Psychometric study of the creative imagination test for young people in the Colombian population

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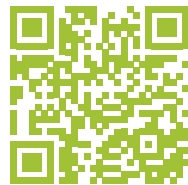
Abstract

The importance of fostering creative thinking in contemporary education implies having adequate and valid measurement instruments to identify these skills and guide educational efforts more accurately. The present study aimed to validate the Test of Creative Imagination for Adolescents in the Colombian population. It was a quantitative, psychometric, descriptive and cross-sectional study. The test was administered to 670 high school students with a mean age of M 14.7

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(SD 1.6), distributed between 12 and 18 years old. The results indicated that the predictive validity of the test was higher in the Colombian sample; however, the creativity scores obtained by the Colombian students were significantly lower than those of the reference population. The greatest difference was found in narrative creativity, with graphic creativity being the most similar to the original sample. Among the variables that make up the narrative creativity factor, the one most affected was narrative flexibility. The importance of educational and cultural factors in the development of the creative potential of young Colombians is discussed.

Keywords: creativity, PIC-J, narrative creativity, graphic creativity, Colombian students

Estudio psicométrico de la prueba de imaginación creativa para jóvenes en la población colombiana

Resumen

La relevancia del fomento del pensamiento creativo en la educación contemporánea implica contar con instrumentos de medición adecuados y validos que permitan identificar estas habilidades y orientar los esfuerzos educativos de forma más acertada. El presente estudio se orientó a validar la prueba de imaginación creativa para jóvenes (PIC-J) en la población colombiana. Fue un estudio de enfoque cuantitativo, psicométrico, de nivel descriptivo y de corte transversal. La prueba se aplicó a 670 estudiantes de bachillerato, con una edad promedio de M 14,7 (DT 1,6), distribuidos entre 12 y 18 años. Los resultados indicaron que la validez predictiva de la prueba fue mayor en la muestra colombiana; sin embargo, los puntajes en creatividad obtenidos por los estudiantes colombianos fueron significativamente menores que los de la población de referencia. La mayor diferencia se obtuvo en la creatividad narrativa, siendo la creatividad gráfica la más parecida a la muestra original. Entre las variables que conforman el factor de creatividad narrativa, la más afectada fue la flexibilidad narrativa. Se discute la importancia de factores educativos y culturales en el desarrollo del potencial creativo de los jóvenes colombianos.

Palabras clave: creatividad, PIC-J, creatividad narrativa, creatividad gráfica, estudiantes colombianos

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Estudo psicométrico do teste de imaginação criativa para jovens da população colombiana

Resumo

A importância de promover o pensamento criativo na educação contemporânea implica ter instrumentos de medição adequados e válidos para identificar essas habilidades e orientar os esforços educacionais com mais precisão. O presente estudo teve como objetivo validar o Teste de Imaginação Criativa para Adolescentes na população colombiana. Foi um estudo quantitativo, psicométrico, descritivo e de corte transversal. O teste foi aplicado a 670 estudantes do ensino médio com idade média de M 14,7 (DP 1,6), distribuídos entre 12 e 18 anos. Os resultados indicaram que a validade preditiva do teste foi maior na amostra colombiana; entretanto, as pontuações de criatividade obtidas pelos estudantes colombianos foram significativamente menores do que as da população de referência. Foi encontrada a maior diferença na criatividade narrativa, com a criatividade gráfica, sendo a mais semelhante à amostra original. Entre as variáveis que compõem o fator de criatividade narrativa, a mais afetada foi a flexibilidade narrativa. Discute-se a importância dos fatores educacionais e culturais no desenvolvimento do potencial criativo dos jovens colombianos.

Palavras-chave: criatividade, PIC-J, criatividade narrativa, criatividade gráfica, estudantes colombianos

Introduction

The promotion of creativity has become one of the most important objectives in contemporary education, not only in terms of educational policies, but also in terms of numerous researches and publications. However, there is still a large gap between the objectives proposed in educational policies and the real situation regarding the promotion of creative abilities in students in the Colombian educational system, a reality that is revealed by their low performance in the PISA tests. Schleicher (as cited by Adamo-Idoeta, 2021), Director of Education for the Organization for Economic Cooperation and Development (OECD), states that Colombian students have low levels of creative thinking skills; they have a good memory and retain information well, but do not know how to apply it in real life for creative problem solving.

