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Evaluation of cognitive skills of critical thinking in basic education institutions

Evaluación de las habilidades cognitivas del pensamiento crítico en instituciones educativas de educación básica

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Abstract

This study aimed to analyze the cognitive skills related to critical thinking in elementary school students. A positivist-quantitative approach was adopted, with a descriptive, basic, non-experimental, cross-sectional, and comparative design. The sample consisted of 304 students from the third to fifth years of secondary school who attended regularly during the 2024 academic year. Selection was carried out using non-random and non-purposive sampling. The data collection instrument was validated by experts, achieving a validity level of 90%, indicating very good validity according to the standards. The instrument's reliability, assessed using Cronbach's alpha, yielded a value of 0.96, reflecting excellent internal consistency. The instrument was administered in person. The results reveal that students perceive difficulties in developing their critical thinking skills. Furthermore, it was found that sociodemographic variables, such as gender, grade level, and school of origin, did not generate statistically significant differences in critical thinking performance. Thus, this analysis contributes to a better understanding of critical thinking skills in elementary school students and highlights the importance of implementing strategies that strengthen these skills regardless of sociodemographic factors.

Keywords: cognition, mental development, critical thinking.

Resumen

El presente estudio tuvo como objetivo analizar las habilidades cognitivas relacionadas con el pensamiento crítico en estudiantes de educación básica. Para ello, se adoptó un enfoque positivista-cuantitativo, con un diseño descriptivo, básico, no experimental, transversal y comparativo. La muestra estuvo compuesta por 304 estudiantes de tercero a quinto grado de secundaria, quienes asistieron regularmente durante el año académico 2024. La selección se realizó mediante un muestreo no aleatorio y no intencionado. El instrumento de recolección de datos fue validado por expertos, alcanzando un nivel de validez del 90%, lo que indica una validez muy buena según los estándares. La confiabilidad del instrumento, evaluada mediante el Alfa de Cronbach, obtuvo un valor de 0.96, reflejando una excelente consistencia interna. La aplicación del instrumento se llevó a cabo de forma presencial. Los resultados revelan que los estudiantes perciben dificultades en el desarrollo de sus habilidades de pensamiento crítico. Además, se constató que las variables sociodemográficas, como el género, el grado de estudio y la institución educativa de procedencia, no generan diferencias estadísticas significativas en el desempeño del pensamiento crítico. Así, este análisis contribuye a comprender mejor las capacidades críticas en estudiantes de educación básica y destaca la importancia de implementar estrategias que fortalezcan dichas habilidades independientemente de factores sociodemográficos.

Palabras clave: cognición, desarrollo mental, pensamiento crítico.

Introduction

The 21st century presents emerging characteristics that underscore the necessity for new learners to develop critical thinking skills (López et al., 2022). It is essential for primary education students to acquire these cognitive skills to make assertive decisions, act consciously and reflectively, and, above all, evaluate their choices to learn from their mistakes (Velázquez & Valenzuela, 2024).

In this context, countries have directed their educational policies towards the transformation of teaching systems, promoting the development of critical thinking from the foundational education level as a prerequisite for the personal, academic, and professional formation of future citizens (Albertos & De la Herrán, 2018; Galeano et al., 2023; Vicente, 2025).

It is crucial to define and characterize this variable; however, the specialized literature indicates that there is no singular or universally accepted definition of critical thinking (Mackay et al., 2018; Vendrell & Rodríguez, 2020). Nevertheless, there is consensus that critical thinking encompasses two essential components: cognitive skills (such as interpretation, analysis, evaluation, and inference) and affective dispositions (Prieto, 2018; Robles, 2019; Rivera et al., 2024). Moreover, transferability and metacognitive processes are also recognized as significant (Halpern, 1998; Júdex-Orcasitas et al., 2019).

From this perspective, critical thinking is defined as a reflective mode of thinking and acting rationally, aimed at analyzing and evaluating one's thought processes in order to improve them (Paul & Elder, 2005; Gómez-Gómez & Botero-Bedoya, 2020). This requires an open mind inclined toward the pursuit of truth, enabling individuals to successfully tackle academic, cultural, and social challenges (Bezanilla-Albisua et al., 2018).

