



Metodología Activa Para Fortalecer El Pensamiento Lógico De Estudiantes Universitarios Active methodology to strengthen the logical thinking of university students.

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Abstract

The objective of this study was to determine the influence of a teaching program based on active learning methodologies on the development of logical thinking in university students at a university in Guayaquil during the year 2025. The research adopted a quantitative, applied approach with a quasi-experimental design that included two study groups, each composed of 40 students. A pre-test and a post-test were administered using a structured Likert-type questionnaire, evaluating the dimensions of inductive reasoning, deductive reasoning, problem-solving, and logical inference. The results showed that, after the implementation of the proposed program, the experimental group demonstrated significant improvements. The low level of logical thinking decreased from 65% to 5%, while the high level increased from 7.5% to 70%. Similar progress was recorded in all the dimensions evaluated, with statistically significant differences confirmed by the Mann-Whitney U test ($p < 0.05$). It is concluded that the teaching program was effective in strengthening logical thinking, demonstrating that active methodologies outperform traditional practices in university education.

Keywords: logical thinking, active methodologies, higher education, cognitive reasoning.

Introducción

Modern university education demands didactic strategies that enhance considered logical thinking, a cognitive skill that enables students to solve complex problems, sustain well-founded debates, and make valid judgments. The OECD, through the Programme for International Student Assessment (PISA), evaluates logical thinking in the area of mathematics, where it measures the capacity for deductive and inductive reasoning to solve



problems. PISA (2022) highlights mathematical reasoning as a requirement for mathematical literacy, allowing students to interpret solutions in daily contexts.

For its part, international organizations such as UNESCO (2023) maintain that brain development in children is stimulated by concrete reasoning through knowledge of the world and prefrontal self-regulation. In light of this, it recommends activities to explore new environments and logical skills from childhood.

In Ecuador, a structural weakness is identified in higher education due to the limited integration between the teaching of logical content and its practical application, causing learning that is not very meaningful and fragmented. Furthermore, numerous reports reveal that many students graduate from secondary education without developing these competencies, affecting their performance in scientific, technological, and social careers (CES, 2022).

A representative example is a university in Guayaquil, where low levels of logical reasoning are detected, along with difficulties in constructing arguments, analyzing cause-effect relationships, and making well-founded decisions. These deficiencies manifest in high failure rates and problems in subjects such as mathematics and logic, which are reflected in research and interdisciplinary projects. Despite taking courses associated with formal logic, the lack of knowledge transfer evidences the gap between the official curriculum and the learning achieved. The problem affects educational quality, generating concern among teachers and authorities. This signals the urgency of designing didactic programs based on pedagogical evidence that stimulate logical thinking from the first university years through active methodologies and technological resources.

Given this panorama, the study presents a model that connects cognitive theory with technological mediation, addressing the relationship between logical thinking, critical thinking, and cognitive inference. In this way, it expands the conceptual framework for the development of higher competencies in university education, responding to the detected problem by improving academic performance.

Methodologically, the quasi-experimental design allows for an objective evaluation of the program's impact, ensuring validity and replicability for future interventions. From a pedagogical perspective, it is based on active methodologies where the teacher is a mediator and facilitator of knowledge, promoting thought and analysis, and aligns with Sustainable Development Goal 4 to offer quality education that develops the cognitive, social, and professional competencies required in the 21st century.

The research seeks to answer the following research question: How does the didactic program influence the development of logical thinking in students at a university in Guayaquil in 2025? Its general objective is to determine this influence, with specific objectives that include diagnosing levels of logical thinking and demonstrating impacts on inductive thinking,



deductive thinking, problem-solving, and logical inference. The program promotes accessible environments that leverage error as a learning opportunity, considering logical thinking not only as an abstract process but influenced by variables such as self-confidence, motivation, perseverance, and emotional management.

The research is based on Ausubel's (1963) theory of meaningful learning and Piaget's (1936) theory of cognitive development, who consider logical thinking as an evolutionary process built through mental schemas (Calderón-López et al., 2025). Likewise, the contribution of didactic design is highlighted, supported by previous research that strengthens capabilities, improves academic performance, and prepares students for complex professional contexts.

