous literature comparing both scales.

Method

Design

This is a cross-sectional survey design of Dominican secondary school students. The sample of participants was gathered in Educative Districts numbers 04-03 and 11-01 in the Dominican Republic. The Universe of students in these two districts was 3387, and they belong to public, private and semi-public schools. This variable (type of school) was used for the stratified sample finally recruited. For a level of confidence of 99% and 3% margin of error (with $p = q = .5$) a total of 1712 students were finally sampled.

Participants

With respect to the participants, 52.72% were girls. Their age ranged from 12 to 20 years, with an average of 14.73 years ($SD = 1.2$). Regarding precedence of participants, 74.65% of the students came from public schools, 15.63% from private owned ones, and 9.70% were students from semi-public school. In relation to the area, 76.4% of the students came from schools in urban areas, while the other 23.6% from rural areas. With respect to school hours, 34.1% of the students had a regular timetable, with 52.51% having extended hours and 13.38% studied in a night shift.

Instruments

The instruments were back-translated into Spanish and reviewed by a committee of experts with knowledge on languages and cultures of both Spain and the Caribbean. Among the scales and questionnaires in the survey, those relevant for this research are the ACRA scale and the achievement measures. Regarding the ACRA scale (Román & Gallego, 1994), we used the abbreviated adaptation by De la Fuente and Justicia (2003). This abbreviated version consists of 44 items measuring three dimensions: (1) *Cognitive strategies and learning control*, including items 1–25; (2) *Support to learning strategies*, including items 26–39; and (3) *Study habits*, with items 40–44. All items were scored in a 1 = Never or almost never to 4 = Always to almost always). On the other hand, the 17-item version of the scale was developed with also with a three factor structure, but very different contents and labels: (1) *Microstrategies* (items 1, 2, 3, 4, and 5); (2) *Keys for memory and metacognition* (items 10, 11, 12, 17, 18, and 27); and (3) *Emotional-social support* (items 31, 32, 34, 35, 36, and 37). With regard to the achievement measures, last grades of several subjects present in the curricula were recorded. Specifically, the subjects considered were Mathematics, Spanish, English (Foreign language), Social Sciences, Natural Sciences, Arts, and Physical Education. All subjects are scored in a 0–100 range, with a cutting point to pass the subject of 70 points.

Procedure

Regarding the survey procedure, had from the Ministry of Education of the Dominican Republic for the study, as well as that of the authorities in the educational centers. This study meets the ethical standards of the American Psychological Association (APA). The survey team were three district techniques and two specialists in the area of School Psychology. These teams contacted the directors of the educational centers to communicate the aim of the study and the dates of the applications. In the schools, students were randomly chosen. Students were informed about the research interest and only those willing to participate were asked to fulfill

the questionnaires. The instruments were self-administered, with help from a member of the research team, and in the classrooms of students during normal class hours. The time needed in completing the survey was around 20 min.

Data analyses

Descriptive statistics for all the variables under study were calculated with SPSS 23. Additionally, several structural models, specifically Confirmatory Factor Analyses (CFA), were specified and tested, using Mplus 8.3 (Muthén & Muthén, 2020). In order to test for the factorial validity of the 44-items ACRA scale and the short version of 17 items developed by Jiménez et al. (2018), two CFAs were estimated according to the three factorial structures suggested by literature. The results of these two CFAs, if they fit the data, will allow the estimation of internal consistency by means of the Composite Reliability Index.

Once the factorial validity of both versions of the scale was stablished, we conducted four measurement invariance routines: measurement invariance by gender in the two versions of the scale, and invariance by age in both versions. Configural, metric and scalar invariance were studied (van de Schoot et al., 2012). The models in this sequence are nested, and may be compared either with formal statistical test or with a modeling strategy (Little, 1997). Cheung and Rensvold (2002) and Little (1997) proposed the modeling strategy as best, and we will use it in this study. This modeling approach seeks for meaningful differences in the fit indexes of .01 or more (Cheung & Rensvold, 2002) or .05 or more (Little, 1997) to prefer a more complex model to a simpler one. After factorial validity and measurement invariance of the two versions of the ACRA was stablished, several others structural models were estimated and tested. These two CFAs were identical to the ones formerly presented, with a significant difference, a factor of achievement with all subjects as indicators was included in each CFA. These CFA allowed us to test for the criterion-related validity of the two versions of the ACRA scale at the latent level.

