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Application of Symposium Learning Method to Enhance Students' Critical Disposition and Critical Thinking Skills in Addressing Socio-scientific Issues

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Abstract— This study explores the effectiveness of the Symposium Learning Method in enhancing critical disposition and critical thinking skills among high school students in the context of biology education. Employing a quasi-experimental design, the research compares the outcomes of students instructed using the Symposium Learning Method with those taught through conventional methods. Pre-test and post-test assessments were conducted to evaluate students' critical disposition and critical thinking skills. The findings reveal a significant improvement in both critical disposition and critical thinking skills among students exposed to the Symposium Learning Method. This underscores the method's efficacy in promoting active participation, collaborative learning, and deeper engagement with course material. The study emphasizes the importance of innovative teaching approaches in nurturing critical thinking skills essential for addressing complex societal issues in biology education.

Keywords— Symposium Learning Method, critical disposition, critical thinking, high school, biology education
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1. Introduction

Critical thinking stands as a cornerstone in contemporary education, recognized as an indispensable skill for navigating the complexities of the 21st century. It transcends the mere acquisition of knowledge, extending to the cultivation of inclusive and holistic thinking capacities. This encompasses the adept selection of information, discernment of relevant and credible data, and the exercise of creativity in ideation. Moreover, educational endeavors should equip individuals to work effectively, both independently and collaboratively, while also addressing everyday challenges [1].

Defined by Facione as a process of deep judgment involving interpretation, analysis, evaluation, and inference, critical thinking demands more than mere evidential reliance. It necessitates consideration of relevant concepts, methodologies, criteria, and contexts. Amijaya et al. emphasize critical thinking as a reflective mode, highlighting disciplined decision-making, particularly in learners' actions [2]. This underscores critical thinking's depth, requiring mature considerations in decision-making beyond surface-level analyses.

Within the realm of biology education, emphasis on critical dispositions and thinking skills gains significance, especially concerning Socioscientific Issues (SSI). These multifaceted issues, encompassing scientific, social, ethical, and sometimes political dimensions, demand a reflective and analytical approach. Critical dispositions underpin students' openness to diverse perspectives, questioning of assumptions, and consideration of societal and ethical implications. Simultaneously, critical thinking skills equip students to analyze evidence, comprehend argument complexities, and devise reasoned solutions within SSI contexts [3].

Despite the acknowledged importance of critical thinking, prevailing teaching methods, often centered on knowledge transfer, fall short in fostering its development in biology education. These methods tend to focus on information dissemination rather than incentivizing students to delve into underlying truths, thereby impeding the cultivation of critical dispositions and skills [4]. Observations at SMA Negeri 8 Mataram, however, reveal students' heightened interests in social, economic, and cultural facets of socio-scientific topics. This presents a fertile ground for integrating critical approaches into their understanding.

The symposium learning method emerges as a potent tool in fostering critical dispositions and enhancing critical thinking skills comprehensively. Its dynamic and interactive nature encourages active participation, structured discussions, and collaboration, thereby facilitating the development of robust critical thinking abilities among students [5].

In light of these considerations, this study aims to investigate the effectiveness of the symposium learning method in enhancing critical dispositions and thinking skills among high school students, particularly concerning socio-scientific issues in

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biology education.

2. Method

The current study was carried out during the academic year 2023/2024, specifically in the months of February to March, corresponding to the second semester, at SMAN 8 Mataram. The research focused on twelfth-grade students enrolled in the science program (XII IPA) at SMAN 8 Mataram.

Table 1. Nonequivalent Control Group Design

Group	***Pretest***	***Treatment***	***Posttest***
experimental class (E)	O_1	X_1	O_2
control class (K)	O_3	X_2	O_4

Description:
E= Experimental group (Using inquiry learning model)
K= Control group (Using the discovery learning model)
X = Treatment (application of inquiry learning model)
O_1 = Experimental class pretest
O_2 = Posttest of experimental class
O_3 = Pretest of control class
O_4 = Posttest of control class

Quantitative research methodology was employed, utilizing a quasi-experimental approach. The research design adopted was the Pretest-Posttest Control Group Design. This design involved two groups, namely the experimental group (XII IPA 1) and the control group (XII IPA 3), selected through purposive sampling. Both groups were subjected to a pretest to assess their initial conditions before the intervention, followed by the implementation of different teaching methods (symposium learning method for the experimental group and conventional discussion method for the control group), and concluded with a posttest to evaluate the effects of the interventions.