Among the relevant studies that have addressed this topic at their time are: Barradas (2022), who verified the improvement of mathematical calculation through the use of the Moodle platform in Ecuadorian students; Quispe (2025), who identifies strategies to strengthen critical thinking in higher education in Peru; and Solís and Ramírez (2024), who analyzed how the teacher's role as facilitator impacts mathematical learning. Likewise, López y Frailé (2023) in Chile Jara et al, (2025) in Cuenca evidence the use of traditional didactic strategies comparing them with active methodologies in problem-solving and technological games. Other studies in Mexico, Bolivia, and Cuba show increases in logical-mathematical skills after applying active methodologies and innovative didactics.

From this perspective, logical thinking stands out as a competency that requires planned transversal pedagogical interventions (Imjai et al., 2024). Cedillo et al. (2025); Rodríguez y Calle (2024); Cervera et al. (2023) y Valdez y Santamaria (2025) agree that logical thinking is central to critical thinking and autonomous learning. For a university committed to sustainable development and educational quality, strengthening these skills is indispensable (Andrey Bernate y Vargas Guativa, 2020). In a global context of information overload and polarization, (UNESCO, 2025) emphasizes logical thinking as a priority civic skill to prepare students for employment, democracy, peaceful conflict resolution, and sustainability, a function that the didactic program seeks to fulfill effectively. Claude-

Methodology

The research adopted an applied character with a quantitative orientation, seeking to provide concrete answers to educational needs identified in the university environment. A quasi-experimental design was implemented with two parallel groups: one experimental and one control, each composed of 40 university students, totaling 80 participants. The study extended over six months, using a longitudinal approach to sequentially record changes in the behavior of variables over time.

The dependent variable was logical thinking, defined as a complex cognitive capacity essential for formal reasoning and decision-making (Vásquez Acevedo et al., 2023). This variable was



broken down into four main dimensions: deductive reasoning, which evaluated the application of general rules to specific cases and the formulation of valid conclusions; inductive reasoning, through which the ability to identify patterns and generalize from particular observations was measured; problem-solving, to analyze the ability to examine problematic situations and develop solution strategies; and logical inference, which explored cause-effect relationships and the construction of well-founded hypotheses.

Regarding the independent variable, it corresponded to the didactic program, structured as a student-centered educational intervention based on constructivist principles and active methodologies that included didactic sequences, logical reasoning exercises, case analysis, and metacognitive reflection (Arellano Pimentel et al., 2024).

The total population was 150 students distributed across three classrooms (A, B, and C); a non-probabilistic and purposive sample of 80 participants was selected. The inclusion criteria considered undergraduate students with a minimum attendance of 80% and willingness to participate actively. Those with significant cognitive difficulties, academic withdrawal processes, or repeated absences were excluded.

For data collection, a structured questionnaire was designed based on the dimensions of logical thinking, applied as an entry test (pretest) and exit test (posttest). The instrument used a Likert scale with five response levels: never (1), almost never (2), sometimes (3), almost always (4), and always (5).

The test application process included: A pilot phase to validate the instrument with a small group to verify clarity and comprehension of the items. Then expert validation corresponding to five specialized doctors who reviewed the questionnaire and guaranteed its relevance, coherence, and content validity.

A preliminary measurement was also conducted through the application of the initial test to the experimental and control groups before implementing the didactic program. Afterward, a post-intervention measurement was performed, with the application of the final test after six months of pedagogical intervention. The observation technique complemented the survey, allowing for the recording of behaviors and dynamics during the development of the program.

For data processing, a systematic sequence was followed: classification of information by dimensions, numerical coding of responses, statistical tabulation, and interpretation of results. This methodology allowed for quantitative comparison of logical thinking levels between both groups and evaluation of the effective impact of the didactic program.

The study was developed under strict ethical guidelines, guaranteeing informed consent, participant confidentiality, and exclusively academic use of the collected data.



Results

The descriptive findings obtained through the initial and final evaluations in relation to the established purposes.

Table 1

Processed data

	Missing					
	Valid		Missing		Total	
	N	%	N	%	N	%
Dependent variable	160	100,0%	0	0,0%	160	100,0%
Dimension_1	160	100,0%	0	0,0%	160	100,0%
Dimension_2	160	100,0%	0	0,0%	160	100,0%
Dimension_3	160	100,0%	0	0,0%	160	100,0%
Dimension_4	160	100,0%	0	0,0%	160	100,0%

The table shows that all 160 cases were valid with no missing data across the dependent variable and all four dimensions.

The table shows that the entire sample was considered valid for statistical analysis, with no missing cases recorded in the dependent variable or in any of its dimensions. This result guarantees the integrity and consistency of the data, allowing for descriptive and inferential analyses to be conducted with greater reliability. Likewise, the absence of missing data strengthens the validity of the results, since the estimates obtained completely represent the studied population.