All CFA models were estimated with Weighted Least Squares Mean and Variance corrected (WLSMV), a recommended procedure for non-normal data of ordinal nature (Finney & DiStefano, 2006). Models fit to the data was assessed using several goodness-of-fit indexes. Specifically, the chi-square statistic, the Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA), and the Standardized Root Mean squared Residuals (SRMR) were used. We have employed the cut-off points for adequate fit proposed by Hu and Bentler (1999) who suggested that a CFI of at least 0.95, a RMSEA less than 0.06 and a SRMR less than 0.08 together would indicate a very good fit of the model to the data.

Results

Factorial validity and internal consistency

The a priori three factor structure of the 44-item's version of the ACRA scale was tested. The three factors were: (1) *cognitive strategies and learning control* (items 1–25); (2) *support to learning strategies* (items 26–39); and (3) *study habits* (items 40–44). Model fit of this model was adequate: χ^2 (899) = 2925.38, $p < .001$, RMSEA = .036 [.035, .038], CFI = .911, SRMR = .031. Factor loadings were all statistically significant ($p < .001$) with values ranging from a minimum of .298 to a maximum of .621. Correlations among the factors were also statistically significant ($p < .001$), and relatively large: *cognitive strategies and learning control* correlated .834 with *support to learning strategies*; *support to learning strategies* corre-

lated .806 with *study habits* and *cognitive strategies and learning control* correlated .743 with *study habits*.

Factor structure of the short 17-item's version of the ACRA scale was also tested. The CFA posited three correlated factors: *micro-strategies*, *keys for memory and metacognition*, and *emotional-social support*. Model fit of this model was excellent: χ^2 (116) = 313.47, $p < .001$, RMSEA = .032 [.027, .036], CFI = .962, SRMR = .029. Factor loadings were all statistically significant ($p < .001$) with values ranging from a minimum of .354 to a maximum of .620. Correlations among the factors were also statistically significant ($p < .001$), and relatively large: *micro-strategies* and *keys for memory and metacognition* correlated .787; *keys for memory and metacognition* and *emotional-social support* correlated .747; and *micro-strategies* and *emotional-social support* correlated .604.

Internal consistency estimates for the three factors in the 44-item ACRA were: α = .835, CRI = .850, and ω = .857 *for cognitive strategies and learning control*; α = .806, CRI = .840, and ω = .838 for *support for learning strategies*; and α = .632, CRI = .700, and ω = .694 for *study habits*. Regarding item's internal consistencies, Table 1 shows the corrected item-total correlations of each item in the 44-item ACRA scale. The same internal consistency estimates were calculated for the three factors of the 17-item version of the ACRA scale. The results were: α = .566, CRI = .620, and ω = .616 for *micro-strategies*; α = .547, CRI = .630, and ω = .595 for *keys for memory and metacognition*; and α = .626, CRI = .670, and ω = .677 for *emotional-social support*. Again, Table 1 also offers corrected item-total correlations for these 17 items.

Measurement invariance by gender and age

Measurement invariance by gender and age has been tested. Two age groups were considered for the measurement invariance: early adolescence (10–14 years) and late adolescence (15–20 years). Three nested models (configural, metric, and scalar) were tested for each version of the scale and for gender and age groups, as already mention in the method section. The goodness-of-fit indexes for the four measurement invariance routines are presented in Table 2. In all cases, scalar invariance across gender and age for both versions of the scale and was supported.

Relations of ACRA's dimensions with achievement

In order to test for relations with other variables, a structural equation model in which the three factors for the 44-item version of the scale predicted a factor of *academic achievement*, comprising all grades in the aforementioned subjects, was estimated. This model allows to get parameter estimates for the relations among the three ACRA factors and *achievement* free of error of measurement, a much better estimation than simple zero-order correlations. Model fit the data well: χ^2 (1218) = 3276.70, $p < .001$, RMSEA = .031 [.030, .033], CFI = .926, SRMR = .039. All standardized factor loadings for this model are presented in Table 3. Regarding the relations of the three ACRA factors predicting achievement, they are presented graphically in Figure 1. *Cognitive strategies and learning control* was the only significant predictor of *achievement* (β = .251, $p < .001$).

The same model was specified for the three factors of the 17-item version of the ACRA scale and *academic achievement*. Again model fit the data extremely well: χ^2 (246) = 539.79, $p < .001$, RMSEA = .026 [.023, .029], CFI = .975, SRMR = .029. All standardized factor loadings are presented in Table 3. Regarding the relations between ACRA and *academic achievement*, *emotional-social support* was the only significant predictor (β = .262, $p < .001$) (Figure 2).

