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The Influence of the Brainstorming Learning Method on Students' Critical Thinking Skills Based on Their Prior Knowledge

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ABSTRACT

This study aims to determine the brainstoming method of the critical thinking ability of learners from the initial ability of learners. This research is an experimental study with 2x2 factorial research design. Research sample for 64 students of class X IPS coming from 2 classes in SMA N 1 Cisarua. Both classes are given pretest and posttes. In the experimental class is given learning using brainstroming method, while in control class using conventional method. The results showed an increase in positive thinking skills provided along with higher brainstroming methods than conventional classes and methods of interaction between brainstorming, preliminary knowledge and critical thinking skills of learners.

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INTRODUCTION

School, as a formal educational institution, holds a vital function in shaping the intellectual, emotional, and social development of students. It serves not only as a place for transferring knowledge but also as an environment where learners are guided to develop essential life skills, personal values, and a strong moral character. A well-functioning school system is one that empowers students to become reflective thinkers, responsible citizens, and lifelong learners. To achieve this, the curriculum and learning activities must be carefully planned and systematically implemented through educational programs that support a holistic development of the learner.

In today's fast-changing world, where information and technology evolve rapidly, students must be equipped not just with knowledge, but with the ability to think critically, solve problems, and adapt to complex real-life situations. Educational institutions are thus expected to be transformative spaces that nurture not only academic achievement but also social-emotional skills and personal resilience. This expectation highlights the school's central role in fostering students who can contribute meaningfully to society (Wanders et al., 2019)

In order for instructional practices to be effective and targeted, teachers must first understand the prior knowledge or existing cognitive frameworks that students bring into the classroom. Prior knowledge acts as a foundational base upon which new information is built. As stated by Joosten and Cusatis (2020), this knowledge provides essential insight for teachers to determine students' readiness to absorb new material, gauge their familiarity with specific concepts, and identify potential learning gaps that need to be addressed. Moreover, Alt (2015) referencing the constructivist learning theory, affirms that learners are not passive recipients of information; rather, they actively construct meaning based on their previous experiences and understanding. This notion aligns with the view that students' existing mental models play a key role in how they process new knowledge.

The constructivist paradigm, as developed by Jean Piaget, has become a foundational theory in contemporary education. Piaget emphasized that learning is not a linear process of absorbing facts but rather a dynamic and personal construction of understanding. His studies on cognitive development demonstrated that children develop knowledge through active exploration and interaction with their environment. As cited by Benke, & Zhang (2019), Piaget is considered a pioneer of constructivist thought because of his groundbreaking work in demonstrating that knowledge is generated within the minds of learners. In this view, effective pedagogy must acknowledge students' existing cognitive structures and create opportunities for learners to reconstruct and expand their understanding through active engagement and reflection.

Among the most important outcomes of modern education are higher-order thinking skills, which include logical reasoning, analytical thinking, critical evaluation, creativity, accuracy, and the capacity to communicate ideas clearly and effectively. These abilities are essential for solving real-world problems, participating in democratic processes, and succeeding in the workforce. However, these skills do not develop automatically. They must be intentionally cultivated through well-planned, meaningful, and challenging learning experiences. When such skills are not evident among students, it often reflects the shortcomings of instructional practices, particularly those that rely heavily on rote memorization or one-way delivery of information (Deslauriers et al., 2019).

Teachers play a central role in cultivating an environment where students feel empowered to question, explore, and synthesize ideas. The teacher's ability to foster active participation and critical dialogue can significantly enhance the depth and quality of student learning. In such environments, learning becomes a shared process, wherein both teacher and students engage in inquiry, discussion, and co-construction of knowledge. This dynamic interaction promotes deeper understanding and strengthens students' intellectual autonomy.

Unfortunately, in many classrooms, traditional teaching methods still dominate. These methods often position students as passive receivers of information rather than as active participants in the learning process. Such an approach can stifle curiosity and limit opportunities for the development of critical thinking. Students may learn to recall facts, but they struggle to evaluate arguments, identify logical fallacies, or apply knowledge in novel situations. This is particularly problematic in subjects like economics, which are inherently tied to real-life decisions and social realities. Teaching economics through lecture-based instruction fails to capture the subject's practical relevance and hinders students from engaging with the complexities of economic life (Maroš et al., 2021).