Table 2

Descriptive Results

Descriptive Statistics of the Dependent Variable

Statistic	Value	Standard Error
Mean	46.99	1.924



Statistic	Value	Standard Error
Lower limit (95% CI)	43.19	—
Upper limit (95% CI)	50.79	—
5% Trimmed Mean	45.54	—
Median	34.00	—
Variance	592.113	—
Standard Deviation	24.333	—
Minimum	26	—
Maximum	95	—
Range	69	—
Interquartile Range	42	—
Skewness	1.103	0.192
Kurtosis	-0.661	0.381

Dimension 1 Statistics

Statistic	Value	Standard Error
Mean	11.81	0.507
Lower limit (95% CI)	10.80	—
Upper limit (95% CI)	12.81	—
5% Trimmed Mean	11.43	—
Median	9.00	—



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Variance	41.189	—
Standard Deviation	6.418	—
Minimum	5	—
Maximum	25	—
Range	20	—
Interquartile Range	12	—
Skewness	1.014	0.192
Kurtosis	-0.666	0.381

Dimension 2 Statistics

Statistic	Value	Standard Error
Mean	11.71	0.428
Lower limit (95% CI)	10.87	—
Upper limit (95% CI)	12.56	—
5% Trimmed Mean	11.45	—
Median	9.00	—
Variance	29.351	—
Standard Deviation	5.418	—
Minimum	4	—
Maximum	24	—
Range	20	—



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Statistic	Value	Standard Error
Interquartile Range	8	—
Skewness	0.850	0.192
Kurtosis	-0.651	0.381

Dimension 3 Statistics

Statistic	Value	Standard Error
Mean	12.13	0.522
Lower limit (95% CI)	11.09	—
Upper limit (95% CI)	13.16	—
5% Trimmed Mean	11.81	—
Median	9.00	—
Variance	43.619	—
Standard Deviation	6.605	—
Minimum	5	—
Maximum	25	—
Range	20	—
Interquartile Range	10	—
Skewness	0.911	0.192
Kurtosis	-0.698	0.381



Dimension 4 Statistics

Statistic	Value	Standard Error
Mean	11.34	0.561
Lower limit (95% CI)	10.24	—
Upper limit (95% CI)	12.45	—
5% Trimmed Mean	10.94	—
Median	7.00	—
Variance	50.302	—
Standard Deviation	7.092	—
Minimum	5	—
Maximum	25	—
Range	20	—
Interquartile Range	11	—
Skewness	1.066	0.192
Kurtosis	-0.651	0.381

Note: The statistics presented in Table 2 correspond to the dependent variable and its four dimensions.

The descriptive results of the dependent variable show an overall mean of 46.99, with a high level of dispersion ($SD = 24.33$), indicating heterogeneity in the scores obtained by the participants. The 95% confidence interval (43.19–50.79) suggests a stable estimation of the population mean. The positive skewness (1.103) reveals a concentration of low values with some high scores, while the negative kurtosis indicates a flatter-than-normal distribution.



Regarding the dimensions, the means range from 11.34 to 12.13, with Dimension 3 showing the highest average. All dimensions present moderate positive skewness, suggesting a predominance of low to medium levels, and considerable variability, especially in Dimension 4 (SD = 7.09). Overall, the results reflect unequal performance among participants, which justifies the implementation of intervention strategies aimed at strengthening the evaluated variable.

Table 3

Initial and final assessment of logical thinking in both groups.

Category	Control Group – Initial		Control Group – Final	
	Frequency	Percentage	Frequency	Percentage
Deficient (20–40)	28	70%	22	55%
Regular (41–70)	10	25%	14	35%
Advanced (71–100)	2	5%	4	10%
Total	40	100%	40	100%

Note: Diagnostic comparison between the initial and final assessments of both student groups.

The initial data indicate that both groups had comparable characteristics, with 70% of the first group and 65% of the second group classified as deficient, thus confirming their equivalence. Both groups showed similar conditions, with 70% of the first group and 65% of the second group classified as deficient, confirming their equivalence.

During the intervention, contrasting transformations were identified. The control group showed only slight improvements: its low level decreased from 70% to 55%, and its advanced level increased from 5% to 10%. This demonstrates that traditional teaching methods do not generate significant changes.

