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RESEARCH ARTICLE

Psychometric Analysis of the Self-Efficacy Inventory for Multiple Intelligences-Revised (SIMI-R) in Peruvian High School Students

Análisis psicométrico del Inventario de Autoeficacia para las Inteligencias Múltiples-Revisado (IAMI-R) en estudiantes peruanos de nivel secundario

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Summary

The objective of this instrumental study (Ato, López & Benavente, 2013) or psychometric-type (Alarcón, 2008) was to estimate the validity and reliability of the Self-Efficacy Inventory for Multiple Intelligences-Revised (IAMI-R, Pérez & Cupani, 2008) in Peruvian students of fifth year of high school. We worked with a sample of 1304 adolescents, with an average age of 16.81, divided into two groups of 652. Reliability was calculated with the *Ordinal Alpha* (Contreras & Novoa-Muñoz, 2018) and with the *McDonald's Omega coefficient*, obtaining appropriate values. The Exploratory Factor Analysis (AFE) confirms the eight factors of the original version that explain 70% of the variability of the scores. With the confirmatory factorial analysis (CFA), adjustment indices were obtained confirming this factorial structure: SSχ2 = 1857.73, gl = 1047, SSχ2 / gl = 1.77, RMSEA = .035, SRMR = .049, CFI = .915 , and TLI = .908. The results confirm that the IAMI-R is adequate to evaluate self-efficacy associated with multiple intelligences in Peruvian students who complete high school.

Keywords: Self-efficacy for multiple intelligences, psychometric analysis, Peruvian students.

Resumen

El presente estudio instrumental (Ato, López y Benavente, 2013) o de tipo psicométrico (Alarcón, 2008) planteó como objetivo estimar la validez y fiabilidad del Inventario de Autoeficacia para las Inteligencias Múltiples-Revisado (IAMI-R, Pérez y Cupani, 2008) en estudiantes peruanos de quinto de secundaria. Se trabajó con una muestra de 1304 adolescentes, edad promedio 16.81, dividida en dos grupos de 652. La confiabilidad se calculó con el *Alfa ordinal* (Contreras & Novoa-Muñoz, 2018) y con el coeficiente *Omega de McDonald*, obteniéndose valores apropiados. El Análisis Factorial Exploratorio (AFE) confirma los ocho factores de la versión original que explican el 70% de la variabilidad de las puntuaciones. Con el análisis factorial confirmatorio (AFC) se obtuvieron índices de ajuste que confirman esta estructura factorial: $SS\chi 2 = 1857.73$, $gl = 1047$, $SS\chi 2 / gl = 1.77$, RMSEA = .035, SRMR = .049, CFI = .915 y TLI = .908. Los resultados confirman que el IAMI-R es adecuado para evaluar autoeficacia asociada a inteligencias múltiples en estudiantes peruanos que culminan la secundaria.

Palabras Clave: Autoeficacia para inteligencias múltiples, análisis psicométrico, estudiantes peruanos.

Introduction

The social context in which a person interacts has a very important role in what this person learns. Bandura (1977a), based on certain aspects of classical and operant conditioning, but disagreeing with these traditional models, introduces the notion of cognitive processes, which mediate between stimulus and response, and which are internal and private. At the same time, he affirms that much of what people learn is through observation, that observers do not develop learned behaviors at the same time they learn, and that reinforcement was not essential for learning to take place (Schunk, 2012). Key concepts of this theoretical model are imitation, identification, modeling, and vicarious learning, which explain the acquisition of different types of behaviors, skills, beliefs, and strategies. Later, he identifies other concepts that were key to his theoretical model, such as self-sufficiency, self-efficacy, self-confidence, and self-instruction as determining factors for regulation and success of goal-directed behavior (Bandura, 1977b, 1986, 1995, 1997), and that are the core elements of his theory. From these, other concepts such as self-organization, self-regulation, self-reflection, personal, environmental, and behavioral determinants, and reciprocal determinism begin to participate, shaping the theory towards a definitive cognitive vision of learning.

Self-efficacy is one of the main concepts of Bandura's theory (1986). He maintains that it is "people's judgments of their capabilities to organize and execute courses of action required to achieve given levels of performance" (p. 386). According to Bandura, people's level of motivation, affective states, and actions are based more on what they believe they can do than on what they can really do, taking into account objective criteria. A person's beliefs about what he or she is capable of doing provide the basis for self-efficacy (Alegre, 2014; Bandura, 1977b, 1995, 1997). Thus, a kind of rule can be sustained: a person with poor judgment of his or her own capabilities will shy away from problem-situations, develop avoidance behaviors, or fail to face the difficulties and adversities that are presented as an obstacle

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to fulfill his or her life objectives, and get discouraged. Conversely, if the person has positive beliefs that he or she can face the problem and solve it, this condition will facilitate direct confrontation and more opportunities to solve the problem (Alegre, 2014; Lazarus & Folkman, 1986; Piergiovanni & Depaula, 2018; among others).