Table 1
Mean, standard deviations and item total correlations for the 44-item (r_1) and 17-item versions (r_2) of the ACRA scale

Indicator	M	SD	r_1	r_2	Indicator	M	SD	r_1	r_2	Indicator	M	SD	r_1	r_2
Item 1	2.30	0.97	.32	.27	Item 16	2.68	1.00	.39		Item 31	2.70	1.09	.36	.33
Item 2	2.33	1.06	.31	.32	Item 17	2.67	1.31	.30	.21	Item 32	2.69	1.21	.43	.32
Item 3	2.78	1.14	.32	.26	Item 18	2.73	1.08	.31	.23	Item 33	2.70	1.13	.36	
Item 4	2.36	1.13	.25	.25	Item 19	2.74	1.11	.31		Item 34	2.66	1.07	.39	.38
Item 5	2.56	1.02	.35	.29	Item 20	2.43	1.13	.32		Item 35	2.88	1.03	.43	.39
Item 6	2.82	1.01	.37		Item 21	2.56	1.02	.28		Item 36	3.19	0.99	.40	.33
Item 7	2.56	1.05	.36		Item 22	3.19	1.36	.28		Item 37	2.86	1.01	.39	.35
Item 8	2.50	1.07	.37		Item 23	3.00	1.00	.36		Item 38	2.65	1.03	.35	
Item 9	2.49	1.35	.22		Item 24	2.96	1.02	.32		Item 39	2.95	1.03	.41	
Item 10	2.68	1.10	.35	.25	Item 25	3.15	0.95	.33		Item 40	2.83	1.02	.43	
Item 11	2.67	0.99	.40	.29	Item 26	3.19	1.41	.41		Item 41	2.86	1.02	.45	
Item 12	2.34	1.00	.39	.28	Item 27	3.31	1.07	.38	.21	Item 42	3.11	0.93	.42	
Item 13	2.57	1.03	.35		Item 28	2.95	1.30	.47		Item 43	2.79	1.04	.33	
Item 14	2.81	1.01	.42		Item 29	3.05	1.00	.41		Item 44	2.97	0.97	.35	
Item 15	2.76	0.99	.32		Item 30	2.46	1.08	.30						

Table 2
Set of nested models to test for measurement invariance

Scale	Invariance by	Model	χ^2	df	p	CFI	ΔCFI	SRMR	RMSEA	90% CI
44 items	Gender	Configural	3700.85	1798	<.001	.913	–	.047	.035	.034 - .037
		Metric	3661.19	1839	<.001	.917	.004	.047	.034	.032 - .036
		Scalar	3793.89	1924	<.001	.914	−.003	.048	.034	.032 - .036
	Age	Configural	3679.98	1798	<.001	.914	–	.048	.035	.033 - .037
		Metric	3572.13	1839	<.001	.923	−.009	.049	.032	.031 - .034
		Scalar	3812.29	1924	<.001	.914	.009	.047	.034	.032 - .035
17 items	Gender	Configural	295.73	232	.002	.966	–	.047	.030	.018 - .040
		Metric	331.23	246	<.001	.954	.012	.049	.034	.024 - .043
		Scalar	364.03	277	<.001	.945	.021	.039	.033	.031 - .039
	Age	Configural	561.14	232	<.001	.935	–	.039	.041	.036 - .045
		Metric	555.04	246	<.001	.939	−.004	.040	.038	.036 - .043
		Scalar	598.85	277	<.001	.937	−.002	.041	.037	.033 - .041

Note. df, degrees of freedom; Δ, differences.

Table 3
Standardized factor loadings for the 44 items (λ_1) and the 17 items (λ_2) versions of the ACRA scale and the grades

Indicator	λ_1	λ_2	Indicator	λ_1	λ_2	Indicator	λ_1	λ_2	Indicator	λ_1	λ_2
Item 1	.36	.45	Item 14	.50		Item 27	.62	.62	Item 40	.61	
Item 2	.39	.49	Item 15	.43		Item 28	.59		Item 41	.59	
Item 3	.44	.54	Item 16	.46		Item 29	.59		Item 42	.62	
Item 4	.29	.38	Item 17	.36	.34	Item 30	.37		Item 43	.44	
Item 5	.45	.57	Item 18	.41	.40	Item 31	.46	.46	Item 44	.51	
Item 6	.45		Item 19	.44		Item 32	.44	.43	Maths	.62	.63
Item 7	.43		Item 20	.41		Item 33	.47		Spanish	.74	.74
Item 8	.46		Item 21	.34		Item 34	.50	.51	English	.66	
Item 9	.34		Item 22	.54		Item 35	.53	.52	Social Sciences	.73	.74
Item 10	.41	.43	Item 23	.53		Item 36	.58	.59	Natural Sciences	.63	.63
Item 11	.48	.52	Item 24	.47		Item 37	.47	.51	Arts	.59	.59
Item 12	.45	.50	Item 25	.55		Item 38	.48		Physical Education	.48	.47
Item 13	.46		Item 26	.60		Item 39	.51				