To address these challenges, educators must adopt student-centered learning methods that actively involve learners in the thinking process. One such method is brainstorming, a strategy that encourages the free flow of ideas, fosters creativity, and promotes collaborative learning. Brainstorming allows students to express diverse viewpoints, develop original ideas, and build upon each other's thoughts. By involving students in problem-solving discussions, brainstorming helps to sharpen their reasoning skills, improve their ability to justify their opinions, and draw logical conclusions based on available information. It also fosters a sense of ownership over the learning process, as students feel that their contributions are valued and essential to the collective understanding.

Furthermore, brainstorming aligns with the principles of constructivist pedagogy, which views learning as an active, social process. During brainstorming sessions, students learn to negotiate meaning, analyze the merits of different ideas, and refine their thinking through dialogue. These interactions help students to engage in metacognition, thinking about their own thinking, which is a crucial component of critical thinking development.

In the context of economic education, brainstorming can be particularly effective. Topics such as cooperatives, markets, consumer behavior, and government policy all involve decision-making, multiple perspectives, and moral considerations. Through brainstorming, students can explore real-world economic dilemmas, propose solutions, and reflect on the implications of various choices. This process helps them connect theoretical knowledge with practical application, deepening their understanding and strengthening their ability to reason economically.

Given the above considerations, the present study seeks to explore the impact of the brainstorming learning method on students' critical thinking abilities, while taking into account their prior knowledge as a moderating factor. The research is designed as an experimental study focusing on economics education, specifically targeting the competency standard of understanding cooperatives. The study is conducted with Grade X students at SMA Negeri 1 Cisarua, located in West Bandung Regency, during the academic year 2015/2016.

This investigation aims to provide empirical evidence on whether the integration of brainstorming techniques can significantly enhance students' critical thinking, especially when aligned with students' initial cognitive capacities. Ultimately, the findings are expected to inform teaching practices that support more effective, engaging, and equitable learning environments in secondary education.

METHODS

This study employed a quantitative research approach using an experimental method with a 2x2 factorial design. The 2x2 factorial design is an experimental setup that allows the researcher to examine the effect of two independent variables and their interaction on a dependent variable. In this case, the two independent variables were (1) the learning method, brainstorming vs. conventional, and (2) the students' level of prior knowledge, high vs. low. The dependent variable was the students' critical thinking ability as measured through a structured assessment following the intervention.

The purpose of using this factorial design was to determine not only the main effect of each independent variable on students' critical thinking skills but also the interaction effect between the type of learning method and the level of prior

knowledge. By doing so, the study could reveal whether the effectiveness of the brainstorming method depends on students' initial competence, thereby offering a more nuanced understanding of how teaching strategies interact with learner characteristics.

Experimental Groups and Research Design

In this study, the students were systematically categorized into four experimental groups based on two independent variables: prior knowledge (high and low) and learning method (brainstorming and conventional). The full factorial 2x2 design used in this research allowed for a comprehensive examination of both the main effects and the interaction effects of these variables on students' critical thinking skills. The grouping is presented in the table below:

Table 1. *Experimental Groups and Research Design*

Prior Knowledge	Learning Method	Group Code
High	Brainstorming	A1B1
High	Conventional	A2B1
Low	Brainstorming	A1B2
Low	Conventional	A2B2

This experimental design offers several advantages in the context of educational research. Firstly, it enables the isolation of each variable's individual contribution to the dependent variable, in this case, students' critical thinking skills. Secondly, it facilitates the identification of interaction effects, which occur when the impact of one independent variable (e.g., teaching method) varies depending on the level of another independent variable (e.g., prior knowledge) (Hainmueller, Mummolo, & Xu, 2016).

Using a factorial design is particularly useful in educational settings where student learning is often influenced by multiple interrelated factors. By simultaneously analyzing the effects of teaching strategies and student characteristics, researchers can gain a more nuanced understanding of how instructional methods work in real classroom contexts (Meng et al., 2024).

Moreover, such a design allows for the detection of differential effectiveness of teaching methods across subgroups of students. For example, it becomes possible to determine whether brainstorming is more beneficial for students with high prior knowledge, or whether it also significantly helps those with lower prior

understanding (Zou et al., 2023). This information can be vital for educators seeking to apply differentiated instruction and tailor learning activities based on students' initial abilities.

In summary, the 2x2 factorial design employed in this study was chosen not only for its statistical efficiency but also for its pedagogical relevance, allowing the research to produce findings that are both scientifically robust and practically applicable in diverse classroom environments (Piepho & Edmondson, 2018).