The Colombian education system suffers from many shortcomings, including: unequal access to educational services; poorly prepared teachers and precarious working conditions; backwardness in rural education; lack of infrastructure and technological resources; and, above all, outdated pedagogical models (Leal-Talero, 2023).

Thus, the transformation of education requires the implementation of innovative methodological strategies aimed at fostering creativity in students throughout the educational cycle, which in turn requires, among other things, the availability of measurement tools that can be applied in educational settings and that provide teachers with information on the difficulties presented by students in order to guide pedagogical interventions in an appropriate manner (Vuk, 2023).

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In this order of ideas, it is important to have instruments that can objectively assess students' creativity, although it is a complex concept that lends itself to different interpretations (Kalogeratos et al., 2023). The assessment of creativity has been a rather controversial issue due to different approaches in its theoretical conceptualization. Therefore, some authors have used several indicators for their respective assessment, depending on whether they have considered only cognitive or emotional aspects, personality, or whether they have approached creativity as a process, product, person or environment (Kalogeratos et al., 2023; Brown et al., 2024).

Traditionally, four areas have been identified in which the evaluation of creativity is carried out: creative processes, where the skills considered necessary for a creative process are assessed; the creative person, where the stable psychological traits that characterize a creative person are studied; creative products, where a consensus is reached on how to determine the criteria for a creative product; and the context that favors creativity, where various factors related to the environment are identified that allow the promotion of creative manifestations (Long et al., 2022).

The present study focuses on the instruments used to assess the cognitive abilities necessary to achieve a creative thinking process. After analyzing the indicators proposed by different authors in this line of studies and in a historical retrospective, it can be pointed out that there are certain central indicators that are used to assess creative ability. For the first time, in 1922, Simpson proposed the following indicators: imagination, fantasy, invention, humor, originality, flexibility and fluency to evaluate creativity. In 1947, in the first edition of their book *Development of Creative Ability*, Lowenfeld and Brittain (1980) proposed the indicators of fluency, flexibility, originality, ability to reorganize, sensitivity to problems, ability to abstract, closure, and intuition. MacKinnon (1965) defined the following criteria: originality, intuition, persistence, sensitivity, cognitive flexibility, curiosity, independence, and openness to experience. Torrance (1969) suggested: fluency, flexibility, originality, elaboration, sensitivity to problems, independence, autonomy, self-confidence,

curiosity, and communication. Marín (1998) emphasized productivity, flexibility, originality, elaboration, analysis, synthesis, openness, communication, sensitivity to problems, and inventiveness. For Violant and De la Torre (2006), the indicators were: resistance to closure, originality, elaboration, expressive richness, figurative expansion, fantasy, and thematic and linear connectivity.

Most instruments for measuring creativity are based on Guilford's (1959a; 1959b) multifactorial concept of intelligence, which conceives of creativity as a set of stable intellectual abilities, among which divergent thinking stands out. The divergent production test constructed by Guilford to assess creativity considers the following indicators: fluency, flexibility, originality, and elaboration.

Another of the most widely used tests for assessing creativity is the Torrance Creative Thinking Test (1972). The test consists of two subtests: verbal and figurative, which can be used individually or together. Like the Guilford test, this instrument aims to assess the four divergent thinking skills: fluency, flexibility, originality and elaboration.

There are other assessment batteries based on Guilford's model, such as Getzels and Jeackson's (1962) and Wallach and Kogan's (1965). These are very similar; the difference lies in the conditions of use; Wallach and Kogan (1965) support a test administration in the form of a game and free of time constraints. According to them, this makes it possible to separate the creative manifestations of intelligence in general.

Mednick's (1962) Distant Associations Test assumes that an important aspect of the creative process is relating or associating distant elements or elements from different areas. The aspects assessed in the test are the need for associative elements, the associative hierarchy, the number of associations, cognitive or personality factors, and the selection of creative combinations.