Multigroup relations among ACRA's dimensions and achievement

The analyzed effects of the different dimensions of the two versions of the ACRA on achievement can be further studied for potential moderator effects of age or gender. In order to do that four multigroup routines have been estimated. First, the model for the three-factor model for the 44-item version explains achievement in boys and girls. Three models are estimated in this case: (1) configural, with same relationships for boys and girls but freely estimated in each group; (2) equal factor loadings, with factor loadings set to equality across gender (this is needed if moderator effects have to be tested); and, (3) equal factor loadings plus structural coefficients. If in the last step of the routine worsen the fit, this gives support to the moderator effects. This three-steps multigroup routine is then repeated for the 44-item version of the ACRA by age, and twice more

(gender and age) for the 17-item version of the scale. Goodness-of-fit indexes for these four multigroup routines are presented in Table 4. Results are quite clear. There is no evidence whatsoever of moderator effects neither for age nor for gender in the two versions of the ACRA scale.

Discussion

The aim of this study was to validate and compare the widely used 44-item version and the new shortened 17-item version of the ACRA in order to provide evidence about their reliability and validity in a sample of Dominican Republic. This general aim was materialized in five specific aims, which will guide the discussion of our results. Regarding the first aim, "to test the factorial validity of the 44- and the 17-item versions of the ACRA", we estimated

Table 4
Set of nested models to test for multigroup invariance of relationships

Scale	Invariance by	Model	χ^2	df	p	CFI	ΔCFI	SRMR	RMSEA	90% CI
44 items	Gender	Configural	4518.98	2527	<.001	.923	–	.046	.030	.029 - .032
		Equal loadings	4518.98	2574	<.001	.926	−.003	.031	.030	.028 - .031
		Equal loadings and effects	4406.14	2577	<.001	.930	−.007	.046	.029	.027 - .030
	Age	Configural	4514.10	2527	<.001	.922	–	.045	.030	.029 - .031
		Equal loadings	4547.80	2574	<.001	.923	−.001	.046	.030	.029 - .031
		Equal loadings and effects	4490.44	2577	<.001	.925	−.003	.046	.029	.028 - .031
17 items	Gender	Configural	963.25	529	<.001	.960	–	.038	.031	.028 - .034
		Equal loadings	968.16	549	<.001	.962	−.002	.039	.030	.028 - .033
		Equal loadings and effects	957.75	552	<.001	.963	−.001	.039	.029	.026 - .032
	Age	Configural	936.81	529	<.001	.961	–	.037	.030	.027 - .033
		Equal loadings	976.53	549	<.001	.959	.002	.039	.030	.029 - .033
		Equal loadings and effects	952.46	552	<.001	.961	−.002	.039	.029	.026 - .032

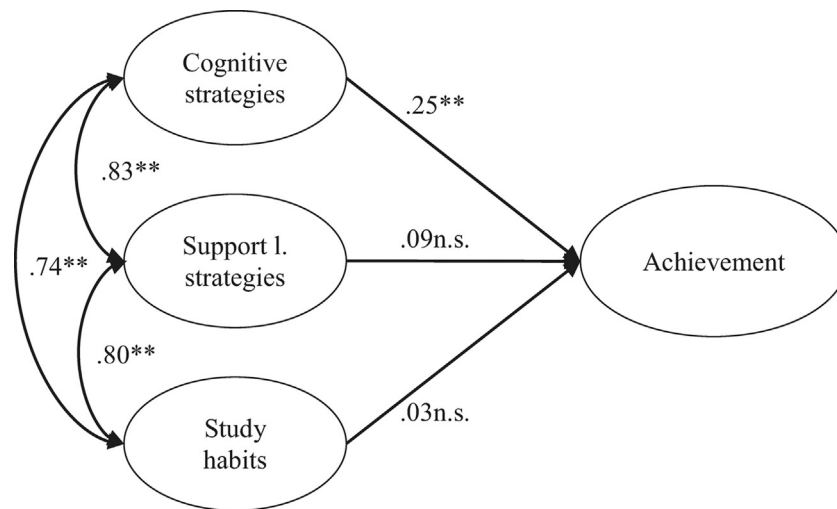Note. df; degrees of freedom; Δ, differences.