However, not everything is belief and high expectation by the individual, self-efficacy is a key belief with the capacity to condition and activate various cognitive, motivational, affective and selective processes (Covarrubias & Mendoza, 2013). But, the satisfactory performance of an activity in a specific situation or task requires a balance between self-efficacy and the possession of the abilities and skills to perform it (Gálvez, Chía & Valdez, 2005; Naranjo, 2009), in addition to the judgment of the most likely consequence a determined behavior will produce (Olaz, 2001).

Likewise, Bandura (1997) explains that people can control many events that he considers important through *self-regulation*, which is applicable to both thoughts and actions. Self-regulation entails setting goals and anticipating by calculation the future outcomes of their actions. Bandura (1986) maintained, "People do not act only to adjust to others' preferences. Much of their behavior is motivated and regulated by internal standards and responses of self-assessment of their own actions" (p. 20).

Furthermore, in 1983 Gardner published *Frames of Mind: The theory of multiple intelligences*, and postulated that the human being has evolved to show not only a flexible form of intelligence but a varied range of different intelligences. Gardner (2006) maintains that intelligence is a "computational capacity - a capacity to process certain kind of information – that originates in human biology and psychology" (p. 6), which is the result of the interaction between biological and environmental factors that depend in some way on the context (cultural factors, psycho-social factors, material resources). These capacities are evidenced in problem-solving or the invention of products typified as valuable in one or more cultural environments or particular community (Gardner, 1983, 2006). From this definition, it can be

inferred that it is possible to develop intelligence, a quality that is linked to the fact that multiple intelligences are autonomous, but, at the same time, when intelligent behavior is developed it requires the interaction of two or more of them (Nadal, 2015).

These proposals by Gardner were and still are innovative in the educational field, where they have received the greatest attention and interest because they provide a different theoretical framework to understand the fulfillment of the student's purposes and goals (Durán-Aponte, Elvira-Valdés & Pujol, 2015), since they present a characteristic profile of different intelligences that can be reinforced with the performance of competent teachers, who will be able to optimize those high-level intelligences and compensate the low-level ones (Pérez & Beltrán, 2006). A key point in the theory is that "most people can develop all their intelligences until they achieve an acceptable mastery of them" (Armstrong, 2006, p.44).

In Gardner's Theory, the mind is organized in such a way that eight intelligences or mental structures can be distinguished: linguistic, logical-mathematical, spatial, musical, bodily-cenesthetic, naturalistic, intrapersonal and interpersonal. The first three ones are also called academic intelligences, and the last two others are called personal intelligences (Gardner, 1999). The proposal of multiple intelligences is based on a set of varied information with factual support of neurological (observations of patients with brain disorders), evolutionist (exceptional children with mental retardation or preservation of some ability, or children and adults with special talents) and transcultural types. Although with little affection for psychometric measurement, Gardner supported the work done by Shearer (1995) who constructed and validated the MIDAS Questionnaire aimed at measuring multiple intelligences. In Peru, the Multiple Intelligences Questionnaire [CUIM] was developed, validated by Aliaga et al. (2012).

Although the Self-Efficacy and Multiple Intelligences Theories were developed for different purposes, they share two common aspects; on the one hand, they both are present in the broad field of cognitivism, and on the

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other, they enjoy empirical support since their deductions have been tested in different fields of psychology, especially in educational psychology. In this field and closely linked to vocational guidance, Pérez, Beltramino, and Cupani (2003) created the Multiple Intelligences Self-Efficacy Inventory (IAMI) composed of 69 items. The study was carried out using a sample of adolescents from senior secondary education in Córdova (Argentina). Pérez and Medrano (2007) then validated the criteria for this instrument and one year later, Pérez and Cupani (2008) published a revised version of the instrument (IAMI-R) to be used for vocational guidance purposes.

IAMI-R has been studied in relation to other variables of the academic world. Arias-Gómez and Durán-Aponte (2017) studied, using Venezuelan university freshmen and sophomores, the academic persistence in relation to the factors prior to university admission, motivational factors and institutional experiences. They found that these factors together explain 56% of the variable studied. Coballes (2015) related self-concept to physical activity, body image and multiple intelligences. Using the IAMI-R, they found statistically significant correlations between the mentioned variables. Zalazar, Aparicio, Ramírez and Garrido (2011), using Argentine students, related one of the IAMI-R scales (logical-mathematical self-efficacy) to a scale of sources of logical-mathematical self-efficacy and another of math outcome expectations. They conclude that these variables show statistically significant correlations. Likewise, Cupani (2010) used one of the IAMI scales (logical-mathematical) as a predictive validity criterion of a scale of math outcome expectations, finding acceptable psychometric properties. Pérez and Medrano (2007) searched for evidence of the IAMI-R criterion validity using the Career Choice Intentions Questionnaire (CIEC). Their conclusions support that IAMI-R is an adequate instrument for vocational guidance. Pérez, Cupani and Ayllón (2005) studied the role of aptitudes, self-efficacy beliefs and academic performance prediction in academic success. Their findings confirm the value of this prediction.