To this end, it is essential to cultivate spaces for critical reflection through deliberative and divergent situations that encourage decision-making in contexts marked by complexity and uncertainty (Morales, 2018; Castillo, 2020). Consequently, students must mobilize tools, processes, and resources that enhance their optimal interaction in complex learning environments (Rivadeneira et al., 2019; Elera et al., 2023).

Thus, learners require cognitive skills such as interpretation, analysis, evaluation, and inference, integrated with the socio-affective domain (Velázquez-Tejeda et al., 2023) and metacognitive monitoring, to successfully adapt to distributed, cooperative, collaborative, and shared learning situations (Halpern, 1998; Júdex-Orcasitas et al., 2019).

However, studies conducted in Sincelejo, Sucre (Colombia) reveal difficulties among learners in comprehending complex texts, comparing ideas, and constructing arguments, placing them at a basic level concerning the development of cognitive skills related to critical thinking (Fuentes et al., 2020). Similarly, in Guayaquil (Ecuador), Rodrigues (2022) reports that primary education students perceive challenges in analysis, evaluation, and reasoning during learning experiences.

In the Peruvian context, Caro and Travieso (2021) found that 55% of students at Dos de Mayo Secondary School (Lechemayo, Ayacucho) lack the necessary cognitive tools for analyzing information, drawing conclusions, proposing alternatives, and adopting critical stances. Additionally, Salas (2023) reported that more than 77% of students in Huari, Áncash, experience difficulties in describing, interpreting, analyzing, evaluating textual information, and in articulating or presenting ideas.

In Tacna, Arce (2020) noted that 73.4% of third-grade secondary students demonstrate poor development in inference, information analysis, argumentation, and alternative proposals. Likewise, in Lima, Álvarez et al. (2020) revealed that 37.3% of students are at an initial level and 42.7% are in progress, indicating deficiencies when confronted with situations that require the use of cognitive skills associated with critical thinking.

In light of this scenario, basic education must provide the conditions, experiences, tools, and resources that enable students to face the challenges of a dynamic and changing environment (Gonzales & Otero, 2021), influencing academic success while fostering autonomy and the ability to manage unforeseen situations (Montoya & Monsalve, 2008; Recalde et al., 2025).

Thus, this study aims to: (1) analyze the development of cognitive skills related to critical thinking among basic education students and (2) evaluate differences in this development based on sociodemographic variables.

Method

This study is grounded in the positivist-quantitative paradigm, utilizing statistical and mathematical techniques to characterize the behavior of categories related to critical thinking skills (Valderrama, 2013). Furthermore, it is classified as descriptive in nature, aimed at delving deeper into the characteristics that define and condition the variable under investigation (Berrocal & Berrocal, 2018). Additionally, this study is considered

basic as its primary focus lies in enhancing the theoretical understanding of skill development in the context of basic education (Carrasco, 2016).

Regarding the research design, it is descriptive-comparative, allowing for the analysis of the variable's behavior according to sociodemographic variables such as gender, age, grade level, and educational institution (Sánchez & Reyes, 2015).

The sample comprised 304 participants from five basic educational institutions: Gloriosa Legión Cáceres (40 students, 13.2%), Alfonso Ugarte (80 students, 26.3%), José María Arguedas (105 students, 34.5%), Julio César Tello (31 students, 10.2%), and Raúl Porras Barrenechea (48 students, 15.8%). Within this total, 24 students (7.9%) were in third grade, 96 (31.6%) in fourth grade, and 184 (60.5%) in fifth grade of secondary education. In terms of gender, 168 (55.3%) were female and 136 (44.7%) male, with an average age of 15.8 years and a standard deviation of 0.75 (X=15.8; S=0.75).

For data collection, non-random sampling was employed, as participation was contingent upon parental consent due to the minor status of the students. It was also ensured that students had sufficient time to complete the instruments in full. Inclusion criteria established that participants must be enrolled regularly in third, fourth, or fifth grade during the 2024 academic year.

Regarding the design and construction of the instrument, the process began with defining the construct, its characteristics, components, methodological structure, and percentage distribution (Martínez et al., 2014). A total of 36 items were created, organized into four dimensions: interpretative (9 questions assessing comprehension and clarification of meanings), analytical (9 questions for review and identification of arguments), evaluative (9 questions on valuing statements and situations), and inferential (9 questions addressing evidence examination and conclusion deduction). Each item features a response scale from 1 (strongly disagree) to 5 (strongly agree), allowing respondents to express their perceptions regarding each item.