Figure 1. Model with the 44item ACRA version and achievement.
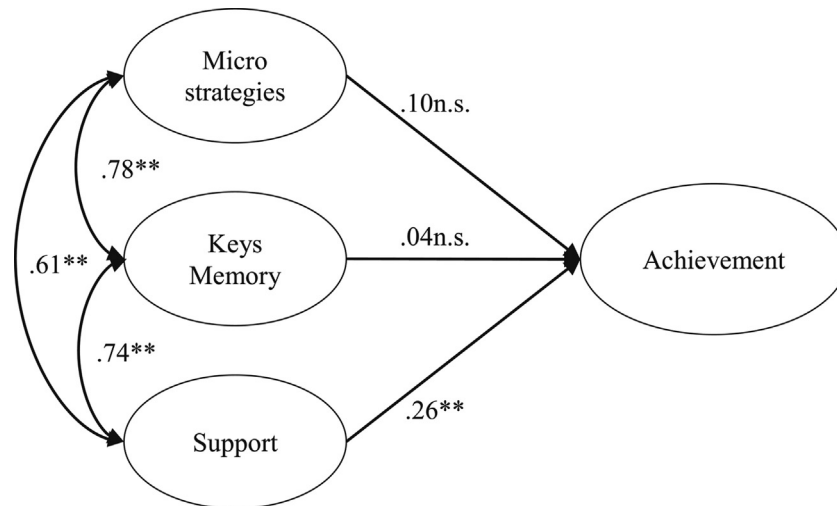

Figure 2. Model with the 17-item ACRA version and achievement.

the factor structures of both scales based on previous literature. They both had a good fit and significant correlations among their factors. We could say, then, evidence supported hypothesis 1: "both versions will offer evidence of factorial validity".

Regarding aim number two, "to test the reliability of the 44- and the 17-item versions of the ACRA", Cronbach's alpha, Composite Reliability Index (CRI), and omegas were estimated. When estimates were compared, the longer version of the ACRA showed better internal consistency indices than the 17-item version. Thus, hypothesis 2 was, "both versions will offer evidence of internal consistency", was only supported for the 44-item version of the ACRA (De la Fuente & Justicia, 2003).

For our third aim, "to test the measurement invariance across gender and age of the 44- and the 17-item versions of the ACRA", we conducted several measurement invariance routines. Gender invariance was confirmed, which was in turn congruent with the results of Jiménez et al. (2018), however, to our concern age groups invariance has not been previously tested on this scale. When latent means were compared, and in order to achieve aim number four, "to test gender and age differences in learning strategies, as measured with the 44- and the 17-item versions of the ACRA", no latent differences were found. This is in line with previous studies, which pointed no gender differences in learning strategies (Mashhady

& Fallah, 2014). Although Jiménez et al. (2018) did found such differences, our results in the Dominican Republic agree with international literature, and may be Jiménez et al. (2018) are due to the Spanish context.

Finally, we tested two predictive models to achieve our fifth aim: "To test the power of the 44- and the 17-item versions of the ACRA to predict academic achievement". When it came to the relation between LS and *academic achievement*, both versions of the ACRA scale predicted *achievement*, measured by the grades in different subjects (Mathematics, Spanish, English, Social Sciences, Natural Sciences, Arts, and Physical Education). In the case of the 44-item version, only *cognitive strategies and learning control* showed a statistically significant relation with *academic achievement*. In the case of the 17-item ACRA, *emotional-social support strategies* were the only with a statistically significant effect, with an almost identical effect size. It is worth noting that *cognitive strategies and learning control* only predicted *academic achievement* when measured with the 44-item version, when the fact is that this relation has been clearly stated in recent research. For example, Manganelli et al. (2019) found evidence of the relation between cognitive strategies, specifically critical thinking, and academic achievement. In the 17-item ACRA presented by Jiménez et al. (2018), factor 1 is divided into two different constructs or factors: *micro-strategies* (with 5

items from the original cognitive strategies) and *key for memory and metacognition* (with 5 items from cognitive strategies and 1 from support to learning strategies). These two factors, together with lower levels of reliability, as stated some lines before, have less predictive power when it comes to *academic achievement*, compared to the original factor of *cognitive strategies and learning control*. If we look closer to the *micro-strategies* factor defined by Jiménez et al. (2018), some important, traditional items representing *cognitive strategies and learning control* have been removed, including highlighting (i.e., items 7 and 9). This also has happened in the new factor *of keys for memory and metacognition*, in which some items regarding organization and elaboration of the materials (i.e., items 13 and 16), and inferential or generalization processes (i.e., items 17, 19, or 20) have not been retained. Thus, it seems that the 44-item version should be preferred when our goal is to evaluate these kinds of strategies, for two major reasons: better reliability estimates and higher predictive power.