The research primarily aimed to investigate the impact of the symposium learning method on students' critical disposition and critical thinking skills in addressing socio-scientific issues in biology, particularly biotechnology. The study population comprised a total of 109 twelfth-grade students, divided into six classes. Data were collected through the administration of a questionnaire on critical disposition and a test on critical thinking skills. Both instruments were subjected to rigorous reliability and validity testing to ensure their accuracy and consistency.

2.1. Critical Disposition Measurement

Instrument carried out on this research is Critical Disposition Questionnaire. In addition to the science process skills assessment, the study employed a questionnaire to gauge students' critical disposition. This questionnaire was designed to capture data on students' critical habits both before and after the intervention. Comprising 28 closed-ended questions/statements, the critical disposition questionnaire focused on seven indicators: truth-seeking, open-mindedness, analytical thinking, systematic thinking, self-confidence, curiosity, and maturity. Respondents were asked to rate their agreement with each item on a Likert scale ranging from 1 to 4, where 4 denoted "strongly agree," 3 denoted "agree," 2 denoted "disagree," and 1 denoted "strongly disagree".

Table 2. Criteria for Scoring Respondents' Answers

Response Options	Score
Strongly Agree (SS)	4
Agree (S)	3
Disagree (TS)	2
Strongly Disagree (STS)	1

(Sumber: Rosidi, 2021)

2.2. Assessment of Critical Thinking Skills

The critical thinking skills assessment represents a crucial component of the research methodology, designed to meticulously evaluate students' cognitive aptitude in addressing Socioscientific issues. Crafted with precision, each of the ten multiple-choice questions is tailored to target specific facets of critical thinking, ensuring a comprehensive assessment of students' analytical capabilities. By delineating critical thinking into distinct dimensions such as interpretation, analysis, evaluation, inference, explanation, and self-regulation, the assessment aims to provide a nuanced insight into students' cognitive processes. Moreover, the incorporation of diverse question types facilitates a holistic examination of students' critical thinking prowess, encompassing both foundational competencies and advanced problem-solving strategies. Through this multifaceted approach, students are provided with opportunities to showcase their proficiency in discerning patterns, synthesizing information, evaluating arguments, drawing logical inferences, articulating coherent explanations, and exercising metacognitive control over their cognitive processes. Thus, the critical thinking skills assessment serves as a robust tool for assessing and nurturing students' analytical acumen in navigating the complexities of Socioscientific domains.

Table 3. Framework of Critical Thinking Skills Test

Topic	Indicator	Option
Genetic engineering issues	Interpretation	A
Issues regarding gene therapy	Analysis	B
Cloning issues	Evaluation	C
Test tube baby issues	Inference	D
Issues regarding the use of anti-pest bacteria	Explanation	E
Issues regarding bioactive compost	Self-regulation	F

2.3. Validity Testing

Validity testing is an effort to ensure the level of validity or reliability of the instrument used for research (Arikunto, 2013). In other words, validity testing aims to determine whether the test instrument used is valid or not. Validity testing is carried out using the Bivariate Pearson correlation equation according to Arikunto (2013) with the formula:

$$r_{xy} = \frac{N\,\Sigma XY - (\Sigma Y)\,(\Sigma Y)}{\sqrt{\{N\Sigma X^2 - (\Sigma X)^2\}\,\{N\Sigma Y^2 - (\Sigma Y)^2\}}}$$

Where:

r_{xy}	The correlation coefficient between variables X and Y
ΣXY	The sum of the products of X and Y
ΣX	The sum of variable X values
ΣY	The sum of variable Y values
N	The number of students

Validity testing in this study was conducted with the assistance of SPSS 25.0 Statistics for Windows software. The validity test criterion is if $r_{xy} > r_{table}$ with α = 0.05, then the research instrument is considered valid, and conversely, if $r_{xy} < r_{table}$, then the research instrument is considered invalid. The results of the validity test for the critical thinking skills test of 18 items indicated validity, and the results of the validity test for the Critical Disposition Questionnaire of 28 items also indicated validity because the calculated r was greater than the r_{table}.