Another more recent instrument is the Corbalán et al. (2003) Test of Cognitive Measurement of Creativity (CREA), which measures creativity through the divergent production of questions.

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It is based on the premise that the ability to formulate 'good' questions demonstrates the capacity for inquisitive thinking, which allows one to discover different facets of a given situation, to search for hidden aspects and to make remote associations, abilities that are necessary for the creative process, among others.

One of the most widely used instruments is the Marín Test (1998), inspired by the Torrance Test, which mainly measures productivity, mental flexibility, originality and elaboration, although it can also detect aspects such as synthesis and humor.

The Artola et al. (2008) test, called PIC-J or creative imagination test for adolescents, is designed to assess «an aspect of creativity, divergent thinking, through the subject's use of imagination or fantasy» (p. 13). The test was initially validated in the Spanish population and has been used in several Latin American populations, such as Guatemala (Ballesteros, 2016), Peru (Albitres, 2017), Argentina (Villadiego et al., 2015), Chile (Olivos et al., 2013), and Colombia (Chaverra-Fernández and Gil-Restrepo, 2016), among others.

Some review studies (Catalán, 2012; Pupiales et al., 2013; Kaufman, 2019; Weisberg, 2020) indicate that the PIC-J is the most complete creativity measurement instrument used in educational contexts to date; it includes items that have been validated in practice in other tests; it is designed to measure one aspect of creativity: divergent thinking, through the use of the subject's imagination or fantasy. Creative imagination allows the creation of new images from previous representations stored in memory. In this way, a different perception of reality is generated, which is not reduced to a mechanical reproduction of previous perceptions and representations, but a creation of new meanings.

Therefore, the present study aimed to validate the PIC-J in the Colombian population in order to have an instrument for the educational context.

Methodology

The design of this research was developed through a quantitative descriptive study with a cross-sectional approach, with the objective of developing the psychometric validation of the PIC-J test in the Colombian population, which evaluates the creative thinking of young people and focuses on the development of cognitive intelligence. A rigorous methodology was used to guarantee the validity and reliability of the results.

In the psychometric validation study, statistical analyses were performed to assess the internal consistency of the test. Content and concurrent validity were also validated. Reliability analysis was performed using Cronbach's alpha. Finally, the results were processed through an interpretation analysis with the intention of structure a reliable and valid tool for educational contexts.

Instrument

The PIC-J test by Artola et al. (2008) consists of four games (tasks), three of which measure narrative creativity and the fourth measures figurative or graphic creativity. Each task has detailed instructions for its administration and scoring. The result of the scoring of the four tasks is the overall creativity score, which in turn is composed of the narrative and graphic creativity scores. The narrative creativity score is composed of scores in narrative fluency, narrative flexibility, and narrative originality; the graphic creativity score is composed of scores in graphic originality, elaboration, title, and special details.

The direct score can also be converted to the percentile score. In the present study, we worked with the direct score, which has reference values for three age groups: 12-13 years, 14-15 years and 16-18 years, from the Spanish population. The test obtained a Cronbach's alpha of 0.85; an exploratory factor analysis was carried out, which showed the presence of two factors with a variance of 53.77%.

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Participants

The instrument was administered to 670 Colombian students belonging to six educational institutions with a mean age of M 14.7 (SD 1.6), with a minimum of 12 and a maximum of 18 years. The predominant strata were 2 and 3. 46.4% of the sample were female and 53.6% were male; 48.5% were students from public schools, while 51.5% were from private schools; 44.5% studied under the traditional pedagogical model and 55.5% under the alternative pedagogical model.

Methodology

First, schools located in the Aburrá Valley, department of Antioquia, Colombia, were contacted and invited to participate in the study; from the 13 institutions that responded, six schools were randomly selected for the sample; finally, and in the same way, high school students were selected from each school. The test was administered in person in the classrooms indicated by each institution. The technical, procedural and ethical regulations set forth in Resolution 8430 of 1993 were followed; informed consents were signed by the parents of the students and by the participating students.

Data Analysis

The analysis procedure for the validation of the PIC-J psychometric test was carried out using SPSS software version 28. Statistical techniques were used to evaluate the reliability and validity of the test in the Colombian population.