As regards the role of *emotional and social support strategies* found for the 17-item version, these constructs and their relation to *academic success* has also been pointed in the literature. For example, Fernández-Lasarte et al. (2019) have offered evidence of the relation between social support, emotional intelligence, and academic achievement. The question here is whether these variables can be assimilated to emotional and social support learning strategies. Out of the 5 items retained for *the emotional and social support strategies* by Jiménez et al. (2018), two of them seem not directly related to learning strategies but to coping and social support (item and item 37). Three of them, however, do address processes and action plans with the objective of fulfilling intellectual tasks, as learning strategies do (Valle et al., 1999): item 31, item 32, and item 35. Despite these differences in meaning, descriptive statistics of these five items are similar both in mean and variability. Indeed, factor loadings are also very similar. All together, they do seem to adequate capture these support strategies. Taking into account that results of this study point better predictive power across gender and age for the support strategies factor defined by Jiménez et al. (2018), we could argue that, when our aim is to predict *academic achievement*, this shorter version of the factor would be preferred, as it will also allow us to save some time in the test administration. This would be, however, at the cost of lower reliability estimates.

Finally, the dimension of *study habits*, only assessed by the 44-item version of the ACRA, has shown no relation to *academic achievement*, according to our results. Taking into account that some traditional works have already pointed out the difference between LS and study habits (Christensen et al., 1991), when using the scale with the aim to predict or improve *academic achievement*, these items could be avoided. Therefore, hypothesis number five, "both versions will predict academic achievement", is partially supported by the data: whereas in both the 44- and the 17-item versions some dimensions predicted academic achievement, some others did not show statistically significant relations. In fact, the factors or constructs that predicted achievement were different across versions.

In conclusion, there are some key notes we could point: First, considering our reliability results, we believe the 17-item version of the ACRA is not an adequate instrument to assess LS in the Dominican Republic, whereas the 44-item version is. Second, when our aim is to predict *academic achievement*, the reformulation of the original, 44-item version dimension of *cognitive strategies and learning control* into two different, shorter factors, *micro-strategies*, and *keys for memory and metacognition*, does not seem a good idea. Together with lower estimates of reliability, the two factors postulated by Jiménez et al. (2018) are not able to predict *academic achievement*, whereas the original one is (De la Fuente & Justicia, 2003). However, the dimension of *support* formulated by Jiménez et al. (2018) is, not only shorter, but better predictor of achievement. Consequently, we

could advocate for a mixed version of the ACRA, which will include the original *cognitive strategies and learning control dimension*, the five-item *emotional-social support* dimension proposed by Jiménez et al. (2018), and the exclusion of the five items corresponding to the *study habits* factor.

As pointed by Stanton et al. (2002), when reducing the length of scales, there are three categories to take into account for evaluating items: internal qualities (reliability, factorial loadings, etc.), external qualities (relations with other variables), and judgmental qualities (those that require subjective judgment, including criteria beyond statistical relations). Jiménez et al. (2018) based the development of the ACRA-C only in the internal qualities (although once developed also tested the external ones). As already Nunnally (1978) stated, just because items load on the same factor does not mean they measure the same thing. This could be the reason once the 17-item version is tested in new data, in this case coming from Dominican Republic, reliability estimates are poor, and traditional cognitive-related learning strategies are not related with *academic achievement*.

Finally, addressing the question weather these two scales measure the same construct or they are different, based on their relations with external variables, we can conclude there is not enough evidence to assume they measure they same construct, although they overlap in some parts.

This study has some limitations. For instance, as the research had a cross-sectional design, we have not been able to test the longitudinal invariance of the ACRA, nor the 44-item neither the 17-item version. Further studies could test it, therefore offering evidence of the adequacy of the instrument to assess changes in learning strategies along time. Also, future research could offer evidence of a mixed version of the ACRA, including the original dimension of *cognitive strategies and learning control* from the 44-item scale (De la Fuente & Justicia, 2003) and the shorter dimension of *emotional and social support* posed by Jiménez et al. (2018), both in the Dominican Republic and other Spanish-speaking countries, so that to assess the appropriateness of its psychometric properties.

Acknowledgments

References

Abad, D., Díaz, P., & Giraldo, U. (2002). *Bases para una política de calidad de la educación superior en Colombia* Retrieved February 26, 2020, from. https://www.cna.gov.co/1741/articles186502_doc_academico10.pdf

Acción Empresarial para la Educación, EDUCA. (2015). *Informe de progreso educativo.* EDUCA.