Population and Sample Selection

The target population of this study comprised all Grade X students enrolled in the academic year at SMA Negeri 1 Cisarua, a public secondary school situated in West Bandung Regency, Indonesia. This school was chosen based on accessibility, curriculum alignment, and the researcher's familiarity with the institutional setting, which facilitated smooth implementation of the experimental design (Harper & Milman, 2016).

To obtain a representative sample from the population, simple random sampling was employed. This technique ensures that each class in the population had an equal probability of being selected, thereby minimizing selection bias and enhancing the external validity of the study's findings (Kuznetsova, 2023). Such randomization is especially important in experimental research as it helps control for pre-existing differences among groups, ensuring that observed outcomes are attributable to the intervention rather than extraneous factors.

Following this procedure, two intact classes were randomly chosen:

1. Class X IPS-5 was designated as the experimental group, receiving instruction through the brainstorming learning method, a student-centered and participatory approach aimed at fostering higher-order thinking.

2. Class X IPS-2 was assigned as the control group, receiving instruction via a conventional learning method, typically characterized by teacher-centered lecturing and minimal interaction.

The composition of these two classes is outlined in the following table:

Table 2: *Description of Research Subjects*

Class	Learning Method	Total Students	Male Students	Female Students
X IPS-5	Brainstorming	32	13	19
X IPS-2	Conventional	32	16	16

To ensure comparability between groups, particular attention was paid to maintaining a balance in terms of the number of students and gender distribution. Equal class sizes helped control for class size effects, which can influence student engagement and learning outcomes (Xu, Bos, & Wu, 2022). Furthermore, the gender balance helped reduce potential biases stemming from gender-related differences in cognitive styles, communication patterns, or participation levels that might influence the results, especially in collaborative learning environments (Feng et al., 2023).

By carefully selecting the sample and controlling key demographic variables, this study aimed to establish a valid experimental framework that would yield reliable and generalizable insights into the effectiveness of the brainstorming method in enhancing students' critical thinking skills in economics education.

Preliminary Data Analysis Procedures

Before proceeding with the main statistical analyses, a series of preliminary data analysis steps were undertaken. These steps were essential to validate the research instruments, confirm group equivalency, and ensure the accuracy and reliability of the data collected. The integrity of these processes forms the foundation for valid inferences and interpretations of the study's findings.

1. **Instrument Testing**:

To ensure the instruments used in this study (particularly the critical thinking test and prior knowledge assessment) met accepted psychometric standards, both validity and reliability tests were conducted:

1.1 **Validity Test**

The validity of the instrument items was evaluated using the Product Moment Correlation formula. This test was employed to assess whether each test item accurately measured the intended construct, in this case, students' critical thinking skills and prior knowledge. A correlation coefficient (r-value) for each item was calculated and compared against a critical value (r-table) at a predetermined significance level (typically $\alpha = 0.05$). Items that met or exceeded the critical value were deemed valid and retained in the instrument (Christensen, Makransky, & Horton, 2017).

1.2 **Reliability Test**

To assess the internal consistency of the instrument, Cronbach's Alpha coefficient was used. A reliability coefficient of ≥ 0.70 is generally considered acceptable in educational research, indicating that the instrument produces stable and consistent results across repeated applications. The reliability test

ensured that the items measured the construct coherently and that the results could be interpreted with confidence.

2. Pre-Experimental Data Processing

Prior to administering the treatment in the experimental and control groups, it was necessary to conduct several statistical procedures to establish the baseline comparability of the groups and the suitability of categorization based on prior knowledge:

2.1 Prior Knowledge Group Verification

To ensure that the classification of students into high and low prior knowledge groups was statistically justifiable, an independent samples t-test was conducted. This test was used to compare the mean scores of students grouped by prior knowledge levels. A statistically significant difference between the two groups confirmed the validity of the categorization and allowed for further analysis of how prior knowledge interacted with teaching methods in influencing critical thinking outcomes (Liu et al., 2019).

2.2 **Equivalence Test (Pre-Test Scores)**

In order to make valid post-treatment comparisons, it was critical to verify that the pre-existing differences in critical thinking skills between groups were not statistically significant. This was achieved through an equivalence test, also using an independent samples t-test. By comparing the pre-test scores of all groups, the analysis confirmed whether the groups started at a similar level. Equivalence in pre-test scores is a necessary condition for asserting that any subsequent differences in post-test results are attributable to the experimental treatment, rather than initial group differences (Emons, & Sijtsma, 2021).