To ensure validity, content validity was established by consulting five experts in university pedagogy, who validated the instrument with an average score of 90%, considered very good according to psychometric standards (Mejía, 2017). Internal consistency was evaluated through a pilot study involving 30 participants, yielding a Cronbach's Alpha coefficient of 0.96, indicative of excellent reliability (Palella & Martins, 2012).

Additionally, the direction of the questions was verified to confirm that all items were scored in the same direction, utilizing an inter-item correlation matrix, which confirmed positive correlations (Hernández-Sampieri & Mendoza, 2018). The discrimination index revealed a minimum value of 0.386, indicating a high degree of discrimination between those who possess or lack the evaluated characteristic (Berrocal et al., 2023).

The instrument was administered in person during the initial class hours, following authorization from the institutions, informed consent from parents, and permission from teachers, who were informed of the study's objectives.

Subsequently, the data were compiled using Excel. To interpret the results, a scale based on percentages was developed, establishing performance levels: deficient (P ≤ 70%), basic (71% ≤ P ≤ 85%), and good (86% ≤ P ≤ 100%).

For statistical analysis, a summary matrix was created to facilitate the generation of statistical tables. As the data did not follow a normal distribution, non-parametric tests such as the Mann-Whitney U test and the Kruskal-Wallis test were applied to test the hypotheses.

Results and discussion

Table 1 displays the percentage assessment of critical thinking skills, highlighting that the largest proportion of students (49.7%) falls within the basic level. These results reflect the challenges faced by elementary students in activities involving interpretation, critical analysis of ideas, arguments, or academic situations, as well as in evaluating the coherence of an argument, discourse, or text fragment. Additionally, these limitations become more pronounced when students are required to examine, conjecture, or deduce to validate evidence based on the arguments presented, with 26% at a deficient level.

Table 1

Estimation of critical thinking skills

Categories	Interpretation	Analysis	Evaluation	Inference	Critical thinking
Deficient	19.1%	25%	29.9%	30.3%	26.0%
Basic	51.6%	51%	42.4%	45.4%	49.7%
Good	29.3%	24%	27.6%	24.3%	24.3%

Regarding the interpretative dimension of critical thinking, 51.6% of students (basic level) report difficulties in understanding complex texts, particularly when encountering unfamiliar terminology that lies outside their prior knowledge. Consequently, 19.1% are categorized as deficient in their ability to articulate what they understood in their own words.

In terms of the analytical dimension, 51% of students identified academic weaknesses in distinguishing main ideas from secondary ones, recognizing the author's intent, and judging the relevance of the information. These limitations hinder the development of ideas and appropriate argumentation during presentations or debates, evidenced by a 25% deficient rating.

With respect to the evaluative dimension, 42.4% (basic level) express challenges in assessing the relevance of statements, evaluating ideas based on their arguments, and taking positions on multiple reasonable arguments. These issues become more pronounced in novel and unforeseen situations that demand greater reflection, resulting in a 29.9% deficiency level.

Finally, in the inferential dimension, 45.4% of students exhibit academic weaknesses in identifying objective and demonstrable facts, especially when facing discrepancies that may lead to erroneous interpretations. They also encounter difficulties in managing controversies and biases, impacting the objectivity of their conclusions, with 30.3% at a deficient level. This reality highlights existing deficiencies in basic education, which may correlate with personal characteristics such as low motivation, limited attitudes toward study, and a reduced predisposition for learning.

However, these challenges are also associated with traditional teaching practices, wherein pedagogical activities focus solely on academic verbalism, the use of textbooks, and the authority of the teacher. In this model, students often limit themselves to passively listening to a lecture aimed at rote memorization (Ross & Gautreaux, 2018). This situation is corroborated by a study conducted in the province of Huaraz, Áncash, Peru, where 59.3% of students reported serious difficulties among educators to foster critical thinking in their classes (Núñez-Lira et al., 2020).

Thus, the implementation of innovative strategies by educators that actively engage students, alongside the utilization of communication technologies and gamification tools, presents viable alternatives to enhance learning experiences.