Psychometric studies have also been developed. Among others, Acosta and Sánchez (2015) analyzed the psychometric properties of IAMI-R using a group of Colombian secondary students, and confirmed its structure of eight factors. They removed an item from the self-efficacy scale for interpersonal intelligence. By using the Cronbach's alpha coefficient, they found values similar to the ones showed in the original work. Thus, they indicate that it is a reliable instrument. Durán-Aponte, Elvira-Valdés and Pujol (2014) carried out a psychometric study and validated the IAMI-R using Venezuelan university freshmen. By using a CFA, they found a structure of 7 factors. In this work, the authors merged the interpersonal and intrapersonal factors in a single one, which they called emotional self-efficacy. With respect to reliability, by using *Cronbach's alpha*, they report values similar to those reported by Perez and Cupani (2008). Heredia, Pérez, Lescano and Zalazar (2010) developed the IAMI-N aimed at identifying children's talents and diagnose their learning profiles.

Currently, it is considered that any instrument validation process must include the construct validation. There are five sources of evidence of validity, including the internal structure of the test (*American Educational Research Association* [AERA], *American Psychological Association* [APA], and *National Council on Measurement in Education* [NCME], 2014). The way to obtain this evidence is to use factor analysis models, including the latent trait model that includes other models such as the common factor model, and the parametric and nonparametric item response models. In this context, the purpose of this study is to validate the IAMI-R in a Peruvian population of secondary education students, according to the procedures followed by Pérez and Cupani (2008), authors of the inventory.

The interest in conducting this research is justified by the quality of development of the IAMI-R and Bandura's proposal (2001) to develop self-efficacy scales. Duran-Aponte et al. (2014) state that it is a well-developed instrument, with items adequately written in the present tense, with emphasis on what the subject can do in specific situations, and which content represents

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different degrees of challenge or impediment to good performance, and that it differs from other self-efficacy assessment instruments. Likewise, the effort is justified because it can make a contribution to the Peruvian psychology, especially the one devoted to education and vocational guidance specifically. Likewise, the original study must be replicated to prove its value in terms of the generalization that can be given to an instrument that was developed according to the parameters of the Classical Theory of Tests (TCT), which has some weak points such as the absence of invariance of the properties of the items and of the test of the samples of the subjects in which it is estimated (Hambleton & Van del Liden, 1982).

Method

Participants

The sample consisted of 1304 participants, who were students from 14 educational institutions in the Lima Metropolitan region, and were in the fifth year of Secondary School of Regular Basic Education, aged between 15 and 19, with an average of 16.92 years old. Forty four percent of the sample were men, and 60% were from public educational institutions. It is a non-probability sample, which was composed for convenience, for the facilities and permits granted by the educational institutions to apply the instrument. It was divided into two samples of the same size (n=652) to apply the Exploratory Factor Analysis [EFA] in one sample and the Confirmatory Factorial Analysis [CFA] in the other.

Instrument

The Revised Multiple Intelligences Self-Efficacy Inventory (IAMI-R) was published by Pérez and Cupani (2008). It is a new version of IAMI (Pérez et al., 2003), which was developed by Pérez (2001) to be used in the vocational guidance of senior high school adolescents. The instrument aims to assess self-efficacy or self-confidence in developing academic activities associated

with multiple intelligences. Previously, Pérez and Medrano (2007) studied the criterion validity of this questionnaire.

Pérez and Cupani (2008) worked with 790 students from Cordova from the last year of middle school. Fifty nine point one percent were women, with an average age of 17.31. They were administered a version with 64 items. The sample was divided into two groups of 395 students each. Each group was applied an EFA, Maximum Likelihood Method, with Promax oblique rotation. Eight factors were identified by using the Kayer-Guttman rule and Scree Plot Test, which allowed to explain 57.50% of the variance. The final inventory has 48 items that are distributed according to their content and psychometric performance. Each factor has six identified items that matched to the eight intelligences proposed by Gardner and that were validated by judges (Pérez & Medrano, 2007). The results of the other sample were analyzed through the CFA, Maximum Likelihood Method. It was observed that the eight-factor model had an acceptable fit, but not optimal. Consequently, the authors deemed convenient to recommend carrying out other similar studies with different samples (Pérez & Cupani, 2008). Additionally, the values of the *Cronbach's alpha* coefficient indicate satisfactory reliability.

Linguistic Self-Efficacy. The belief related to spoken and written language skills, language learning and the use of language to achieve certain goals. Items 1 through 6 (α =.76).

Logical-Mathematical Self-Efficacy. The belief that includes logical problem analysis, numerical calculation, and scientific research skills. Items 7 through 12 (α =.89).

Spatial Self-Efficacy. The belief in the ability to recognize and manipulate broad and specific response patterns. Items 13 through 18 (α =.87).

Musical Self-Efficacy. The belief that includes the skills to successfully perform, compose, and appreciate musical patterns. Items 19 through 24 (α =.92).