Assumptions for Inferential Statistics

Following the initial preparatory procedures, the next critical stage involved evaluating the statistical assumptions necessary for conducting valid inferential analysis. These assumptions underpin the reliability and accuracy of parametric statistical methods, particularly the use of Analysis of Variance (ANOVA). Two primary assumptions were assessed:

1. Normality Test

The assumption of normality refers to the requirement that the data, particularly the post-test scores for each group, be approximately normally

distributed. This assumption ensures that the sampling distribution of the means approaches normality, which is fundamental for the robustness of parametric statistical tests such as ANOVA.

To assess this, measures of skewness and kurtosis were employed. A dataset is considered to be normally distributed when the skewness and kurtosis values fall within the acceptable range of -2 to +2. In this study, all post-test score distributions met the normality criterion, indicating that the data were suitable for further parametric testing (Ehsanian et al., 2024).

2. Homogeneity of Variance Test

The assumption of homogeneity of variances implies that the variance of the dependent variable (students' critical thinking scores) is consistent across all groups. To test this assumption, Levene's Test for Equality of Variances was applied. The resulting p-value was compared to the standard significance level ($\alpha = 0.05$).

In this case, the test yielded a p-value greater than 0.05, indicating that there were no statistically significant differences in variances across the groups. This result confirms that the assumption of equal variance was met.

Nevertheless, it is important to note that even if the homogeneity assumption were violated, the ANOVA test remains robust, particularly when the sample sizes are approximately equal across groups. According to Box (1954), as cited by Sauder & DeMars (2019), ANOVA can still yield reliable results despite moderate violations of this assumption.

Main Data Analysis: Two-Way ANOVA

To test the research hypotheses, the data were analyzed using Two-Way Analysis of Variance (Two-Way ANOVA). This statistical method is appropriate when investigating:

1. The main effect of each independent variable (learning method and prior knowledge).
2. The interaction effect between the two independent variables on the dependent variable.

According to Guillén-Gámez et al. (2020), the Two-Way ANOVA (also known as the two-factor model) is highly effective in educational research as it allows for the exploration of complex relationships between instructional strategies and learner characteristics. This test also included an ANOVA table for linearity testing, ensuring

that the relationships between predictor variables and the outcome variable were linear and appropriate for analysis.

The interaction effect was of particular interest in this study. It aimed to identify whether the effectiveness of the brainstorming method varied depending on students' prior knowledge levels. For instance, brainstorming may be more effective for students with high prior knowledge, while its effects may be less pronounced for those with lower baseline understanding, or vice versa. Identifying such moderating effects is essential for developing differentiated instruction strategies that cater to diverse student needs.

RESULT

The implementation of this research was conducted at SMA Negeri 1 Cisarua, West Bandung Regency, involving tenth-grade students in the social sciences program. The researcher took on an active role as the instructor in the experimental class (X IPS 5) and served as an observer in the control class (X IPS 2), where the economics subject teacher acted as the instructor. This arrangement was made to ensure that the application of the instructional method in the experimental group was carried out effectively, while observation in the control group allowed for objective comparison of the teaching and learning process.

Before the implementation of the study, the researcher and the subject teacher collaboratively designed the lesson plans (RPP) and agreed upon the instructional strategies and learning objectives. This collaborative process helped maintain consistency in curriculum content delivery across the two groups.

The study was conducted over four class meetings. In the initial phase, students were administered a prior knowledge diagnostic test to classify them into two categories: high and low prior knowledge. This test consisted of 20 multiple-choice questions derived from previously taught material in economics, particularly on basic management concepts. The mean score obtained from the test was 10.46. Therefore, students who scored greater than or equal to the mean were categorized as having high prior knowledge, while those who scored below the mean were classified as having low prior knowledge (Simonsmeier et al., 2021).

Table 3. *Prior Knowledge Classification*

Prior Knowledge Level	Total Score	Mean	Brainstorming Frequency	%	Conventional Frequency	%
High	225		16	50%	16	50%
Low	110	10.46	16	50%	16	50%
Total	325		32	100%	32	100%

Source: Processed using SPSS 22.0

Following the classification, a pre-test was administered to both groups to determine their initial critical thinking skill levels. The brainstorming method, known for encouraging active participation and idea generation, was implemented in the experimental class, while the traditional (conventional) teaching method, typically characterized by teacher-centered instruction, was used in the control class (source needed for theoretical differences between methods). After two learning sessions, a post-test was conducted to measure any change in students' critical thinking performance.