First, a calculation was made using Cohen's Kappa index, which allowed us to evaluate the analyses of agreement between the direct scores obtained in the PIC-J test. This index generates the proportion of measures of agreement with the categorical or nominal data that make up the test. In this sense, the internal consistency of the items and the reliability of the test as a whole were determined, guaranteeing the consistency and quality of the results.

Next, an exploratory type of factor analysis was performed, as indicated by López-Aguado and Gutiérrez-Provecho (2019), using the principal component extraction method. In this sense, this analysis allowed the identification of the dimensions underlying the PIC-J test. The patterns of responses that explain the extraction of the factorial components and the variability of the data were determined. Among them, the eigenvalues resulting from the extracted components were studied; the analysis of the amount of variability explained by each component was carried out. In addition, the sedimentation technique was used to identify the inflectional data in the decrease of the eigenvalues, with the factors to be retained, considering the communality of the items in the proportion of variance of the extracted factors and the evaluation of the factorial structure of the PIC-J test.

Subsequently, a descriptive statistical analysis was performed (López and Hernández, 2019) for the study of the scores in each item of the test, generating a calculation from the measures of central tendency and dispersion, as observed in the standard deviation and range. In this way, a detailed description of the analyzed results was obtained, considering the established analyses related to the reliability and validity criteria in the validation of the psychometric test PIC-J in the Colombian context.

Results

First, the authors of the test were asked for permission to adapt and validate it, and once obtained, the test was evaluated by two experts: one from Colombia and the other from Cuba. The evaluation matrix was designed in Excel to evaluate the sufficiency, coherence, relevance and clarity of each item on a scale from 1 to 5. The Cohen's Kappa index was calculated from the evaluations of each expert whose results are presented in Table 1.

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Table 1

Calculation of Cohen's Kappa index to measure sufficiency, coherence, relevance and clarity of writing game instructions

Measurement		Value		Approximate Sig.
Sufficiency	Measure of agreement	Kappa	1,000	,046
	Number of valid cases	4		
Coherence	Measure of agreement	Kappa	1,000	,046
	Number of valid cases	4		
Relevance	Measure of agreement	Kappa	1,000	,046
	Number of valid cases	4		
Clarity of wording	Measure of agreement	Kappa	,200	,046
	Number of valid cases	4		

For the clarity item, the concordance obtained was weak, and the judges' scores were lower for the first three items, so they requested adjustments in the wording of the instructions. Both the national and international judges suggested a small adjustment to the instructions in terms of language expressions to make them more understandable to the Latin American public.

The following is a list of the initial and final instructions after the adjustments suggested by the judges:

Game #1 (original test instructions): Look carefully at the picture on the previous page. Your task is to imagine everything that could happen in this scene. Write down anything that comes to mind. Remember that there are no right or wrong answers in this game, so use your imagination and try to come up with lots of ideas. For example: «It's an adventure on a lake».

Game #1 (adapted version): Look carefully at the picture on the previous page; imagine as many different situations as possible that could occur and write them down below. Note that there are no right or wrong answers; just try to generate as many ideas as possible. For example: «It's an adventure on a lake».

Game # 2 (original test instructions): Make a list of all the things a rubber tube can be used

for. Think of interesting and original uses. Write down all the uses you would make of it, even if they are imaginary. You can use any number and any size. For example: «As a water pipe».

Game #2 (adapted version): Imagine as many different uses as you can for a tube made of rubber. The tube can be any size and you can use as many as you want. Think of something original and interesting. For example: «As a pipe for water».

Game # 3 (original test instructions): Imagine and answer what you think would happen if what this sentence says occurred: What would happen if the ground suddenly became elastic? Example: «We'd be bouncing around all day».

Game # 3 (adapted version): Imagine that the ground under our feet suddenly becomes elastic. Write down all the things you think might happen. For example: «We would be bouncing around all day».

No changes were made to game #4, as the judges did not indicate the need for it. The final version of the instructions was left in its original form, as follows: On this page you can see some incomplete drawings. Try to complete them by making a drawing so original that no one else would have thought of it; then give each of the drawings an interesting title.