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Interpersonal Self-Efficacy. The belief of possessing abilities to understand the personality of other human beings and to work effectively with them. Items 25 through 30 (α =.79).

Cenesthetic-Bodily Self-Efficacy. The belief related to skills to use one's own body or part of it to solve problems or create products, specifically those related to sports. Items 31 to 36 (α =.86).

Intrapersonal Self-Efficacy. The belief in understanding one's own reasons, feelings, and abilities. Items 37 to 42 (α =.79).

Naturalistic Self-Efficacy. The belief related to competences for the recognition and classification of objects of the natural world in their environment. Items 43 to 48 (α =.91).

Procedure

With the authorization of the educational institutions to administer the instrument, we coordinated with the classroom teachers and the parents' committees of the classrooms deemed available. Likewise, the students were informed of the purpose of the study, and all the aforementioned consents were obtained through informed consent forms. Then, the team in charge of applying the instrument (psychology senior students) supervised by the researchers and authors of the study collectively administered the IAMI-R in the classrooms in good conditions in terms of comfort.

The information generated was entered into a database using a Microsoft Office Excel spreadsheet. The suitability of the database was then checked, and incomplete information, missing values and/or out-of-range values (12 cases) were detected. Additionally, univariate (14 cases) and multivariate (31 cases) outliers were identified and removed, according to the Mahalanobis

distance criterion with p cut-off point ≤ .001 for chi-square (Tabachnick & Fidell, 2001).

Data Analysis

The psychometric analysis was carried out with the free *software* R, version 3.5.0 (R *Core Team*, 2018) supported by the specialized packages Psych (Revelle, 2018) to obtain the descriptive statistics of the items, multivariate outliers and EFA, Lavaan (Rosseel, 2012) for the CFA, and SemTools (semTools Contributors, 2016) to analyze the reliability from the CFA modeling.

The items were descriptively analyzed by calculating the mean, standard deviation, asymmetry and kurtosis values. The asymmetry and kurtosis values were assessed to determine whether they fit a normal distribution, using as criterion that their results lie between 0 and 1.50 in absolute value (Tabahnick & Fidell, 2001). In order to provide evidence of validity based on the internal structure of the test by factor analysis, two sub-samples were generated by dividing the database through random sampling into two "A" and "B" databases, both with n= 652 subjects. In the first sample, the exploratory factorial analysis (EFA) was performed, and in the second sample, the confirmatory factorial analysis (CFA) was carried out.

In the EFA process, analyses previous to its implementation were carried out, such as the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and the Bartlett's sphericity test. The Maximum Verisimilitude (MV) method was used to estimate the factor structure. Also, to determine the number of factors to be retained, two procedures were used: the Kaiser-Guttman rule or Autovalues greater than 1, and the sedimentation graph (Scree plot test). With respect to the rotation of the factors, the Promax oblique rotation was used with a 4-parameter Kappa (Hendrickson & White, 1964).

With respect to the CFA, an estimation method other than the MV used by Pérez and Cupani (2008) was used. In fact, due to the fact that the IAMI-R

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is an ordinal response instrument, the polychoric correlation matrix (Elosúa & Zumbo, 2008) was used as input in order to estimate the fit of the model using the *Weighted Least Squares Means and Variance adjusted* (WLSMV) method with robust standard errors and SS (*Scaling-Shifted*) scaled statistical test. The overall fit indexes (χ^2 and RMSEA), robust incremental or comparative fit indices (CFI and TLI) and parsimony index ($SS\chi^2/gl$) were taken into account. This analysis was applied under the hypothesis that the internal structure of the IAMI-R fit a linear model of eight factors. Two statistical models were evaluated. The first model evaluates the structure of the test and relates the latent factors, i.e. they correlate among themselves, while the second model indicates correlations among all latent factors and the presence of errors correlated among the test items.

In addition, following the Classical Theory of Tests (TCT), reliability is theoretically based on the concept of parallelism: two tests - or in our case items - are parallel if they have equal mean and variance, but since it is difficult to empirically compare this concept, the conditions were eased to make the empirical testing of reliability feasible. In this sense, the choice coefficient, the alpha coefficient, is best interpreted when the test is tau-equivalent, that is, when it is assumed that the variance of the true score is the same in all tests (items), but without the same variance of error. In this study, the correlation of the errors of some of the items relaxes, in a sense, the tau-equivalence. Therefore, it was also convenient to estimate the reliability by treating the test (items) as congeneric, that is, by assuming that the means and variances of the true test scores (items) and the error variance may vary, but the true scores are linearly related to each other and to the latent variable (Raykov & Marcoulides, 2011). In other words, it was assumed that the scores measure the same dimension, factor or trait, although to different degrees and with different measurement errors. In this framework, in order to estimate the reliability of the instrument, the internal consistency method was used by estimating the McDonald's coefficient omega (McDonald, 1999) because

different factorial loads among the items and different degrees of errors in their measurement were considered, but the ordinal alpha coefficient was also estimated for comparison purposes.