Table 4. Critical Thinking Scores (Pre- and Post-Test)

Test	Method	Mean	Std. Dev.	Min	Max
Pre-Test	Brainstorming	8.81	1.891	5	13
	Conventional	7.69	2.320	3	12
Post-Test	Brainstorming	15.13	1.338	13	18
	Conventional	10.53	2.079	6	14

Source: Processed using SPSS 22.0

The data show that students in the experimental group achieved higher gains in critical thinking scores than those in the control group. This indicates a positive impact of the brainstorming instructional method in enhancing students' analytical abilities.

To examine the suitability of the data for further statistical analysis, a normality test using skewness and kurtosis was conducted. Data are considered normally distributed if the skewness and kurtosis values fall within the range of -2 to +2.

Table 5. Normality Test (Skewness and Kurtosis)

Group	Skewness	Std. Error	Result	Kurtosis	Std. Error	Result
Experimental Pretest	0.288	0.414	Normal	-0.268	0.809	Normal
Control Pretest	0.361	0.414	Normal	-0.648	0.809	Normal
Experimental Posttest	-0.106	0.414	Normal	-0.574	0.809	Normal
Control Posttest	-0.174	0.414	Normal	-0.375	0.809	Normal
Gain Experimental	-0.303	0.414	Normal	-0.662	0.809	Normal
Gain Control	0.433	0.414	Normal	-0.410	0.809	Normal

Source: Processed using SPSS 22.0

Additionally, Levene's Test for homogeneity of variances was conducted to verify whether the variance across groups was equal. A significance value (p-value) greater than 0.05 indicates that the assumption of equal variances is met.

Table 6. *Levene's Test for Homogeneity of Variances*

Levene Statistic	df1	df2	Sig.
1.277	1	62	0.263

Source: Processed using SPSS 22.0

The p-value of 0.263 indicates that the data meet the assumption of homogeneity, thereby allowing for the application of two-way ANOVA for hypothesis testing.

The following results were derived from the Between-Subjects Effects test using two-way ANOVA, which examines the influence of two independent variables (teaching method and prior knowledge) on a dependent variable (critical thinking skills), including the interaction effect.

Table 7. *Tests of Between-Subjects Effects*

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	458.750	3	152.917	136.940	0.000
Intercept	10506.250	1	10506.250	9408.582	0.000
Prior Knowledge	110.250	1	110.250	98.731	0.000
Teaching Method	342.250	1	342.250	306.493	0.000
Prior Knowledge * Method	6.250	1	6.250	5.597	0.021
Error	67.000	60	1.117		
Total	11032.000	64			
Corrected Total	525.750	63			

R Squared = 0.873 (Adjusted R Squared = 0.866)

These results indicate that both teaching method and prior knowledge significantly influenced students' critical thinking skills, and that there was also a statistically significant interaction between the two.

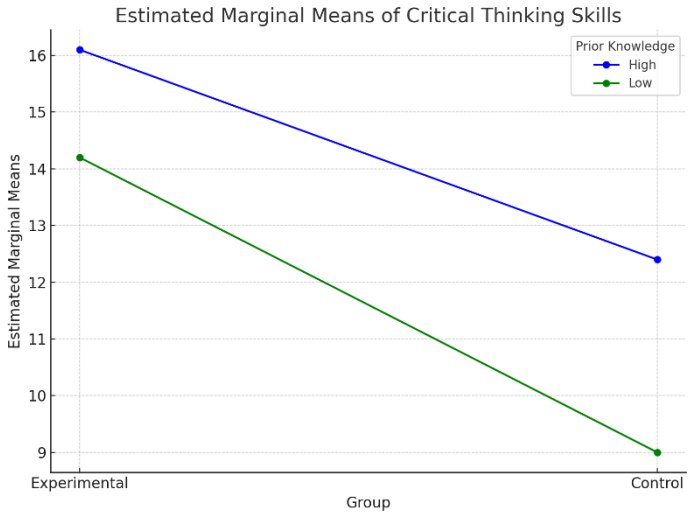
DISCUSSION

The discussion section should focus on the interpretation of the findings and link them to existing literature. The author should explain why the findings are significant and how they contribute to enhancing theoretical understanding in the researched field. Additionally, the discussion should include an analysis of any contradictions or differences with previous studies, as well as provide practical and theoretical implications.