Ambreen, M., Haqdad, A., & Saleem, W. A. (2016). Fostering self-regulated learning through distance education: A case study of M.pHil secondary teacher education program of Allama Iqbal open university. *Turkish Online Journal of Distance Education*, 17(3), 120–135. http://dx.doi.org/10.17718/tojde.89562

Añez, M. (2016). Relación entre las estrategias de aprendizaje y el rendimiento académico en estudiantes de educación básica primaria. *Revista Encuentros, 13*, 87–101. http://dx.doi.org/10.15665/re.v14i1.671

Ángel-González, M., Pedroza-Cabrera, F. J., Colunga-Rodríguez, C., Vázquez-Colunga, J. C., Vázquez-Juárez, C. L., Orozco-Solis, M. G., et al. (2017). School wellbeing, learning strategies and expected learning in college students. *Open Access Library Journal, 4*, e3362. http://dx.doi.org/10.4236/oalib.1103362

Bahamón, M. J., Vianchá, M. A., Alarcón, L. L., & Bohórquez, C. I. (2012). *Estilos y estrategias de aprendizaje: una revisión empírica y conceptual de los últimos diez años. Pensamiento Psicológico, 10*, 129–144.

Bustos, V., Oliver, A., Galiana, L., & Sancho, P. (2017). Propiedades psicométricas del CEVEAPEU: Validación en población peruana. *Educación XX1*, *20*, 299–318. http://dx.doi.org/10.5944/educxx1.17513

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling A Multidisciplinary Journal*, *9*, 233–255. http://dx.doi.org/10.1207/S15328007SEM0902_5

Christensen, C. A., Massey, D. R., & Isaacs, P. J. (1991). Cognitive strategies and study habits: An analysis of the measurement of tertiary students' learning. *The British Journal of Educational Psychology*, *61*(3), 290–299. http://dx.doi.org/10.1111/j.2044-8279.1991.tb00986.x

Da Cuña, I., Soto, M., Lantarón, E. M., & Labajos, M. T. (2014). Influencia del género en los estilos y estrategias de aprendizaje en estudiantes de fisioterapia. *Revista de Estilos de Aprendizaje*, *7*(14), 150–177. http://dx.doi.org/10.14201/gredos.139779

De la Fuente, J., & Justicia, F. (2003). Escala de estrategias de aprendizaje ACRA abreviada para alumnos universitarios. *Revista Electrónica de Investigación Psicoeducativa y Psicopedagógica*, *1*, 139–158. http://dx.doi.org/10.25115/ejrep.2.114

Ergen, B., & Kanadli, S. (2017). The effect of self-regulated learning strategies on academic achievement: A meta-analysis study. *Eurasian Journal of Educational Research*, *69*, 55–74. http://dx.doi.org/10.14689/ejer.2017.69.4

Fernández-Lasarte, O., Ramos-Díaz, E., Goñi, E., & Rodríguez-Fernández, A. (2019). Estudio comparativo entre educación superior y educación secundaria: efecto del apoyo social percibido, el autoconcepto y la reparación emocional en el rendimiento académico. *Educación XX1*, *22*(2), 165–185. http://dx.doi.org/10.5944/educxx1.22526

Finney, S. J., & DiStefano, C. (2006). Nonnormal and categorical data in structural equation modeling. In G. R. Hancock, & R. O. Mueller (Eds.), *Structural equation modeling: A second course* (pp. 269–313). IAP Information Age Publishing.

Guapacha, M. E., & Benavidez, L. H. (2017). Improving language learning strategies and performance of pre-service language teachers through a CALLA-tblt model. *Profile Issues in Teachers Professional Development*, *19*, 101–120. http://dx.doi.org/10.15446/profile.v19n2.57581

Gutiérrez-Braojos, C., Salmerón-Vilchez, P., Martín-Romera, A., & Salmerón, H. (2013). Efectos directos e indirectos entre estilos de pensamiento, estrategias metacognitivas y creatividad en estudiantes universitarios. *Anales de Psicología*, *29*, 159–170. http://dx.doi.org/10.6018/analesps.29.1.124651

Hu, L., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55. http://dx.doi.org/10.1080/10705519909540118

Iniciativa Dominicana por una Educación de Calidad, IDEC. (2014). *Informe anual de seguimiento y monitoreo*. Dominicana por una Educación de Calidad (IDEC).