Table 2

Comparison of critical thinking scores by gender

Evaluated components	Gender	Mann-Whitney U Test			
		Mann-Whitney U	Wilcoxon W	Z	Sig.
Interpretation	Male / Female	10504.0	19820.0	-1.210	0.226
Analysis	Male / Female	10624.0	19940.0	-1.051	0.293
Evaluation	Male / Female	10903.0	20219.0	-.685	0.493
Inference	Male / Female	10912.0	20228.0	-.673	0.501
Critical thinking	Male / Female	10721.50	20037.50	-.922	0.357

$p \leq 0,05$

Table 2 summarizes the results concerning critical thinking skills using the non-parametric Mann-Whitney U test. The analyses demonstrate the absence of statistically significant differences based on the gender of the participating students ($p = 0.357$). This conclusion is consistent when assessing each dimension of critical thinking: interpretation, analysis, evaluation, and inference. Therefore, it can be asserted that gender does not influence the development of these skills within the studied sample, as both genders encounter similar difficulties in expressing their competencies regarding complex learning activities.

Table 3

Comparison of critical thinking scores by grade level

Evaluated components	Grade	Kruskal-Wallis Test

		Level	Kruskal-Wallis	df	Sig.
Interpretation	Third	122.60	5.551	2	0.062
	Fourth	143.53			
	Fifth	161.08			
Analysis	Third	130.81	1.962	2	0.375
	Fourth	149.94			
	Fifth	156.67			
Evaluation	Third	145.06	1.080	2	0.583
	Fourth	146.28			
	Fifth	156.72			
Inference	Third	127.00	5.243	2	0.073
	Fourth	142.02			
	Fifth	161.30			
Critical thinking	Third	131.08	3.493	2	0.174
	Fourth	144.19			
	Fifth	159.63			

$p \leq 0.05$

Table 3 summarizes the results of critical thinking skills obtained through the non-parametric Kruskal-Wallis test. The analyses indicate no statistically significant differences based on the grade level of the participating students ($p = 0.174$). This conclusion holds for each dimension of critical thinking: interpretation, analysis, evaluation, and inference. These results suggest that academic level does not influence the development of critical thinking skills, reflecting a low level of preparedness among basic education students that does not improve as they advance to higher grades.

Table 4

Comparison of critical thinking scores by educational institution

Evaluated components	Educational institutions	Kruskal-Wallis Test		
		Kruskal-Wallis	df	Sig.
Interpretation	5	1.087	4	0.896
Analysis	5	2.247	4	0.690
Evaluation	5	2.697	4	0.610
Inference	5	0.626	4	0.960
Critical thinking	5	1.817	4	0.769

$p \leq 0.05$

Table 4 summarizes the results concerning critical thinking skills using the non-parametric Kruskal-Wallis test. The findings indicate a lack of statistically significant differences based on the educational institutions of the participating students ($p = 0.769$). This conclusion is consistent across each component of critical thinking: interpretation, analysis, evaluation, and inference. Therefore, similar difficulties in developing these skills are consistently observed in the various sampled basic education institutions.

Regarding the differences in critical thinking based on sociodemographic variables such as gender, academic level, and educational institution, it was found that these characteristics do not influence students' perceptions of their predisposition or development of these skills. This result may be linked to the particularities of the sample, which is predominantly composed of students from national educational institutions, as well as the prevalence of traditional teaching strategies employed in these settings.

Conclusions

Understanding critical thinking in its entirety is crucial, considering its complexity, which includes cognitive, metacognitive, and socio-affective components that must be integrated through the pedagogical actions of educators.

The results obtained highlight the existing deficiencies among basic education students regarding the articulation of their thinking skills. This finding necessitates a greater commitment from educators, who should

implement active methodologies designed to enhance the pedagogical process and promote the development of these skills among students.

Furthermore, the analysis of the collected evidence suggests that sociodemographic variables, such as gender, level of education, and institution of origin, do not significantly influence the development of critical thinking. Consequently, it can be confirmed that no statistically significant differences exist in these domains within this study.

Regarding the limitations of this work, the sample size and the number of participants stand out. Additionally, incorporating variables related to metacognitive monitoring and affective components may prove useful for furthering the understanding of the conditions that foster the development of critical thinking among basic education students.

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AUTHORSHIP CONTRIBUTION

Carmen Rosa Berrocal Villegas: Coordination of the project, conceptualization, data curation, formal analysis, methodology, validation, drafting of the original manuscript, proofreading, and editing.

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