The results of this study reveal three central findings that have significant implications for pedagogical practice in economics education. First, there is a significant main effect of the brainstorming method on students' critical thinking skills, indicating that instructional techniques grounded in collaborative and idea-generating strategies are more effective than conventional, teacher-centered approaches. Second, the results show that students with higher levels of prior knowledge perform better than those with lower prior knowledge, confirming that foundational knowledge plays a crucial role in the learning process. Third, a statistically significant interaction was identified between teaching method and prior knowledge, suggesting that the effectiveness of a teaching strategy may depend on students' existing cognitive frameworks (Liu et al., 2019).

Interaction Effect Visualization

Figure 1. *Plot Uji Analysis of Variance Between Subject Design*



The interaction plot shows a clear divergence between the groups. Students with high prior knowledge who were taught using the brainstorming method achieved the highest scores in critical thinking, demonstrating that when students are cognitively prepared, brainstorming serves as a powerful mechanism for

enhancing complex reasoning skills. Interestingly, even students classified as having low prior knowledge in the brainstorming group outperformed their peers in the control group, reinforcing the notion that student-centered, collaborative learning environments benefit learners across the ability spectrum.

The greater effectiveness of the brainstorming method can be attributed to several interrelated instructional and psychological factors:

1. Active engagement: Students worked in teams and were encouraged to share their opinions freely, which enhanced their participation and cognitive processing.
2. Increased focus on specific problems: The structure of brainstorming guided students to analyze and solve particular issues collaboratively.
3. Collaborative problem-solving: The learning process involved negotiating meaning, exchanging multiple perspectives, and revising ideas based on group discussion.
4. Enjoyable and safe learning environment: All contributions were treated equally, creating an atmosphere where students felt confident to speak up and take risks in their thinking.

In contrast, students in the conventional group were largely passive. Instruction focused on teacher explanations, with minimal opportunities for discussion or interaction. As a result, students were less cognitively involved, limiting their development of higher-order thinking skills such as analysis, synthesis, and evaluation.

These findings are consistent with constructivist learning theory, which posits that students actively build knowledge based on their experiences and interactions. According to Flockhart (2016) the core assumptions of constructivism include:

1. Knowledge is constructed through experience.
2. Learning is a personal interpretation of the real world.
3. Learning is an active process of constructing meaning.
4. Conceptual growth arises from negotiation and collaboration.
5. Learning should occur in authentic contexts where assessment is integrated.

Such principles are particularly relevant in the context of economics education, where understanding abstract concepts like cooperative management demands active exploration and practical reasoning. These learning activities enable

students not just to memorize facts but to evaluate socio-economic systems and apply knowledge to real-world scenarios.

Additionally, the role of prior knowledge in this study cannot be overlooked. Grimm, Edelsbrunner, & Möller (2021) emphasized that prior knowledge is a prerequisite for meaningful learning transformation, as it acts as a cognitive scaffold upon which new information can be integrated. The importance of this foundation is echoed in the work of Sahid, & Hussin (2023), who argue that the ultimate goal of economic education is the development of economic literacy, a skill necessary for effective participation in civic life and economic decision-making.

This aligns with instructional psychology literature, Song (2016) emphasize the principle of sequential learning, i.e., the importance of building upon previously acquired knowledge to foster deeper understanding. Similarly, Davis et al. (2022) support the idea that effective learning is cumulative, and that each new concept must connect to a meaningful cognitive framework to be fully internalized.

To further substantiate the quantitative findings, a Post Hoc Tukey HSD test was conducted. The results confirmed significant differences between all group pairings, reinforcing the effectiveness of the brainstorming method regardless of students' prior knowledge levels.

Table 8. *Post Hoc Test (Tukey HSD)*

Group Comparison	Mean Difference	Std. Error	Sig.	Interpretation
High Prior Knowledge * Brainstorming vs Low * Brainstorming	10.00	1.868	0.000	Significant
High * Brainstorming vs High * Conventional	20.00	1.868	0.000	Significant
High * Brainstorming vs Low * Conventional	36.25	1.868	0.000	Significant
Low * Brainstorming vs High * Conventional	10.00	1.868	0.000	Significant
Low * Brainstorming vs Low * Conventional	26.25	1.868	0.000	Significant
High * Conventional vs Low * Conventional	16.25	1.868	0.000	Significant

Source: Processed using SPSS 22.0

These findings confirm that student-centered instructional strategies such as brainstorming significantly enhance learning outcomes across different levels of prior knowledge. However, their impact is especially pronounced among students who already possess a strong knowledge foundation. This group is more likely to maximize the cognitive advantages of collaborative, interactive, and reflective learning activities, resulting in improved critical thinking performance.