Jiménez, L., García, A. J., López-Cepero, J., & Saavedra, F. J. (2018). The brief-ACRA scale on learning strategies for university students. *Revista de Psicodidáctica*, *23*, 63–69. http://dx.doi.org/10.1016/j.psicoe.2017.03.001

Juárez-Lugo, C. S., Pichardo-Silva, K., & Rodríguez-Hernández, G. (2015). Características psicométricas de la Escala ACRA en población universitaria mexicana. *Revista de Educación y Desarrollo*, *34*, 15–24.

Little, T. D. (1997). Mean and covariance structures (MACS) analyses of cross-cultural data: Practical and theoretical issues. *Multivariate Behavioral Research*, *32*, 52–76. https://doi.org/10.1207/s15327906mbr3201_3

López-Aguado, M. (2010). Diseño y análisis del Cuestionario de Estrategias de Trabajo Autónomo (CETA) para estudiantes universitarios. *Revista de Psicodidáctica*, *5*, 77–99.

Mall-Amiri, B., & Fekrazad, S. A. (2015). The relationship among Iranian EFL learners' creativity, emotional intelligence, and language learning strategies. *Theory and Practice in Language Studies*, *5*(9), 1863–1873. http://dx.doi.org/10.17507/tpls.0509.14

Manganelli, S., Cavicchiolo, E., Mallia, L., Biasi, V., Lucidi, F., & Alivernini, F. (2019). The interplay between self-determined motivation, self-regulated cognitive strategies, and prior achievement in predicting academic performance. *Educational Psychology*, *39*(4), 470–488. http://dx.doi.org/10.1080/01443410.2019.1572104

Mashhady, H., & Fallah, N. (2014). The relationship between language learning strategies, field of study, gender, and language proficiency. *Research in English Language Pedagogy*, *2*, 46–61.

Monereo, C., Pozo, J. I., & Castelló, M. (2001). La enseñanza de estrategias de aprendizaje en el contexto escolar. In C. Coll, J. Palacios, & A. Marchesi (Eds.), *Psicología de la educación escolar* (pp. 235–258). Alianza Editorial.

Muthén, L. K., & Muthén, B. O. (2011). *Mplus user's Guide* (sixth edition). Muthén & Muthén.

Navarro, I., González, C., & Real, M. (2018). Relación entre técnicas de estudio, rendimiento académico y género. *Revista de Investigación Educativa Universitaria*, *1*(1), 1–12.

Nosratinia, M., Saveiy, M., & Zaker, A. (2014). EFL learners' self-efficacy, metacognitive awareness, and use of language learning strategies: How are they associated? *Theory and Practice in Language Studies*, *4*, 1080–1092. http://dx.doi.org/10.4304/tpls.4.5.1080-1092

Nunnally, J. C. (1978). *Psychomtietric theory*. McGraw-Hill.

OECD. (2019). *PISA 2018 results (Volume I): What students know and can do*. PISA. OECD Publishing.

Olivares, S. L., & Heredia, Y. (2012). Desarrollo del pensamiento crítico en ambientes de aprendizaje basado en problemas en estudiantes de educación superior. *Revista Mexicana de Investigación Educativa*, *17*, 759–778. http://dx.doi.org/10.22201/iisue.20072872e.2017.23.3012

Román, J. M., & Gallego, S. (1994). *Escala de estrategias de aprendizaje*. TEA.

Stanton, J. M., Sinar, E. F., Balzer, W. K., & Smith, P. C. (2002). Issues and strategies for reducing the length of self-report scales. *Personnel Psychology*, *55*(1), 167–194. http://dx.doi.org/10.1111/j.1744-6570.2002.tb00108.x

Fondo de las Naciones Unidas para la Infancia, UNICEF. (2017). *Niños y Niñas fuera de la Escuela en la República Dominicana*. Santo Domingo: UNICEF República Dominicana.

Valle, A., Barca, A., González, R., & Núñez, J. (1999). Las estrategias de aprendizaje. Revisión teórica y conceptual. *Revista Latinoamericana de Psicología*, *31*(3), 425–461.

van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *The European Journal of Developmental Psychology*, *9*, 486–492. http://dx.doi.org/10.1080/17405629.2012.686740

Vega-Hernández, M. C., Patino-Alonso, M. C., Cabello, R., Galindo-Villardón, M. P., & Fernández-Berrocal, P. (2017). Perceived emotional intelligence and learning strategies in Spanish university students: A new perspective from a canonical non-symmetrical correspondence analysis. *Frontiers in Psychology*, *8*, 1–10. http://dx.doi.org/10.3389/fpsyg.2017.01888