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Factor Analysis

This factor analysis of the test yielded the results described below: the scores in the dimensions evaluated by the test were used for the AFE: narrative fluency, narrative flexibility, narrative originality, graphic originality, title, elaboration, special details.

The KMO master adequacy with a value greater than or equal to 0.5 shows that the partial correlations between the variables are relevant for the factor analysis. Bartlet's sphericity test indicates that the correlations between the variables are significant (see Table 2).

Table 2

KMO and initial Barlett's test - PIC-J factor analysis

Kaiser-Meyer-Olkin sample adequacy measure		,810
Bartlet's sphericity test	Approximate Chi-square	2608,417
	gl	21
	Sig.	,000

The factor analysis showed the presence of two factors, with an explained variance of 67%. This value is higher than the value obtained in the Spanish population (53.77%), thus fulfilling the criterion of parsimony, since with two factors the variance is greater than 50%. The two components have eigenvalues greater than 1 (see Table 3).

Table 3

Initial factor variance

Component	Initial eigenvalues			Sums of the squared saturations of extraction			Sum of the saturations squared by rotation		
	Total	% of variance	% accumulated	Total	% of variance	% accumulated	Total	% of variance	% accumulated
1	3,417	48,808	48,808	3,417	48,808	48,808	2,982	42,595	42,595
2	1,272	18,170	66,977	1,272	18,170	66,977	1,707	24,382	66,977
3	,849	12,124	79,102						
4	,640	9,136	88,238						
5	,561	8,012	96,250						
6	,178	2,544	98,794						
7	,084	1,206	100,000						

Note. Extraction method using principal component analysis.

The criterion used in the rotation analysis was that the components had factor loadings greater than 0.4 (see Table 4).

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The factor loadings show the first component of narrative creativity, which includes: narrative flexibility, narrative fluency, and narrative originality; the second component, graphic creativity, with graphic originality, details, elaboration, and title.

Although all variables had a factorial loading value above 0.5, the title and elaboration variables had a lower loading. The above is different from the initial analysis of the test. In the Spanish version, graphic originality obtained a factorial loading of .44 (the lowest); elaboration, .73 (the highest); title, a loading equal to .52. In the Colombian version, originality obtained a factor loading of .76 (the highest); followed by special details with .65), elaboration with .62), and title with .52.

The above suggests that graphic originality is the variable that contributes most to the assessment of graphic creativity, since it represents the ability to create original and unusual images from undefined initial strokes. Likewise, the Special Details variable contributes significantly in the same direction, as it reveals the ability to create unusual spatial relationships and representations, which is also a key element of graphic creativity. Elaboration has a lower but important load, since it is an aspect more related to the completeness and embellishment of drawings, considering that unoriginal drawings can be embellished with details. Thus, the results of the factor analysis indicate that graphic originality is more relevant than elaboration for the evaluation of graphic creativity, contrary to the results of the analysis carried out with the Spanish population.

Table 4

Matrix of rotated components

	Component	
	1	2
Narrative flexibility	,945	,157
Narrative fluency	,943	,099
Narrative originality	,916	,131
Graphic originality	,142	,759
Details	-,102	,651
Elaboration	,385	,618
Title	,426	,522

In view of the above, a second analysis, equally relevant and significant, was carried out, excluding two variables (see Table 5), which also showed an increase in the variance explained by the factors, amounting to 79.9% (see Table 6).

Table 5

KMO and Barlett's test second analysis

Kaiser-Meyer-Olkin sample adequacy measure		,761
	Approximate Chi-square	2201,853
Bartlett's sphericity test	gl	10
	Sig.	,000

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Table 6

Second Analysis of Explained Variance

Component	Initial eigenvalues			Sums of the squared saturations of extraction			Sum of the saturations squared by rotation		
	Total	% of variance	% accumulated	Total	% of variance	% accumulated	Total	% of variance	% accumulated
1	2,846	56,930	56,930	2,846	56,930	56,930	2,745	54,902	54,902
2	1,148	22,969	79,899	1,148	22,969	79,899	1,250	24,997	79,899
3	,742	14,834	94,733						
4	,178	3,567	98,300						
5	,085	1,700	100,000						

Note. Extraction method using principal component analysis.

