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THE RELATIONSHIP BETWEEN CRITICAL THINKING
AND PROBLEM-SOLVING SKILLS AMONG STUDENTS
AT THE UNIVERSIDAD VERACRUZANA, MEXICO:
A QUANTITATIVE STUDY

RELACIÓN ENTRE PENSAMIENTO CRÍTICO Y
SOLUCIÓN DE PROBLEMAS EN ESTUDIANTES DE
LA UNIVERSIDAD VERACRUZANA, MÉXICO:
UN ESTUDIO CUANTITATIVO

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ABSTRACT

This study analyzed the relationship between critical thinking and problem-solving skills in students from the Veracruz region of the Universidad Veracruzana, Mexico. It was conducted with a quantitative approach with a non-experimental, cross-sectional, and correlational design. The sample consisted of 140 students from various academic disciplines. Data was collected using a structured questionnaire of 36 items, organized into dimensions of critical thinking (analysis, inference, and evaluation) and problem-solving (problem identification, alternative generation, and decision-making), using a Likert-type scale. The results showed that both variables were at a moderate level, with a mean of 3.67 for critical thinking and 3.59 for problem-solving. Furthermore, a strong positive correlation was identified between the two competencies ($r = .83, p < .01$), demonstrating a significant relationship between them. In conclusion, critical thinking emerges as a key factor in the development of problem-solving skills in university students. These findings suggest the need to strengthen pedagogical strategies aimed at developing higher-order cognitive skills, contributing to the improvement of academic training and professional performance in complex contexts.

Keywords: critical thinking, problem-solving, higher education, cognitive skills, university students.

RESUMEN

El presente estudio analizó la relación entre el pensamiento crítico y la capacidad de solución de problemas en estudiantes de la región Veracruz de la Universidad Veracruzana, México. Se desarrolló bajo un enfoque cuantitativo, con un diseño no experimental, transversal y de alcance correlacional. La muestra estuvo conformada por 140 estudiantes de diversas áreas académicas. Para la recolección de datos se utilizó un cuestionario estructurado de 36 ítems, organizado en dimensiones de pensamiento crítico (análisis, inferencia y evaluación) y solución de problemas (identificación del problema, generación de alternativas y toma de decisiones), empleando una escala tipo Likert. Los resultados mostraron que ambas variables se ubicaron en un nivel moderado, con una media de 3.67 para el pensamiento crítico y 3.59 para la solución de problemas. Asimismo, se identificó una correlación positiva alta entre ambas competencias ($r = .83, p < .01$), lo que evidenció una relación significativa entre ellas. En conclusión, el pensamiento crítico se posiciona como un factor clave en el desarrollo de la capacidad de solución de problemas en estudiantes universitarios. Estos hallazgos sugieren la necesidad de fortalecer estrategias pedagógicas orientadas al desarrollo de habilidades cognitivas de orden superior, contribuyendo a la mejora de la formación académica y al desempeño profesional en contextos complejos.

Palabras clave: pensamiento crítico, solución de problemas, educación superior, competencias cognitivas, estudiantes universitarios.

1. INTRODUCTION

In a world characterized by accelerating change, increasingly complex problems, and a constant demand for innovative solutions, the development of higher-order cognitive skills has become a priority in higher education institutions (HEIs). Among these skills, critical thinking stands out for its ability to promote in-depth analysis, information evaluation, and informed decision-making. Various international organizations have emphasized its relevance in contemporary university education, considering it a key skill for navigating uncertain and dynamic contexts. In this regard, recent studies indicate that critical thinking not only enhances academic performance but also strengthens students' ability to solve complex problems in a reflective, creative, and context-sensitive manner (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2021; Organisation for Economic Co-operation and Development [OECD], 2023).

In the Mexican context, the promotion of critical thinking has emerged as a cornerstone for shaping citizens capable of analyzing reality from diverse perspectives and proposing relevant solutions to complex social issues. International organizations have emphasized in recent years that higher education must foster not only the acquisition of knowledge but also the development of cognitive skills that enable students to actively participate in transforming their environment. In this sense, critical thinking is closely linked to adaptability, informed decision-making, and social responsibility (UNESCO, 2021; OECD, 2022). From this perspective, institutions such as the Universidad Veracruzana (UV) in Mexico have incorporated educational experiences aimed at developing these competencies into their educational model, highlighting the course *Critical Thinking for Problem Solving* as a key academic space for strengthening these skills.