CONCLUSION

Based on the findings derived from hypothesis testing and the interpretation of results, several comprehensive conclusions can be drawn that shed light on the complex interplay between instructional strategies, students' prior knowledge, and their critical thinking skills in the context of learning economics.

To begin with, this study confirmed a significant difference in the critical thinking abilities of students who were taught using the brainstorming method compared to those who received conventional instruction. Students in the experimental group, who experienced the brainstorming approach, consistently exhibited higher critical thinking scores than their counterparts in the control group. This suggests that brainstorming, as a student-centered and interactive method, is not only effective in transferring content knowledge but also in nurturing cognitive processes essential for critical thinking. The nature of brainstorming, which emphasizes open-ended questioning, collaborative dialogue, and the free exchange of ideas, provides a fertile environment for learners to practice analysis, synthesis, and logical reasoning. In contrast, conventional teaching methods that rely heavily on lectures, rote memorization, and passive listening may limit students' opportunities to engage in deeper cognitive processes, thereby constraining the development of their critical thinking competencies.

Furthermore, this research revealed a notable distinction in critical thinking outcomes based on students' levels of prior knowledge. Students with high prior knowledge demonstrated significantly better critical thinking skills than those with lower prior knowledge. This finding underscores the importance of recognizing students' initial cognitive frameworks before engaging in instructional interventions. Prior knowledge serves as a scaffold for new learning, allowing students to make connections between previously acquired information and new material, thereby enhancing comprehension and critical evaluation. Students who already possess a robust understanding of key concepts are more likely to engage with content analytically, pose thoughtful questions, and consider multiple perspectives. Conversely, those with insufficient foundational knowledge may struggle to grasp new content, participate effectively in discussions, or critically assess information,

resulting in a lower level of critical thinking performance. Thus, teachers must be attentive to these differences when planning lessons and delivering content.

Another major finding of this study is the existence of a significant interaction between the teaching method used, the level of prior knowledge, and the development of students' critical thinking skills. This interaction indicates that the effectiveness of a particular teaching method is not uniform across all learners but is instead mediated by the learners' prior knowledge. In other words, how well students benefit from a given instructional approach depends partly on what they already know. For example, students with high prior knowledge who were exposed to brainstorming sessions showed the highest gains in critical thinking, suggesting that they were more capable of maximizing the learning opportunities offered by this approach. However, the brainstorming method also proved beneficial for students with low prior knowledge, indicating that even those with limited background knowledge can achieve improved outcomes when immersed in collaborative, dialogue-rich learning environments. This reinforces the importance of adapting instructional strategies to meet diverse learning needs rather than applying a one-size-fits-all model.

In a broader sense, the findings of this study affirm the value of active learning approaches in contemporary education. In particular, the use of brainstorming as a pedagogical tool highlights the necessity of shifting from teacher-centered to learner-centered models of instruction, especially in subjects that demand analytical and evaluative thinking, such as economics. Such methods empower students to take ownership of their learning, develop their reasoning abilities, and build confidence in expressing and defending their ideas. Additionally, the inclusion of prior knowledge assessments at the beginning of a learning sequence enables teachers to differentiate instruction more effectively and address learning gaps in a timely manner.

Therefore, this research advocates for an intentional and thoughtful integration of active learning methodologies like brainstorming into the teaching of economics, particularly when the goal is to enhance critical thinking. It also emphasizes the crucial role of teachers in identifying students' readiness levels and designing learning experiences that align with these individual differences. By doing so, educators can create inclusive learning environments that not only improve academic achievement but also cultivate the intellectual habits necessary for students to thrive in complex, real-world contexts.

In conclusion, the intersection of teaching strategy and prior knowledge significantly influences the development of critical thinking skills. Educational practices should be grounded in evidence-based approaches that recognize the

diverse capabilities and learning trajectories of students. Only by aligning instructional methods with learners' cognitive profiles can we truly foster the kinds of thinking skills that are essential for academic success, informed citizenship, and lifelong learning.

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