With the elimination of the title and elaboration variables, the factor loadings of the graphic originality and special details variables increased for the graphic creativity factor. It is interesting to note that the special details variable had a higher factor loading (.84) than the graphic originality variable (.72). This suggests the importance of visualization and spatial thinking skills in assessing graphic creativity. Imagining the union of several drawings, the rotation of an object in space, or an unusual perspective, among others, are key elements of graphic creativity (see Table 7).

Table 7

Matrix of Rotated Components Second Analysis

	Component	
	1	2
Narrative flexibility	,959	,119
Narrative fluency	,955	,069
Narrative originality	,930	,106
Special Details	-,041	,837
Graphic originality	,218	,721

Finally, considering the theoretical importance of all the variables included in the test to assess graphic creativity, it is recommended to keep both the elaboration variable and the title variable, especially the latter, which reflects the ability to relate the graphic image to a linguistic concept whose degree of abstraction and metaphorical language reflects the level of conceptual complexity that the subject is dealing with. The above contributes to an assessment of general creativity, since this variable contributes to both factors, its loading being higher for graphic creativity (.522), but also important (although below the factorial loading acceptance limit: .426) for the narrative

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creativity factor, closely related to the personal linguistic pool. The internal consistency analysis (Cronbach's coefficient calculation) gave satisfactory results (see Table 8).

Table 8

Internal consistency data for the PIC-J

	Alpha	N	Elements
Total PIC-J	0,74	670	7

Table 9 shows the values of the descriptive measures obtained in the normative sample of the study, according to age and criteria of the original study, whose scales are divided according to these age groups.

Table 9

Descriptive Data of the Total Sample by Age

Age		Minimum	Maximum	Media	Dt
12-13	Total creativity	3	170	53,6	32,3
	Narrative creativity	0	155	47,0	30,3
	Graphic creativity	0	21	6,5	4,1
	Narrative fluency	0	77	24,23	16,1
	Narrative flexibility	0	36	14,6	7,2
	Narrative originality	0	49	8,3	8,1
	Graphic originality	0	9	4,1	2,2
	Elaboration	0	8	1,0	1,4
	Title	0	4	1,4	1,4
	Special details	0	1	,08	,3
	Total cases		183		
14-15	Total creativity	4	196	53,1	33,8
	Narrative creativity	0	187	46,4	31,9
	Graphic creativity	0	21	6,7	3,8
	Narrative fluency	0	105	23,0	15,8
	Narrative flexibility	0	42	14,7	7,5
	Narrative originality	0	49	8,7	9,8
	Graphic originality	0	11	4,4	2,1
	Elaboration	0	8	1,0	1,4
	Title	0	8	1,2	1,6
	Special details	0	1	,07	,3
	Total cases		244		

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Age		Minimum	Maximum	Media	Dt
	Total creativity	8	191	51,2	29,5
	Narrative creativity	4	180	44,9	27,8
	Graphic creativity	0	21	6,3	3,9
	Narrative fluency	2	106	21,9	13,8
16-17	Narrative flexibility	2	35	14,6	6,9
	Narrative originality	0	43	8,5	8,2
	Graphic originality	0	12	4,2	2,2
	Elaboration	0	5	,86	1,2
	Title	0	6	1,1	1,5
	Special details	0	2	,07	,3
	Total cases		243		

Discussion and Conclusions

The predictive validity of the test was higher in the Colombian sample; however, the creativity scores obtained by the Colombian students were much lower than those of the reference population. The greatest difference was obtained especially in narrative creativity, with graphic creativity being more similar to the original sample. Among the variables that make up the narrative creativity factor, the one most affected was narrative flexibility.

The lack of creativity in Colombian students has been highlighted by several authors, who point to the existence of gaps in educational practice between what is proposed by educational policies and what is actually done in the classroom (Cárdenas, 2019; Mejía et al., 2022).

These deficiencies are evident in the low performance of Colombian students in the PISA tests, which indicates that the teaching methods in Colombian education are oriented toward the memorization of content rather than its understanding and creative application (Montero, 2021; Castro, 2023; Leal-Talero, 2023).