The educational experience *Critical Thinking for Problem Solving* is designed to help students identify problems, analyze their causes, and propose well-founded solutions, integrating elements of creativity, logical reasoning, and the evaluation of alternatives. At UV, this course is offered to students from various degree programs, which fosters the exchange of perspectives and the collaborative construction of knowledge. However, although its curriculum design emphasizes the development of these competencies, questions remain regarding the extent to which students are able to transfer these skills to real-world situations—an aspect that has been identified as one of the main challenges in contemporary higher education (OECD, 2023).

Various studies have highlighted the importance of analyzing the relationship between critical thinking and problem-solving skills in the university setting. In particular, it has been shown that the implementation of active methodologies, such as problem-based learning and collaborative work, contributes significantly to the development of these competencies by placing students in contexts of analysis, decision-making, and solution-building (OECD, 2023; UNESCO, 2022). However, recent studies also note that, although many higher education institutions incorporate these skills into their graduate profiles, limitations persist in the implementation of systematic strategies for their assessment and monitoring. This situation highlights the need to generate contextualized

empirical evidence that allows for an understanding of the actual level of development of these competencies in specific educational settings (Banco Interamericano de Desarrollo [BID], 2021).

At the national and Latin American levels, various studies have indicated that the lack of systematic assessment mechanisms can limit the effectiveness of programs aimed at developing critical thinking. Likewise, it has been shown that including this skill in curricula does not guarantee its mastery, as its development depends largely on the teaching strategies implemented by the teacher and the level of student engagement in the learning process (IDB, 2021). These considerations reinforce the need for empirical research that analyzes the reality of specific groups of students, taking into account variables such as the academic context, disciplinary diversity, and available educational resources.

In the case of the Veracruz region in Mexico, the diversity of academic programs and interdisciplinary interaction create a conducive environment for analyzing critical thinking and problem-solving from a comprehensive perspective. However, there are no recent studies that quantify the level of these competencies or examine the relationship between them in this particular context. This lack of empirical evidence limits the ability to design and implement targeted pedagogical strategies that address students' actual needs, a situation that has been identified as a recurring challenge in improving educational quality at the higher education level (OECD, 2023).

Based on this issue, the central research question arises: ¿Is there a significant relationship between the level of critical thinking and problem-solving ability among students in different academic areas at the UV? Answering this question will not only shed light on the current state of these competencies but also generate empirical evidence that contributes to the improvement of teaching practices and curriculum design in higher education, particularly regarding the development of higher-order cognitive skills, which are considered essential for lifelong learning (UNESCO, 2021).

The aim of the study was to analyze the relationship between critical thinking and problem-solving skills among UV undergraduate students who took the educational course *Critical Thinking for Problem Solving* between August 2025 and January 2026. Specifically, the study sought to: a) measure the students' level of critical thinking; b) evaluate their problem-solving ability; and c) determine the statistical relationship between the two variables. In line with these objectives, three research questions were posed: ¿What is the level of critical thinking among students in the Veracruz region of Mexico?; what is their problem-solving ability?; and is there a significant correlation between these two competencies in this group?

Consequently, this study sought to contribute to the body of knowledge on the development of cognitive competencies in higher education through a quantitative analysis that serves as a foundation for the design of future pedagogical interventions. In this way, the aim is to strengthen the role of the UV as an institution that fosters skills to prepare its graduates to face the professional and social challenges of the 21st century. In this regard, it is essential to delve deeper into the conceptual frameworks and theoretical models that underpin the development of critical thinking and problem-solving, in order to contextualize their application in educational settings.