2.4. Reliability testing

Essential for determining data validity, was conducted in this study using Cronbach's alpha via SPSS 25.0 Statistics for Windows. Cronbach's alpha serves as a measure of correlation between the scale and existing variable scales, with values > 0.6 indicating instrument reliability. The formula for Cronbach's alpha is

$$\propto_u = \left(\frac{k}{k-1}\right)\left(1 - \frac{\Sigma S1^2}{S1^2}\right)$$

The resulting coefficient is categorized as very high (0.800 – 1.000), high (0.600 – 0.799), moderate (0.400 – 0.599), low (0.200 – 0.399), or very low (0.00 – 0.199). In this study, the Critical Disposition Questionnaire yielded a highly reliable Cronbach Alpha of 0.885, while the critical thinking skills test showed moderate reliability with a Cronbach Alpha of 0.470. Further details are available in Appendix 6.

This equation is used to calculate the correlation between two variables, namely the scores obtained from the test instrument and the scores obtained from the validation criteria.Data analysis involved various statistical techniques, including tests for normality, homogeneity, hypothesis testing using the t-test, and N-gain analysis to measure the improvement in learning outcomes.

2.5. Data Analysis Techniques

This study employed quantitative data analysis techniques, which involve numerical data obtained from the field Damayanti (2021). Quantitative research operates under the assumption that phenomena can be classified, and their relationships are causal (cause and effect). Therefore, researchers can focus on specific variables. The quantitative data collected were analyzed using statistical methods.

2.5.1. Normality Test

The normality test was conducted to determine whether the acquired data followed a normal distribution Rahman et al (2020). A normal distribution is symmetrical with mode, mean, and median. The Kolmogorov-Smirnov test formula was utilized for this purpose:

$$D = Maks|Fa(x) - Fe\,(x)|$$

Decision-making was based on whether the calculated D value was less than the critical D value at α = 0.05, indicating normal distribution.

2.5.2. Homogeneity Test

The homogeneity test determines if two or more sample data groups are derived from populations with the same variance

Rahman et al (2020). This was achieved using a variance test or F-test:

$$F = \frac{Varians\ terbesar}{Varians\ terkecil}$$

Homogeneity of variance was determined by comparing the calculated F value to the critical F value at α = 0.05.

2.5.3. t-Test (Hypothesis Testing)

Hypothesis testing was conducted using the t-test, specifically the pooled variance t-test, due to the heterogeneous sample sizes and homogenous variances, and normal distribution. The formula for the pooled variance t-test, with assistance from SPSS 25.0 Statistics for Windows, is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Decision-making was based on whether the calculated t value was less than the critical t value at α = 0.05.

2.5.4. N-Gain Test

The N-gain test measures the improvement in learning outcomes before and after the application of an intervention (Hake, 1999). In this study, the N-*gain* test was employed to assess the enhancement of students' critical thinking skills and disposition. The N-gain formula developed by Hake (1999) is:

$$\langle g \rangle = \frac{S_{post} - S_{Pre}}{S_M - ideal - S_{Pre}}$$

The obtained N-*gain* value was interpreted based on predefined criteria according to Hake (1999).

In conclusion, the research aimed to provide insights into the effectiveness of the symposium learning method in enhancing critical disposition and critical thinking skills among high school students when addressing socio-scientific issues in biology.Research design and method should be clearly defined**.**

The study embarked on a quest to unravel the influence of distinct teaching methodologies on students' critical disposition and critical thinking skills. Set against the backdrop of SMAN 8 Mataram during the academic year 2023/2024, the research unfolded its narrative amidst the vibrant corridors of learning in February to March, marking the second semester. Within this dynamic educational milieu, twelfth-grade students enrolled in the science program (XII IPA) at SMAN 8 Mataram emerged as the protagonists of this academic odyssey.

As the curtains rose on this scholarly endeavor, a total of 109 twelfth-grade students, scattered across six classes, stood at the forefront of exploration. With a keen eye for diversity, two classes were handpicked through purposive sampling, forging the experimental group (XII IPA 1) and the control group (XII IPA 3) that would navigate the labyrinth of learning.