On the other hand, the experimental group showed a substantial change, moving from a poor level of 65% to a good level of 5%, and from a good level of 7.5% to a good level of 70%, which represents an increase of 62.5 percentage points. These findings indicate the superior effectiveness of the implemented program, validating the premise that innovative pedagogical



strategies significantly outperform traditional methods in improving logical thinking at the university level.

Specific objective: To demonstrate the impact of the pedagogical program on inductive reasoning in the university student population of Guayaquil during 2025.

Table 4

Initial and final assessment of inductive reasoning ability

Level	Control Group – Pre-test	Control Group – Post-test	Experimental Group – Pre-test	Experimental Group – Post-test
	N	%	N	%
Deficient (20–40)	39	97,5%	37	92,5%
Regular (41–70)	0	0%	1	2%
Advanced (71–100)	1	2,5%	2	5%
Suma total	40	100%	40	100%

Note: Comparative results of inductive reasoning before and after the pedagogical intervention.

The data collected indicate that both groups initially presented identical conditions, with high concentrations at the insufficient level: 97.5% in the control group and 90% in the experimental group, highlighting significant deficiencies in the formulation of inductive hypotheses. Both groups initially showed identical conditions, with high concentrations at the insufficient level—97.5% in the control group and 90% in the experimental group—revealing important shortcomings in the formulation of inductive hypotheses.

This difference of 67.5 percentage points at the highest level between the two groups is the clearest evidence that the educational intervention was effective. This demonstrates that the innovative strategies used were highly successful in improving inductive reasoning skills, enabling participants to master complex cognitive processes such as formulating generalizations based on specific observations—skills essential for scientific thinking and problem-solving in the university context.



After the intervention, the control group showed only a slight improvement. The percentage of students at the insufficient level decreased from 97.5% to 92.5%, while the percentage of those who achieved an outstanding level increased from 2.5% to 5%. This indicates that the methods used to teach this type of complex reasoning were not very effective.

In contrast, the experimental group underwent the pedagogical intervention: the insufficient level decreased from 90% to 0%, while the outstanding level increased from 2.5% to 72.5%, representing a remarkable increase of 70 percentage points. This pedagogical transformation shows that participants mastered complex cognitive processes such as forming generalizations based on specific observations—skills that are fundamental for scientific thinking and problem-solving in the university context.

Specific objective: To verify the influence of the pedagogical program on the deductive reasoning of university students in Guayaquil in 2025.

Table 5

Initial and final measurement of deductive reasoning

Evaluative category	Control Group – Pre-test	Control Group – Post-test	Experimental Group – Pre-test	Experimental Group – Post-test
	Núm.	Porcentaje	Núm.	Porcentaje.
	36	90%	35	87,5%
	3	7,5%	4	10%
	1	2,5%	1	2,5%
Total	40	100%	40	100%

Note: Comparison of performance in deductive reasoning before and after implementation of the program.

According to the information presented, a significant discrepancy in deductive thinking is observed between both groups after the implementation of the program. The static performance of the control group maintained almost 90% of the participants in the basic level, both in the initial and final evaluation.

This demonstrates that, without specialized interventions, no significant changes in this skill are observed. The experimental group, on the other hand, showed great progress: at the beginning of the test, 87.5% were at the basic level, but at the end, this number had dropped to



2.5%. 65% reached the optimal level and 32.5% reached the satisfactory level. On the other hand, they showed great progress: at the beginning of the test, 87.5% were at the basic level, but at the end, this number had dropped to 2.5%. 65% reached the optimal level and 32.5% reached the satisfactory level.

These data show that the strategies used in the experimental group were very effective in improving deductive thinking skills, causing the majority of participants to move from low performance to excellent, which had a positive and statistically significant pedagogical impact.

Specific objective: To verify the impact of the pedagogical program on the problem-solving capacities of university students in Guayaquil in 2025. Claude es IA y puede cometer errores. Por favor, verifica las respuestas.

Table 4

Comparative evaluation of problem-solving competencies

Escala	GC Evaluación 1	GC Evaluación 2	GE Evaluación 1	GE Evaluación 2
		%	Cantidad	%
Low (20–40)	25	62,5%	29	72,5%
Moderate (41–70)	7	17,5%	4	10%
High (71–100)	8	20%	7	17,5%
Total	40	100%	40	100%

Note: Comparative analysis of deductive reasoning performance before and after the implementation of the program.