Various theoretical models have sought to explain the structure and development of critical thinking in educational contexts. Among the most influential, the model proposed by Paul and Elder (2020) outlines a series of intellectual standards (such as clarity, precision, relevance, and depth) that enable the evaluation of the quality of thinking and guide it toward informed decision-making. This approach is complemented by metacognitive perspectives that emphasize skills such as self-regulation, reflection, and evidence-based analysis, fostering a deeper and more intentional understanding of knowledge (metacognition). Likewise, models such as the *Big6*, initially geared toward information literacy, propose a structured process for problem-solving through the strategic management of information, making it a tool that can be transferred to the university setting to strengthen critical thinking.

In terms of teaching strategies, problem-based learning (PBL) has established itself as one of the most effective methodologies for developing critical thinking in higher education, as it places students in real-world scenarios that require analysis, reasoning, and decision-making. Recent evidence indicates that its implementation, combined with techniques such as critical debate and the use of visual organizers, significantly promotes the development of problem-solving skills and analytical thinking (Chacón-Cueva et al., 2023). Complementarily, the *Science, Technology, Engineering, Arts, and Mathematics* (STEAM) approach promotes interdisciplinary learning environments centered on solving real-world problems, integrating science, technology, engineering, arts, and mathematics, which enhances both critical and creative thinking through collaborative and contextualized processes (Pineda Caro, 2022).

2. METHOD OF RESEARCH

This study was conducted using a quantitative approach, as its purpose was to measure and analyze the relationship between critical thinking and problem-solving skills among college students using numerical data and statistical methods. This approach allows for the identification of patterns, relationships, and levels of correlation between variables, yielding objective and replicable results that facilitate evidence-based decision-making (Hernández-Sampieri et al., 2021).

In terms of design, a non-experimental, cross-sectional approach with a correlational scope was adopted. The non-experimental nature of the study is justified by the fact that the variables were observed in their natural

context without deliberate manipulation. The cross-sectional design involved data collection at a single point in time, while the correlational scope made it possible to determine the magnitude and direction of the relationship between critical thinking and problem-solving (Hernández-Sampieri et al., 2021).

The study population consisted of students enrolled in various undergraduate programs offered at the UV during the period from August 2025 to January 2026. A non-probabilistic convenience sample of 140 participants was selected. Inclusion criteria included being enrolled in a Basic Education course related to critical thinking and voluntarily agreeing to participate in the study. The sample was diverse in terms of gender, age, and academic program. This allowed for a broad view of the context under analysis.

A structured questionnaire divided into two sections was used to collect the data. The first section assessed critical thinking using an adaptation of the *Critical Thinking Skills Questionnaire* (CTSQ), while the second section measured problem-solving ability using a scale based on the *Problem Solving Inventory* (PSI). Both instruments used a five-point Likert scale, ranging from *strongly disagree* (one) to *strongly agree* (five). Content validity was established through expert judgment, and reliability analysis yielded a Cronbach's alpha coefficient of 0.88 for critical thinking and 0.85 for problem-solving, indicating adequate internal consistency.

The procedure involved administering the questionnaire both in person and online, using the institutional platform *Eminus* to facilitate student participation. Participants were informed in advance of the study's objectives, and the voluntary, anonymous, and confidential nature of their participation was guaranteed. The survey took approximately 20 minutes to complete and was supervised by the research team to ensure consistent conditions during data collection.

Descriptive statistics were used to analyze the data, including measures of central tendency and dispersion, as well as inferential statistics to examine the relationship between the variables. Pearson's correlation coefficient was used to determine the strength and direction of the association between critical thinking and problem-solving, with a significance level of $\alpha = .05$. Additionally, Student's t-tests were applied to identify significant differences based on sociodemographic variables. The analyses were performed using *IBM SPSS Statistics* version 27.

With regard to ethical considerations, the study was guided by the principles set forth in the Declaration of Helsinki (2013 update, currently in force), as well as by the institutional regulations of the UV. Informed consent was obtained from all participants, data confidentiality was guaranteed, and it was ensured that the data would be used exclusively for academic and research purposes. Furthermore, no incentives were offered, thereby avoiding any form of coercion regarding participation.