The Organization for Economic Cooperation and Development (OECD, 2023), in its analysis of the quality of education in Colombia, points out, among other things, methodological deficiencies and the presence of difficulties in terms of teacher qualifications, the disparities between rural and urban education, the lack of infrastructure and technological resources, which is reflected in the training of students, including their creative capacity.

Considering the differences in creativity between diverse countries and cultures, it is important to observe other factors, such as the combination of the level of economic development of the country with the climatic conditions (Van de Vliert and Murray, 2018), the social mentality (Richter and Kruglanski, 2004), and especially the mentality of the adolescents who formed the study sample. Regarding this last factor, an interesting study conducted in 55 countries on some elements that contribute to people's life satisfaction found that Colombia belongs to the countries with a collectivist culture and that, for its inhabitants, vertical collectivism or conformity is positively correlated with life satisfaction (Diener et al., 1995). This is an attractive aspect that reflects the cultural mentality of conformism, which can have a significant impact on the promotion of creative and innovative thinking, the latter being a characteristic contrary to the conformist thinking that is fostered in children and adolescents from an early age in educational and family environments.

Another striking aspect is the low performance of Colombian students in narrative creativity. It is necessary to consider that creativity, being a

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complex mental capacity, is related to several higher mental functions, including language. Palacios et al. (2022) show that creativity has a positive correlation with expressive language. Gil (2018), for his part, also refers to linguistic creativity, showing the relationship that exists between creativity and language.

The above, applied to the educational context, allows us to understand that in order to promote creativity in students, it is essential to adopt a comprehensive approach that includes the promotion of different competencies, including linguistic and reading comprehension. Currently, this competence is also lacking in Colombian students, according to a report by the OECD (2023).

At a general level, the results of the present study indicate good psychometric properties of the PIC-J test in the Colombian population, allowing the use of this test in educational contexts, achieving the possibility of generating feedback regarding the application of pedagogical and didactic strategies oriented to the promotion of creative abilities in students.

Among the limitations of the study, it is possible to point out deficiencies in the selection of the sample, although it meets the criteria for this type of study due to its size and random selection procedure. Nevertheless, for the next evaluations of the psychometric properties of the test, it is convenient to extend the sampling to the population of rural students in different departments of the country with cultural differences, in order to improve the representativeness of socioeconomic strata, both of lower and higher economic.

With regard to the results of this validation and, above all, the levels of the scores obtained in the reference population, we recommend continuing the same line of study and expanding the sample both nationally and internationally, i.e. in other Latin American countries.

Conflict of interest

The authors of this article declare that they have no conflicts of interest related to the work presented.

Ethical responsibilities

The ethical considerations, in accordance with Colombian regulations, were based on the guidelines of Resolution 8430 of 1993 of the Ministry of Health and Protection and Law 1090 of the Colombian College of Psychologists, which establishes the technical and administrative scientific contemplations for conducting research with humans in Colombia, taking into account those that guarantee the well-being of patients. For this reason, this research is considered to be of minimal risk; in addition, the confidentiality and privacy of the data collected have been guaranteed; therefore, the treatment of the data has been respected.

Likewise, informed consent was signed by each of the participants; clear and precise information on the procedure and the possible risks and benefits was provided to the academic community, considering the right to withdraw at any time from the research. The principle of beneficence and non-maleficence was manifested, ensuring ethical procedures. Equally, the transparency and disclosure of the results of the validation and standardization of the PIC-J test was guaranteed, respecting the rights and welfare of the participants in the psychometric research.

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Contribution

Olena Klimenko: principal investigator. Statistical processing of data, writing of materials and methods and obtaining results.

Nubia Hernández-Flórez: analysis and interpretation of results, writing the introduction, methods, discussion and conclusions.

Annia Esther Vizcaino Escobar: data processing, content generation and validation analysis and standardization.

Elisama Beltrán de la Rosa: analysis and interpretation of results, generation of discussion contributions, and conclusions.

Diana Lucia Arroyave Jaramillo: interpretation of statistical data, writing of discussion, conclusions.

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