According to the information presented, a significant discrepancy in deductive thinking is observed between both groups after the implementation of the program. The static performance of the control group kept nearly 90% of the participants at the basic level, both in the initial and final assessments.

This indicates that, without specialized interventions, no significant changes are observed in this skill. In contrast, the experimental group showed remarkable progress: at the beginning of the test, 87.5% of the participants were at the basic level, but by the end, this figure had decreased to 2.5%. Meanwhile, 65% reached the optimal level and 32.5% achieved the satisfactory level.



These data demonstrate that the strategies used in the experimental group were highly effective in improving deductive thinking skills, enabling most participants to move from low to excellent performance. This resulted in a positive and statistically significant pedagogical impact.

Specific objective: To verify the impact of the pedagogical program on the problem-solving abilities of university students in Guayaquil in 2025.

Table 5

Measurement of logical inference abilities before and after the intervention

Range	Control Group		Experimental Group	
	– Pre-test	Post-test	– Pre-test	– Post-test
	Number	Percentage	Number	Percentage
Low (20–40)	35	87,5%	32	80%
Medium (41–70)	2	5%	3	7,5%
High (71–100)	3	7,5%	5	12,5%
Total	40	100%	40	100%

Note: Comparative analysis of logical inference in both groups before and after the program.

The results in the logical inference dimension show different trends between the two groups. The control group showed only slight improvements: the low level decreased from 87.5% to 80%, and the high level increased from 7.5% to 12.5%. However, these changes are minimal, and most of the group continues to show low performance.

In contrast, the experimental group demonstrated very positive results: the percentage at the low level dropped dramatically from 82.5% to 5%, while the percentage at the high level increased from 7.5% to 70%. These findings indicate that the methodology applied in the experimental group had a remarkably positive effect on strengthening logical inference skills, enabling most participants to progress from an initially deficient performance to levels of



academic excellence. This establishes a significant difference compared to the control group, which maintained low results despite the slight improvements observed.

Inferential Statistical Analysis

Hypothesis Testing

General hypothesis: The implemented pedagogical program generates a favorable impact on the strengthening of logical thinking among university students in Guayaquil during 2025.

Table 6
Normality Test of Data Distribution

Variable/Dimension	Kolmogorov–Smirnov Statistic	Degrees of Freedom	Significance	Shapiro-Wilk
Logical Thinking (variable)	0,319	160	0,000	0,963
First dimension	0,267	160	0,000	0,963
Second dimension	0,212	160	0,000	0,945
Third dimension	0,233	160	0,000	0,954
Fourth dimension	0,288	160	0,000	0,965

Note: Results of the Kolmogorov–Smirnov normality test applied to the main variable and its dimensional components.

To verify data normality, the Kolmogorov–Smirnov test was applied to a sample of 40 participants. The results indicate that both the main variable, *logical thinking*, and its four constituent dimensions present significance values of 0.000 ($p < 0.05$), confirming that the data do not follow a normal distribution. The lack of normality in the data distribution suggests that the non-parametric Mann–Whitney U test should be used for inferential analysis instead of parametric tests, since the latter require the assumption of normality to ensure the validity of their conclusions.



Table 7

Effect of the pedagogical program on logical thinking.

Assessment	Participants	Mean rank	Sum of ranks	U Mann-Whitney	Significance
Pre-intervention	40	37,16	1486,50	666,500	0,197
Post-intervention	40	60,50	2420,00	-	0,000
Total muestra	80	-	-	-	-

Note: Impact of the implemented program measured through the Mann-Whitney U test.

The findings of the initial evaluation show an average rank of 37.16 with a significance value of 0.197. Considering that p is greater than 0.05, the null hypothesis is accepted, indicating the absence of significant differences between both groups prior to the application of the pedagogical program.

After the implementation of the program, the final evaluation scores reached an average rank of 60.50 with a significance value of 0.000. Applying the statistical decision criterion, these results lead to rejecting the null hypothesis and accepting the research hypothesis, given that there are statistically significant and positive differences between both groups, demonstrating that the pedagogical program exerted a favorable effect on the development of logical thinking in students of the experimental group.

Table 8

Impact of the program on inductive reasoning

Evaluation moment	N	Mean rank	Sum rangos	U Mann-Whitney	Sig.
Medición inicial	40	40,45	1618,00	820,000	0,095
Medición final	40	60,50	2420,00	7,7480	0,000
Total	80	-	-	-	-

Note: Effectiveness of the program on the inductive reasoning dimension evaluated through Mann-Whitney U.