3. RESULTS

The results are based on a structured questionnaire administered to 140 students from the Veracruz region of the UV between August 2025 and January 2026 (Table 1). It was found that 50.0% of the participants were female and 46.4% were male. In terms of age, the 18–20 age group was the most common (42.9%), followed by the 21–23 age group (39.3%). Regarding academic fields, the largest proportion of students was in the Humanities (54.3%), followed by Agricultural and Biological Sciences (21.4%) and Economics and Business Administration (16.4%).

Table 1
Sociodemographic characteristics of the sample

Variable	Category	Frequency (n)	Percentage (%)
Gender	Man	65	46.4%
	Woman	70	50%
	I'd rather not say/other	5	3.6%
Age	18-20 years old	60	42.9%
	21-23 years old	55	39.3%
	24 years old and more	25	17.8%
Academic department	Humanities	76	54.3%
	Agricultural Biotechnology	30	21.4%
	Health Sciences	9	6.5%
	Business and Administration	23	16.4%
	Technical	2	1.4%

The overall level of critical thinking had a mean of 3.67 (standard deviation [SD] = 0.67), suggesting a moderate level in the sample analyzed. The analysis dimension recorded the highest mean (Mean [M] = 3.70, SD = 0.65), while the inference (M = 3.65, SD = 0.68) and evaluation (M = 3.65, SD = 0.70) dimensions showed similar values (Table 2).

Table 2

Levels of critical thinking

Variable	Mean	Standard deviation
Analysis	3.70	0.65
Inference	3.65	0.68
Evaluation	3.65	0.70
Total	3.67	0.67

With regard to problem-solving, an overall mean of 3.59 (SD=0.69) was observed, which also indicates a moderate level. The dimension of generating alternatives had the highest score (M=3.74, SD=0.66), while problem identification had the lowest mean (M=3.48, DE=0.72) (Table 3).

Table 3*Levels of problem-solving*

Variable	Mean	Standard deviation
Identification of the problem	3.48	0.72
Generating alternatives	3.74	0.66
Decision-making	3.56	0.69
Total	3.59	0.69

A strong positive correlation was identified between critical thinking and problem-solving ($r=.83$, $p<0.01$), indicating that higher levels of critical thinking are associated with greater problem-solving ability. According to the criteria for interpreting the correlation coefficient, this value represented a strong, statistically significant relationship. These results confirmed the existence of a consistent relationship between the two variables in the study population (Table 4).

Table 4*The rRelationship between critical thinking and problem solving*

Variables	r	p
Critical Thinking–Problem Solving	.83	< .01

4. DISCUSSION

The results of this study revealed a strong positive relationship between critical thinking and problem-solving skills among UV students ($r=.83, p<0.01$). This finding indicates that both competencies are closely linked, such that the development of one significantly contributes to the strengthening of the other. The magnitude of the observed correlation suggests a particularly strong association, which could be explained by the complementary nature of both cognitive skills within educational contexts. However, it is important to consider that high correlation values may also be influenced by the conceptual proximity between the variables or by characteristics of the measurement instrument. This should be explored in future research, particularly in terms of internal consistency and construct validity (Tavakol & Dennick, 2021).

Furthermore, the high correlation coefficient ($r = .83$) also calls for critical reflection, as it could suggest a possible conceptual overlap between the measured variables. In this regard, it is pertinent to question whether the instruments used clearly differentiate between critical thinking and problem-solving, or whether both constructs share similar components that influence the results obtained. This consideration is relevant from a methodological standpoint, as it could imply the need to refine the measurement instruments for future research. These results are consistent with recent research that has documented the interdependence between critical thinking and problem-solving in higher education contexts (Bezanilla et al., 2021; Saiz Sánchez & Fernández Rivas, 2012). This research reinforces the idea that both competencies are part of the same system of higher-order cognitive skills.

From a theoretical perspective, the findings were consistent with the model of critical thinking proposed by Paul and Elder (2020), who argue that skills such as analysis, inference, and evaluation are essential for informed decision-making. Likewise, these results were consistent with contemporary approaches that link critical thinking to processes of self-regulation and metacognition, which play a central role in autonomous learning and the resolution of complex problems (Dinsmore et al., 2021; Schunk & Zimmerman, 2011). In this study, the dimensions of critical thinking showed moderate levels, with analysis standing out as the most developed skill. This suggests that students possess relevant cognitive foundations. However, there is still room for improvement in more complex processes such as critical evaluation and inference, which are essential for effectively addressing real-world problems.