Results

Internal Consistency

The estimated ordinal alpha coefficients (Contreras & Novoa-Muñoz, 2018) and McDonald's Omega (McDonald, 1999) were pretty similar as shown in Table 6. When compared with the range of intervals of values proposed by George and Mallery (2013): Unacceptable (<.50), poor (.50 - .60), questionable (.60 - .70), acceptable (.70 - .80), good (.80 - .90), and excellent (>.90).90), it is observed that the self-efficacy for mathematical-logical intelligence has the highest coefficient (.945/.946), and the self-efficacy for musical intelligence has reliability categorized as excellent, while the other IAMI-R scales show coefficients categorized as good. The lowest is the self-efficacy for intrapersonal intelligence (.859/.857). In synthesis: from the sizes of the ordinal alpha coefficient and McDonald's coefficient omega of the scales of IAMI-R, in the sample of Peruvian senior high school students, it can be understood that they show similar responses to items that are different but that conceptually manifest the measured latent variable.

Descriptive Results

Table 1 shows the descriptive analysis of the items. Among the arithmetic mean values, it is observed that six items have means slightly higher than 7 (bolded) in the scale from 1 to 10. The mean of the other 42 items fluctuates below 7 to 4. Item 42 (*quickly identifying your emotions*) has the highest mean, while item 22 (*tuning a musical instrument*) has the lowest mean. The standard deviation values vary from 2.06 to 2.78, with item 23 showing the highest standard deviation (*playing an instrument in an orchestra or musical group*), and item 41 showing the lowest standard deviation (*knowing your abilities to face different situations*). Finally, the asymmetry and kurtosis

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values indicate that 40 items have values in the range +1/- 1, which is a result categorized as excellent, while the other 8 have a maximum value of -1.12, categorized as adequate (George & Mallery, 2013). These results suggest that the IAMI-R items distributions fit a normal distribution pattern.

Table 1.

Descriptive Analysis, Asymmetry and Kurtosis of the Items of the IAMI-R (n = 1304).

Scale	Item	M	SD	Asymmetry	Kurtosis
Linguistic S.	01	5.65	2.34	0.07	-0.78
	02	4.96	2.18	0.35	-0.46
	03	5.77	2.25	-0.03	-0.78
	04	5.16	2.32	0.21	-0.73
	05	5.81	2.32	-0.08	-0.77
	06	5.59	2.41	0.01	-0.84
Logical-Mathematical S.	07	5.14	2.50	0.14	-0.85
	08	5.76	2.67	-0.04	-1.02
	09	5.51	2.60	0.06	-1.01
	10	5.64	2.57	-0.02	-0.94
	11	6.08	2.65	-0.19	-1.00
	12	5.81	2.58	-0.07	-0.96
Spatial S.	13	5.70	2.69	-0.06	-1.08
	14	5.92	2.59	-0.13	-0.95
	15	5.57	2.53	-0.01	-0.92
	16	5.57	2.51	-0.05	-0.83
	17	5.58	2.53	0.00	-0.90
	18	5.31	2.69	0.07	-1.03
Musical S.	19	5.99	2.83	-0.20	-1.12
	20	4.88	2.78	0.28	-1.02
	21	4.82	2.77	0.32	-1.02
	22	4.13	2.66	0.58	-0.69
	23	4.68	2.96	0.33	-1.12
	24	4.46	2.72	0.46	-0.83
Interpersonal S.	25	7.09	2.22	-0.65	-0.16
	26	6.63	2.24	-0.39	-0.43

	27	6.21	2.55	-0.23	-0.92
	28	7.07	2.29	-0.58	-0.33
	29	6.95	2.36	-0.54	-0.43
	30	7.13	2.29	-0.58	-0.37
Cenesthetic-Bodily S.	31	6.65	2.50	-0.45	-0.67
	32	6.38	2.41	-0.30	-0.70
	33	6.08	2.76	-0.20	-1.05
	34	6.27	2.73	-0.30	-0.97
	35	6.27	2.61	-0.29	-0.90
	36	5.88	2.51	-0.18	-0.81
Intrapersonal S.	37	6.94	2.18	-0.54	-0.23
	38	6.76	2.71	-0.60	-0.63
	39	6.88	2.28	-0.55	-0.30
	40	7.26	2.18	-0.65	-0.18
	41	7.20	2.06	-0.66	0.15
	42	7.53	2.13	-0.76	0.07
Naturalistic S.	43	5.57	2.60	-0.05	-0.94
	44	5.16	2.44	0.12	-0.83
	45	4.74	2.49	0.31	-0.77
	46	4.82	2.56	0.27	-0.82
	47	4.64	2.59	0.34	-0.86
	48	5.85	2.55	-0.13	-0.84

Explanatory Factor Analysis (EFA)

The KMO index had a value of .926 categorized as excellent (García, Gil & Rodríguez, 2000), while the Bartlett's sphericity test yielded a statistically very significant result X^2 (23085.258, $p < .001$). After applying the Maximum Verisimilitude (MV) method, a solution of eight factors was identified, followed by a Promax rotation due to the fact that intercorrelations greater than 0.32 were present in several items (table 2) (Tabachnick & Fidell, 2001). Intercorrelations that, on the other hand, are distant from .80, a value proposed as an indicator of collinearity (Berry & Feldman, as cited in Cea, 2004).