The results of the initial measurement present a mean rank of 40.45 with a significance value $p = 0.095$. Since p exceeds 0.05, the null hypothesis is accepted as no significant differences are evidenced prior to the intervention. This finding verifies that any difference identified in the final measurement is directly attributed to the effect of the pedagogical program.

The findings of the final measurement show a higher mean rank of 60.50 with a significance value $p = 0.000$. This leads to rejecting the null hypothesis and accepting the alternative hypothesis, since the existence of significant differences confirms that the pedagogical program generated a positive and statistically relevant impact on the experimental group, substantially improving the performance of the intervened group compared to the control group that did not receive the specialized intervention.

Table 9

Influence of the program on deductive reasoning

Phase	Quantity	Average rank	Cumulative sum	Mann-Whitney U	Asymptotic significance
Pre-evaluation	40	37,21	1488,50	13,500	0,054
Post-evaluation	40	60,16	2406,50	13,500	0,000
Total participants	80	-	-	-	-

Note: Effects of the pedagogical program on the deductive reasoning dimension.

The data from the pre-evaluation show a rank of 37.21 with a U value equivalent to 13.500 and significance of 0.054. According to the statistical decision criterion, since $p = 0.054 > 0.05$, the null hypothesis is accepted, which indicates the absence of statistically significant differences before the application of the pedagogical program.

The results of the post-evaluation reached a higher average rank of 60.16 with a U value = 13.500 and significance $p = 0.000$. In this scenario, the null hypothesis is rejected, indicating that there are statistically significant differences after the pedagogical intervention.



Table 10

Effects of the program on problem-solving

Evaluation group	N°	Average ranks	Sum of ranks	Mann-Whitney U	Asymptotic Sig.
Pre-test	40	38,15	1526,00	706,000	0,362
Post-test	40	60,50	2420,00	0,000	0,000
Total sample	80	-	-	-	-

Note: Impact of the pedagogical program on problem-solving abilities.

The results of the initial evaluation present a rank of 38.15 with U value = 706.000 and a significance level $p = 0.362$. According to the decision criterion, given that $p = 0.362 > 0.05$, the null hypothesis is accepted, confirming the absence of significant differences prior to the implementation of the pedagogical program.

The inferential findings in the final evaluation show a higher average rank of 60.50 with U value equivalent to 0.000 and significance 0.000. This allows for rejecting the null hypothesis and accepting the alternative hypothesis, confirming that the statistical differences after the intervention are conclusive, attributable to the effect of the implemented pedagogical program.

Table 11

Impact of the program on logical inference.

Measurement	Participants	Mean rank	Sum of ranks	U Mann-Whitney	Significance
Initial	40	40,88	1635,00	785,000	0,878
Final	40	60,50	2420,00	0,000	0,000
Total	80	-	-	-	-

Note: Effects of the pedagogical program on logical inference competencies.

The results of the initial measurement reflect average ranks of 40.88, with U value = 785.000 and significance $p = 0.878$. Given that p equals 0.878, a value greater than 0.05, the null



hypothesis is accepted, confirming the absence of significant differences between both groups prior to the application of the pedagogical program.

The results of the final measurement reveal an average rank of 60.50, with U value = 0.000 and significance $p = 0.000$. Applying the statistical decision criterion, given that $p = 0.000 < 0.05$, the null hypothesis is rejected and the research hypothesis is accepted, since the results demonstrate that there are indeed significant differences between both groups after the pedagogical intervention. Claude es IA y puede cometer errores. Por favor, verifica las respuestas.

Discussion

The research proposed to evaluate the level of logical thinking development in university students in Guayaquil through the implementation of an innovative didactic program. The results demonstrated that this pedagogical intervention generated transformations in the cognitive capacities of the participants. The proportion of students placed in the low level experienced a considerable reduction, decreasing from 65% to 5%, while those in the high level increased from 7.5% to 70%. These transformations validate the approaches of many researchers, who characterize logical thinking as a competency for reasoning and solving complex situations in academic contexts.

The inferential analysis revealed that, prior to the intervention, both groups presented equivalent performances without significant differences. However, after the application of the program, the experimental group reached higher values with robust statistical significance, which confirms the direct impact of the implemented strategies. These results align with recent research in Peruvian institutions that also evidenced improvements in critical thinking through active methodologies, indicating the importance of factors such as motivation, reasoning, and creativity in these processes.