In crafting the research's blueprint, a quasi-experimental approach was meticulously woven into the fabric of inquiry, embodying the essence of a nonequivalent control group design. This methodological framework heralded pretest and posttest assessments for both the experimental and control cohorts, tracing their intellectual trajectory amidst the academic landscape.

As the study unfolded, the experimental group (XII IPA 1) embarked on an exhilarating journey through the corridors of symposium learning, while their counterparts in the control group (XII IPA 3) traversed the trodden paths of conventional discussion methods. Armed with instruments finely tuned to capture the nuances of critical disposition and critical thinking skills, the researchers navigated the terrain of data collection with precision and purpose.

The Critical Disposition Questionnaire, adorned with 28 thought-provoking inquiries, sought to plumb the depths of students' critical habits, anchoring its gaze on pillars of truth-seeking, open-mindedness, analytical thinking, systematic thinking, self-confidence, curiosity, and maturity. Meanwhile, the Critical Thinking Skills Test, adorned with 10 probing inquiries, embarked on a quest to unearth the intricacies of critical thinking amidst the fertile fields of socio-scientific issues in biology.

With the data canvas laid bare, the brushstrokes of quantitative analysis breathed life into the research narrative. Statistical techniques such as tests for normality, homogeneity, hypothesis testing using the t-test, and N-gain analysis emerged as beacons of insight, illuminating the path towards empirical understanding. Armed with SPSS 25.0 Statistics for Windows, the researchers navigated the labyrinth of data with dexterity and discernment.

Validity and reliability emerged as twin pillars of assurance, underpinning the integrity of the research endeavor. Through expert review and statistical scrutiny, the instruments underwent rigorous validation, while the mantle of reliability found solace in the sanctuary of Cronbach's alpha. Thus, the narrative arc of the study bore witness to the convergence of meticulous planning, methodological rigor, and scholarly endeavor, culminating in a tapestry of insight and illumination.

3. Result and Discussion

3.1. The Utilization of The Symposium Learning Method in Cultivating Students' Critical Disposition

Critical disposition, a pivotal aspect in the realm of education, encompasses the inclination to think and act critically towards various issues and challenges encountered in academic and real-life contexts [7]. It represents a multifaceted cognitive and

behavioral orientation characterized by several key indicators: truth-seeking, open-mindedness, analytical thinking, systematic thinking, self-confidence, curiosity, and maturity. These indicators collectively underscore an individual's capacity to engage deeply with complex problems, exhibit intellectual flexibility, and approach challenges with a discerning mindset [8]. Within the educational sphere, fostering critical disposition is paramount as it not only cultivates students' cognitive skills but also nurtures their ability to navigate uncertainties, evaluate information critically, and make informed decisions [9].

In this study, critical disposition is conceptualized not merely as a static trait but as a dynamic process influenced by various educational interventions and contextual factors. The research endeavors to illuminate the nuanced dynamics of critical disposition development among high school students, particularly in the context of addressing socio-scientific issues in biology. Through a comprehensive analysis of students' responses and performance across multiple dimensions of critical disposition, including truth-seeking, open-mindedness, and analytical thinking, this study offers insights into the intricacies of critical thinking development within the educational milieu.

Table 4 presents a detailed overview of the research findings, delineating the nuances of students' critical disposition across different indicators and experimental conditions. Additionally, Figure 1 provides a visual representation of the enhancement in critical disposition observed among students following the implementation of the symposium learning method. Together, these empirical findings shed light on the efficacy of pedagogical approaches in nurturing critical disposition and advancing students' cognitive development.