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Table 2.

Intercorrelations between Factors (EFA) (n_A=652).

Item	F-I	F-II	F-III	F-IV	F-V	F-VI	F-VII	F-VIII
F-I	-							
F-II	.176	-						
F-III	**.351**	**.365**	-					
F-IV	**.388**	**.347**	**.443**	-				
F-V	.246	.299	**.435**	.278	-			
F-VI	**.375**	.280	.287	.312	**.488**	-		
F-VII	.285	**.424**	**.477**	**.422**	**.419**	**.418**	-	
F-VIII	**.334**	**.390**	**.456**	.294	**.655**	**.545**	**.450**	-

The Promax rotation determined that the factorial weights of the items, all higher than .30, correspond to the theoretical order of the IAMI-R. Consequently, the first factor was labeled as self-efficacy for linguistic intelligence, the second factor as self-efficacy for logical-mathematical intelligence, the third factor as self-efficacy for spatial intelligence, the fourth factor as self-efficacy for musical intelligence, the fifth factor as self-efficacy for interpersonal intelligence, the sixth factor as self-efficacy for cenesthetic-bodily intelligence, the seventh factor as self-efficacy for intrapersonal intelligence, and the eighth factor as self-efficacy for naturalistic intelligence.

Table 3.

Exploratory Factor Analysis, Promax Rotation, Structure Matrix ($n_{A\,652}$).

Item	ALING	ALOMA	AESPA	AMUSI	AINTER	ACENE	AINTRA	ANATU	h^2
01	.560								.405
02	.608								.423
03	.578								.471
04	.935								.751
05	.710								.600
06	.859								.670
07		.633							.491
08		.904							.768

09	.883							.791
10	.886							.819
11	.925							.846
12	.930							.864
13		.806						.605
14		.851						.705
15		.935						.787
16		.792						.675
17		.651						.538
18		.673						.511
19			.737					.622
20			.686					.538
21			.751					.595
22			.870					.746
23			.885					.734
24			.859					.707
25				.500				.474
26				.723				.635
27				.583				.488
28				.763				.612
29				.725				.637
30				.715				.589
31					.610			.521
32					.617			.586
33					.856			.668
34					.802			.608
35					.959			.800
36					.873			.740
37		.320				.378		.503
38						.525		.406
39						.752		.619
40						.952		.771
41						.821		.686
42						.748		.576
43							.486	.410
44							.629	.530
45							.771	.634

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46								.968	.863
47								.879	.694
48								.568	.394
Variance explained	30%	9%	8%	6%	5%	5%	4%	3%	

Note. ALING = Self-efficacy for linguistic intelligence, ALOMA = Self-efficacy for logical-mathematical intelligence; AESPA = Self-efficacy for spatial intelligence; AMUSI = Self-efficacy for musical intelligence; AINTER = Self-efficacy for interpersonal intelligence; ACENE = Self-efficacy for cenesthetic-bodily intelligence; AINTRA = Self-efficacy for intrapersonal intelligence; ANATU = Self-efficacy for naturalistic intelligence.

Table 3 only shows loads or saturations (*loading*) greater than .30. In the case of item 37 which loaded in self-efficacy for spatial intelligence and in self-efficacy for intrapersonal intelligence, it was determined to group it in the latter since it had the highest load there. Likewise, it can be inferred that the average of the loads in all the factors is greater than .50, which denotes well-defined factors (Comrey, 1985) that explain 70% of the variance of the scores.

Table 4.

Descriptive Statistics of Factors (n_A = 652).

Factor (*)	M	SD	Asymmetry	Kurtosis
ALING	33.94	13.82	-0.01	-0.88
ALOMA	28.96	14.11	0.30	-0.77
AESPA	37.52	12.82	-0.23	-0.72
AMUSI	33.66	12.78	0.02	-0.74
AINTER	42.57	10.57	-0.46	-0.20
ACENE	32.93	10.76	0.07	-0.53
AINTRA	30.79	12.11	0.19	-0.60
ANATU	41.07	11.02	-0.37	-0.44

(*) ALING = Self-efficacy for linguistic intelligence, ALOMA = Self-efficacy for logical-mathematical intelligence; AESPA = Self-efficacy for spatial intelligence; AMUSI = Self-efficacy for musical intelligence; AINTER = Self-efficacy for interpersonal intelligence; ACENE = Self-efficacy for cenesthetic-bodily intelligence; AINTRA = Self-efficacy for intrapersonal intelligence; ANATU = Self-efficacy for naturalistic intelligence.