The program is based on constructivist principles that emphasize the active construction of knowledge, respecting the stages of cognitive development. This proposal represents a significant contribution to university educational quality, highlighting the effectiveness of active methodologies for training autonomous professionals.

The second dimension analyzed was inductive reasoning, where the results showed notable improvements in the experimental group after the intervention. Students who were initially placed in the high level at 7.5% increased significantly to reach 70%, while the control group maintained its values without changes. This evidence supports Piagetian theory on the progressive development of logical thinking and agrees with recent studies that validate the effectiveness of active approaches to enhance logical-mathematical skills in higher education.

The reduction of the low level from 65% to 5% in the experimental group indicates a qualitative transformation in fundamental cognitive competencies. Although some research documents



resistance to changing traditional practices, this study demonstrates that well-structured interventions can overcome such barriers. The statistical analysis confirmed that the program constitutes a significant predictor of cognitive development, with highly favorable coefficients that rule out chance as an explanation for the observed improvements. These findings contrast with studies that attribute deficiencies in logical thinking to traditional methodologies and limited time to solve problems, demonstrating that teacher training in innovative practices generates transformative results.

Regarding deductive reasoning, understood as the ability to start from general premises to reach specific conclusions, the results revealed extraordinary transformations. The experimental group reduced its low level from 87.5% to 2.5%, while the high level increased from 2.5% to 65%. These changes significantly surpass the findings of previous research that reported improvements from 42% to 79%, which validates the superior effectiveness of the current intervention.

The pretest analysis confirmed the initial equivalence between groups, but the posttest demonstrated statistically significant differences that allow accepting the working hypothesis. These results are based on theories that postulate deductive reasoning as a facilitator of thought structuring and the ability to establish connections between general theories and specific data. Similar research on innovative strategies in problem-solving and technological games has reported comparable results, reinforcing the need to develop structured logical competencies in the university environment. This dimension is particularly relevant for optimizing academic performance and training students for activities that demand rigorous analysis and informed decision-making.

The fourth dimension examined was problem-solving, conceptualized as the ability to understand, analyze, and argue to develop functional competencies in a demanding society. The descriptive results showed that the low level decreased from 70% to 27.5%, while the high level increased from 12.5% to 62.5%, representing a 50% advance. The inferential analysis confirmed statistically significant differences between groups after the intervention, validating the program's effectiveness.

These findings converge with theories that demonstrate that problem-based learning and didactic games increase both performance in logical-mathematical skills and student autonomy. Problem-solving constitutes an indispensable transversal competency that not only improves academic performance but also develops essential metacognitive skills for professional contexts. The ability to decompose complex situations, analyze components, and evaluate alternatives represents a fundamental skill for the 21st century.

It is relevant to note that these results contrast with research reporting that 85.7% of Ecuadorian students present low levels due to traditional teaching methods. Although this study started



from similar unfavorable initial conditions, the systematic application of the program managed to reverse this situation, demonstrating that it is possible to overcome structural deficiencies through innovative pedagogical interventions supported by scientific evidence.

The fifth dimension, logical inference, is defined as a superior cognitive ability that allows establishing causal relationships, formulating hypotheses, and deriving coherent conclusions. From contemporary theoretical perspectives, this capacity constitutes a fundamental intellectual tool in formal sciences and philosophical thinking, being an essential component of critical thinking for the rational evaluation of arguments. Constructivist pedagogical approaches justify the use of active strategies that promote autonomy, knowledge construction, and metacognition.

The inferential results confirmed the program's effectiveness, showing that both groups started from equivalent performances without significant initial differences. However, the posttest revealed that the experimental group reached highly favorable values with statistical significance that allowed rejecting the null hypothesis. The descriptive data indicated a decrease in the low level from 82.5% to 5% and an increase in the high level from 7.5% to 70% in the experimental group, while the control group maintained minimal improvements. The integration of active strategies confirms the validity of the constructivist approach and demonstrates agreement with previous cognitive theories, evidencing that structured didactic programs generate significant changes in logical inference competencies.

Contributions and Conclusions

This research constitutes a contribution to both the educational field and cognitive psychology, by demonstrating that logical thinking can be systematically developed through planned pedagogical interventions based on theories of meaningful learning. The study scientifically validates the relationship between logical thinking, critical thinking, and cognitive inference, evidencing that these cognitive processes can be enhanced through the integration of educational technology and appropriate pedagogical teacher guidance.