With regard to the problem-solving variable, the results indicated that generating alternatives was the most highly rated dimension, while problem identification received the lowest scores. This finding is consistent with recent studies suggesting that students tend to focus on finding solutions without conducting a thorough analysis of the initial problem, which can limit the effectiveness of decision-making. In this regard, the need to strengthen the initial stages of the problem-solving process within the educational setting was emphasized.

Furthermore, the results supported the effectiveness of active methodologies such as PBL, which have been widely documented as strategies that promote the simultaneous development of critical thinking and problem-solving skills. Various studies have shown that the implementation of these methodologies in higher education promotes analytical, argumentative, and decision-making skills in real-world contexts, which is consistent with the findings of this study (Chacón-Cueva et al., 2023). Complementarily, emerging educational approaches such as STEAM education also highlight the importance of integrating interdisciplinary knowledge for the development of complex competencies in students.

On the other hand, the moderate level identified in both variables suggests that, although students have developed certain skills, these have not yet been fully consolidated. This finding aligns with research indicating that the inclusion of critical thinking in curricula does not guarantee its effective development, as this depends largely on the pedagogical strategies implemented and the degree of student engagement in their learning process (IDB, 2021). Furthermore, international reports emphasize that strengthening 21st-century skills remains a significant challenge in contemporary education systems (UNESCO, 2021; OECD, 2022).

In the specific context of the UV, these findings have significant implications. While the educational experience *Critical Thinking for Problem Solving* provides a key setting for developing these competencies, the results suggest a need to strengthen teaching strategies aimed at transferring knowledge to real-world situations. This involves promoting activities that integrate in-depth analysis, critical reflection, and contextualized decision-making, as well as the use of interdisciplinary approaches that foster meaningful learning.

It is also important to note that the cross-sectional design of the study does not allow for the establishment of causal relationships between the variables analyzed; therefore, the results should be interpreted with caution. In this regard, the relationship identified reflects an association but does not imply that one variable directly determines the other.

Finally, this study provided relevant empirical evidence on the relationship between critical thinking and problem-solving in the specific context of higher education. However, we acknowledge the need for future research that increases the sample size, incorporates longitudinal designs, and considers additional variables—such as academic performance or the use of educational technologies—in order to deepen our understanding of these phenomena. These efforts are essential in a global context that demands the development of cognitive competencies to navigate complex, dynamic, and uncertain environments (OECD, 2023).

5. CONCLUSIONS

The study examined the relationship between critical thinking and problem-solving skills among students at the University of Valencia. It revealed a strong positive correlation between the two variables. This finding confirmed that the development of critical thinking is a key factor in strengthening students' ability to address and solve complex problems.

Furthermore, it was found that both critical thinking and problem-solving skills are at a moderate level. This suggests that, while students have developed these skills, there is still significant room for improvement. In particular, there is a need to strengthen skills related to problem identification and critical evaluation, which are key to more effective decision-making.

In this regard, the findings underscored the importance of implementing pedagogical strategies that promote the comprehensive development of these skills, such as the use of active learning methods, problem-based learning, and collaborative work. These strategies can facilitate the transfer of knowledge to real-world situations, thereby strengthening students' academic education.

From an institutional perspective, this study provided relevant evidence for the UV by offering information that can be used to improve the curriculum design and teaching practices in the educational program *Critical Thinking for Problem Solving*. In this way, it strengthens the graduate profile and the development of key skills for the 21st century. It is recommended that future research expand the scope of the study by using more representative samples, longitudinal designs, and the inclusion of additional variables, in order to deepen the understanding of the development of cognitive competencies in higher education.

In summary, this study not only confirmed the close relationship between critical thinking and problem-solving but also provided empirical evidence within a Mexican university context, thereby contributing to the discussion on the development of cognitive competencies in higher education in Latin America. These findings reinforced the need to move toward educational models that not only transmit knowledge but also actively promote skills in analysis, reflection, and decision-making—skills that are indispensable for addressing the challenges of complex and changing environments.

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