Table 4 shows that self-efficacy for interpersonal intelligence shows the highest mean, followed by self-efficacy for naturalistic intelligence, self-efficacy for spatial intelligence, self-efficacy for linguistic intelligence, self-efficacy for musical intelligence, self-efficacy for cenesthetic-bodily intelligence, self-efficacy for naturalistic intelligence, and, at the bottom of the table, self-efficacy for logical-mathematical intelligence with the lowest mean and, in turn, the largest dispersion, while self-efficacy for interpersonal intelligence shows the smallest dispersion. In addition, the asymmetry and kurtosis values of the factors ranged between +/-1, indicating that their distributions are normal (George & Mallery, 2013).

Confirmatory Factor Analysis (CFA)

This second model considers the correlation of errors between items 4 and 6 (self-efficacy for linguistic intelligence), 13, 14 and 15 (self-efficacy for spatial intelligence), 35 (self-efficacy for cenesthetic-bodily intelligence), and 45 (self-efficacy for naturalistic intelligence), due to the presence of modification indices that suggest it and the detection of wording similar to the beginning of the item and also its reference to linguistic concepts that may have been confused by subjects, for example item 4 says: "*Writing a short composition without grammatical errors*", while item 6 says: "*Writing a short composition without spelling errors*". The results are shown in Table 5.

Table 5.

Fit indices of two measurement models in IAMI-R in the Peruvian sample (n_B = 652).

Model	$SS\chi^2$	gl	$SS\chi^2/gl$	RMSEA [IC 90%]	SRMR	CFI	TLI
Model 1	1950.11	1052	1.85	.037 [.035, .040]	.050	.906	.899
Model 2	1857.73	1047	1.77	.035 [.033, .038]	.049	.915	.908

$SS\chi^2$ = adjusted chi-square; gl = degrees of freedom; $SS\chi^2/gl$ = parsimony index; RMSEA= Root Mean Square Error of Approximation; SRMR= Standardized Root Mean Square Residual; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index.

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The overall fit index RMSEA shows in both models a value lower than .05 indicating a good fit to the data, an assertion that is also based on in the fact that the 90% confidence interval (CI) is between 0 and .05 (Schumacker & Lomax, 2016). The same occurs with the SRMR index. On the other hand, the comparative fit indices indicate that in the CFI both models show values above .90, an acceptable value according to Hu and Bentler (1999), while model 2 also fulfills this specification in TLI, but not model 1. Likewise, with respect to the $SS\chi^2$/gl parsimony index, both models show values below 3, which is adequate (Marsh & Hocevar, 1985), but model 2 presents a better relationship between the adjusted chi-square value and its degrees of freedom. Finally, the joint observation of the values of the statistical indicators used shows that model 2 has a better overall satisfactory fit after verifying the internal structure of the IAMI-R of eight factors or self-efficacies for multiple intelligences in senior high school students in the Lima Metropolitan area, but it should be noted the existence of correlated errors in some items belonging to some of the IAMI-R scales noted above that would be affecting their reliability.

Table 6 shows the standardized factorial weights of the CFA for the second model. It is observed that the lowest standardized factorial load is 0.573 for item 3 of the dimension self-efficacy for spatial intelligence, while the highest load is 0.902 for item 9 of the dimension self-efficacy for mathematical-logical intelligence. In addition, it was found that the correlations between the factors fluctuate between 0.134 (self-efficacy for mathematical-logical intelligence and self-efficacy for musical intelligence), and 0.712 (self-efficacies for interpersonal and intrapersonal intelligence).

Table 6.

CFA. Saturations of Items in Model 2 of the IAMI-R (n_B = 652).

Item	ALING	ALOMA	AESPA	AMUSI	AINTER	ACENE	AINTRA	ANATU
01	.726							
02	.691							
03	.739							
04	.667							
05	.741							
06	.672							
07		.812						
08		.855						
09		.902						
10		.880						
11		.864						
12		.856						
13			.573					
14			.762					
15			.715					
16			.818					
17			.832					
18			.753					
19				.790				
20				.765				
21				.838				
22				.844				
23				.802				
24				.855				
25					.675			
26					.816			
27					.740			
28					.730			
29					.777			
30					.717			
31						.740		
32						.833		
33						.721		
34						.749		
35						.760		
36						.785		

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37							.741	
38							.583	
39							.778	
40							.715	
41							.800	
42							.674	
43								.707
44								.714
45								.786
46								.753
47								.775
48								.716
Alpha	.865	.945	.899	.922	.880	.899	.859	.891
Omega	.833	.946	.824	.922	.881	.880	.857	.892

Note. ALING = Self-efficacy for linguistic intelligence, ALOMA = Self-efficacy for logical-mathematical intelligence; AESPA = Self-efficacy for spatial intelligence; AMUSI = Self-efficacy for musical intelligence; AINTER = Self-efficacy for interpersonal intelligence; ACENE = Self-efficacy for cenesthetic-bodily intelligence; AINTRA = Self-efficacy for intrapersonal intelligence; ANATU = Self-efficacy for naturalistic intelligence.