From an epistemological perspective, the research maintains that knowledge construction is an active process where the student becomes the protagonist of their learning, surpassing the role of passive receiver. The main scientific contribution consists of presenting an innovative and validated methodological framework that integrates cognitive theory, pedagogical practice, and technological mediation to foster advanced logical and cognitive competencies.

The intervention model developed is replicable and adaptable to various educational levels, serving as a foundation for future research. The results demonstrate that structural deficiencies in logical thinking can be overcome through well-designed programs that incorporate active methodologies, constructivist approach, and contextualized strategies. This scientific evidence represents a call to transform traditional pedagogical practices and train teachers in innovative



approaches that promote the comprehensive development of higher cognitive competencies in university students.

Proposal

Introduction and Justification

The problem for many students who advance to higher levels of education is that they do not have sufficient logical thinking skills, which is reflected in high failure rates in subjects such as mathematics and logic. This deficiency negatively affects their immediate academic performance and limits their ability to solve complex problems, build convincing arguments, and make informed decisions.

Logical thinking goes beyond academics; it is a necessary skill to face current problems, such as information overload, misinformation, and increasing social complexity. In this regard, higher education institutions have the duty to train citizens who can analyze information, construct valid arguments, identify fallacies, and base their decisions on evidence. However, the Ecuadorian university system has structural problems in the connection between the theoretical teaching of logic and its use in real life, which makes learning not very useful and fragmented.

The general objective of the proposal is to design and validate a didactic program based on active methodologies that allows developing logical thinking in students at a university in Guayaquil, through innovative pedagogical strategies, relevant didactic resources, and a formative evaluation system that promotes meaningful learning. For their part, the specific objectives respond to: diagnosing the level of logical thinking development in university students; analyzing current didactic strategies used for teaching logical skills; designing a didactic program that integrates active methodologies and innovative resources; validating the program's effectiveness through pilot application and analysis of results.

The dimensions covered: deductive reasoning - application of general rules; inductive reasoning - observation of patterns; problem-solving or systematic analysis; logical inference - cause-effect relationships.

The program is based on constructivist principles (Ausubel), Jean Piaget's theory of cognitive development, active learning, and metacognitive strategies. Methodologies such as problem-based learning (PBL), case studies, simulations, and interactive technologies will be privileged. The design integrates authentic assessment, pedagogical reflection, and competency-based teaching, promoting the active construction of knowledge and respecting the evolutionary stages of cognitive development.



Administrative Aspects

Item	Detail
Program duration	16 weeks
Total budget	\$7,582.00
Non-monetary resources	\$4,520.00
Monetary resources	\$3,062.00

Note: The table shows funding from the researcher's own resources.

This research constitutes a significant contribution to the educational field and cognitive psychology by demonstrating that logical thinking can be developed through planned pedagogical interventions. The program represents a model adaptable to various educational levels, aligned with global labor market demands and 21st-century competencies. Furthermore, it contributes to closing educational gaps, promoting equitable education that prepares professionals capable of participating in democratic societies, resolving conflicts, and making informed decisions in complex contexts.

The research positions itself as a concrete response to the structural deficiencies of the Ecuadorian university system, offering scientific evidence on the effectiveness of active methodologies to overcome traditional pedagogical practices that limit the development of higher cognitive competencies.

Conclusions

The results obtained show that the didactic program generated significant improvements in the logical thinking of the experimental group compared to the control group.

In relation to the first objective, considerable progress was noted by moving from 65% of students placed in the low level to 70% in the high level, which demonstrates a strengthening of comprehension, analysis, and interpretation of information. For its part, the control group presented minor progress.

Regarding the second objective, inductive reasoning showed a 90% decrease in the low level and an increase up to 72.5% in the high level, demonstrating the effectiveness of strategies based on observation and pattern recognition.



As for deductive reasoning, the results reflected a great improvement, with the low level being reduced from 87.5% and 65% being reached in the high level, which allowed students to develop well-founded deductions and judgments.

In relation to problem-solving, an increase in the high level from 12.5% to 62.5% was observed, which indicates considerable progress in planning capacities, decision-making, and evaluation of alternatives. In logical inference, the experimental group managed to decrease the low level from 82.5% to 5% and increase the high level to 70%, confirming that activities oriented toward critical analysis and hypothesis formulation significantly strengthened inferential reasoning. Claude es IA y puede cometer errores. Por favor, verifica las respuestas. Sonnet 4.5

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