Discussion

Self-efficacy and multiple intelligences are cognitive constructs that since their inception (Bandura, 1997; Gardner, 1983) aroused the interest of Latin American psychologists and educators for their theoretical and practical value for the analysis, explanation, and prediction of behaviors that are present in the academic world, including academic performance, academic persistence, teaching performance, academic goal orientation, vocational guidance (Alegre, 2014; Aliaga et al, 2012, Arias-Gómez & Durán-Aponte, 2017; Covarrubias & Mendoza, 2013; Olaz, 2001; Pérez et al, 2005).

In consideration of this goodness, based on the conceptual frameworks of Gardner's theory of multiple intelligences (1983) and Bandura's social-cognitive theory (1997) and on a social cognitive model of career development proposed by Olaz (2003), Pérez, Beltramino and Cupani (2003) created the IAMI for use in vocational guidance, which is an instrument that operationally unified both constructs to measure Argentinian senior

high school students' confidence in the process of successfully carrying out activities related to the eight multiple intelligences. In 2008, the instrument was revised and psychometrically adapted for use with younger high school students, a version known as IAMI-R. Within this framework, this psychometric and instrumental study aimed to establish the validity and reliability of the IAMI-R in Peruvian senior high school students from public and private schools in the Lima Metropolitan area, following a procedure as close as possible to that followed by the test authors.

The descriptive results indicate that all the items of the instrument have good psychometric characteristics. Likewise, the EFA and CFA results indicate that in the sample of Peruvian adolescents it is found and confirmed the internal structure of eight factors of the IAMI-R observed in the original study conducted by Perez and Cupani (2008) with a sample of Argentinian adolescents from the city of Cordova, ratified by the data obtained in the study carried out by Acosta and Sanchez (2015) with Colombian students who are in the same year of high school. This replica makes it possible to maintain that there is sufficient empirical evidence of generalization of the validity of the IAMI-R in reference to this structure for its use as a measuring instrument of self-efficacy for multiple intelligences in Latin American senior high school students. The followed process is solid and robust, which makes its results right. However, due to the characteristics of the TCT, which is the psychometric theory on which the construction of the IAMI-R is based, it is convenient to carry out additional studies that include other sources of validity, not only for their use in the field of vocational guidance, which was the primary interest of their authors, but also for other purposes in the field of educational psychology and potentially in other non-educational contexts.

There are also other studies using the IAMI-R that did not validate the eight factors but seven, and integrated the intrapersonal and interpersonal intelligence factors into a single factor, an issue that interpretively does not generate many conceptual differences either (Durán-Aponte et al., 2014;

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Pérez & Medrano, 2013) and that in fact have been integrated into the concept of emotional intelligence that has been under way since Goleman (1995).

Additionally, considering that the correlation of errors in a few items implies the analysis of their formulation, the measurement of the constructs underlying the inventory scales can be done accurately since the scores of the Peruvian adolescents showed appropriate reliability indices in their internal consistency modality both in their calculation via *ordinal alpha* coefficient and in their calculation via *McDonald* coefficient, even some of the indices found are higher than those obtained in Argentinian adolescents by Pérez and Cupani (2008), being valued as indicators of reliability ranging from good (0.865/0.833 Linguistic self-efficacy) to excellent (0.945/0.946 Logical-mathematical self-efficacy) (George and Mallery, 2013).

Consequently, with respect to the purpose of the study, it can be concluded that the validity of the IAMI-R is established through the analysis of its internal structure via EFA and CFA, and there is also evidence of the generalization of its structure of eight factors in both Argentinian, Colombian and Peruvian senior high school students. Likewise, the reliability of the IAMI-R is confirmed since the ordinal alpha and McDonald's Omega reliability indices have amounts of sufficient size to accurately measure the eight self-efficacies for the multiple intelligences in the Peruvian students.

Finally, this work represents a contribution to the professional work of the Peruvian educational psychologist with respect to the measurement of variables that have an impact on the academic performance of the student and on applications in different activities of the school psychologist. These results as well as others obtained using the IAMI-R confirm that it is useful both for vocational guidance and counseling with students who are in the process of choosing a career and for choosing a university specialty and also for student academic guidance from a cognitive profile (as a diagnosis of students' self-perceived strengths and weaknesses). Likewise, it could be useful to develop cognitive potentialities through intervention programs.

An interesting finding in the factor structure of the IAMI-R is that, except for some order differences in the research conducted by Pérez and Cupani's (2003), that carried out by Acosta and Sánchez's (2015) and this study, the factors with the highest variance are linguistic self-efficacy, logical-mathematical self-efficacy and spatial self-efficacy that, in the case of multiple intelligences, Gardner (1999) calls academic intelligences. It is likely that this finding is due to the fact that the analyzed population is composed of high school students. But these conjectures, such as the profiles that primary education, secondary education and university students can develop, and the necessary comparisons by sex, may be part of the problems for subsequent research studies.

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