Table 4. Recapitulation of Pretest and Posttest Scores, Along with Statistical Testing of Students' Critical Disposition

Component	**Eksperimental class**		**Control class**	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Number of Students	27	27	27	27
Mean Score	68	73	67	70
Minimum Score	44	57	47	53
Maximum Score	69	78	72	75
Standard Deviation	5.419	5.413	5.373	4.880
N-*gain*	0.16		0.05	
Normality Test	0.62 (Normal)	0.208 (Normal)	0.08 (Normal)	0.09 (Normal)
Homogeneity Test	0.31 (Homogeneous)	0.42 (Homogeneous)	0.31 (Homogeneous)	0.42 (Homogeneous)
Mean Difference (*t-Test*[*]) with significance at 0.05	Pretest : *Sig.* Value (2-*tailed*) = 0.637 Postest :*Sig.* Value (2-*tailed*) = 0.002			

Delving deeper into the intricate nuances of the statistical analysis encapsulated within Table 4, it becomes abundantly clear that the posttest findings pertaining to students' critical disposition unfurl a narrative of profound significance. With a discerning eye cast upon the t-test outcomes, one unearths a Sig. Value (2-tailed) of 0.002, a figure that unequivocally breaches the customary threshold of 0.05. This statistical revelation serves as the clarion call for a momentous paradigm shift: the null hypothesis (H0) is resolutely repudiated, paving the way for the triumphant ascendancy of the alternative hypothesis (Ha). In essence, the hallowed halls of academia resonate with the resounding affirmation that the Symposium learning method emerges as an indispensable conduit for fortifying students' critical disposition, heralding a new epoch characterized by heightened cognitive acuity and analytical prowess.

Elevating the discourse to a loftier plane, a meticulously curated exposition awaits within the confines of Figure 1. Here, amidst the juxtaposition of mean scores extracted from both the pretest and posttest phases, a vivid tapestry is woven, chronicling the transformative odyssey undertaken by students under the tutelage of the Symposium learning method. As the data-laden tableau unfolds, it becomes patently evident that the experimental and control classes stand as crucibles wherein the alchemy of pedagogy and practice converges. Each incremental shift in the mean scores serves as a testament to the transformative potential inherent within the Symposium learning paradigm, offering a tantalizing glimpse into the vista of possibilities that lie ahead.

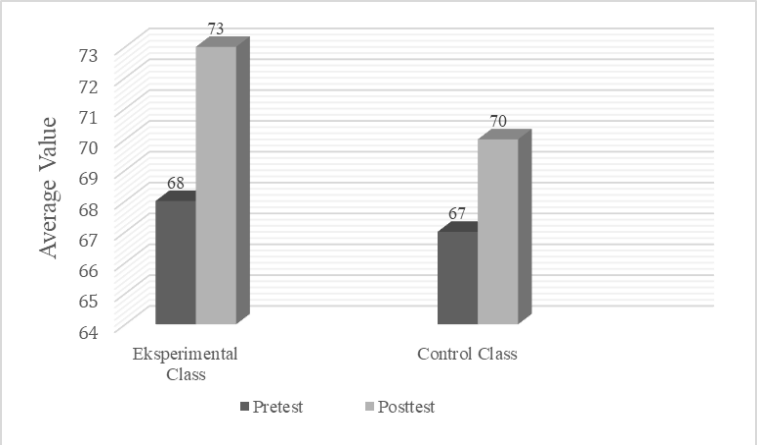

Average Value
73
72
71
70
69
68
67
66
65
64
73
68
70
67
Eksperimental Class
Control Class
Pretest
Posttest

Fig. 1. The mean scores of the pretest and posttest for critical disposition

Figure 1 showe the average pretest and posttest scores for critical disposition in the experimental and control classes are Based on the analysis depicted in Figure 1, the comparison between the average pretest and posttest scores for critical disposition in both the experimental and control classes was conducted subsequent to the completion of the learning program. Within the experimental class, where the symposium learning method was implemented, the average pretest score for critical disposition stood at 68, slightly surpassing the control class's pretest score of 67, which relied on conventional discussion methods. As the learning program concluded, a significant enhancement was observed in the average posttest scores for critical disposition. Specifically, the experimental class demonstrated a notable increase to 73, while the control class exhibited a rise to 70. These findings underscore a substantial improvement in students' critical disposition in both classes following the intervention, with a more marked advancement discernible in the experimental group. Thus, the data unequivocally supports the effectiveness of the learning program, particularly within the experimental cohort utilizing the symposium learning method, in cultivating students' critical disposition. Moreover, this assertion is further corroborated by the considerable discrepancy in the average N-gain scores between the two groups, as illustrated in Figure 2, thereby emphasizing the superior efficacy of the symposium learning approach in fostering critical thinking skills among students.

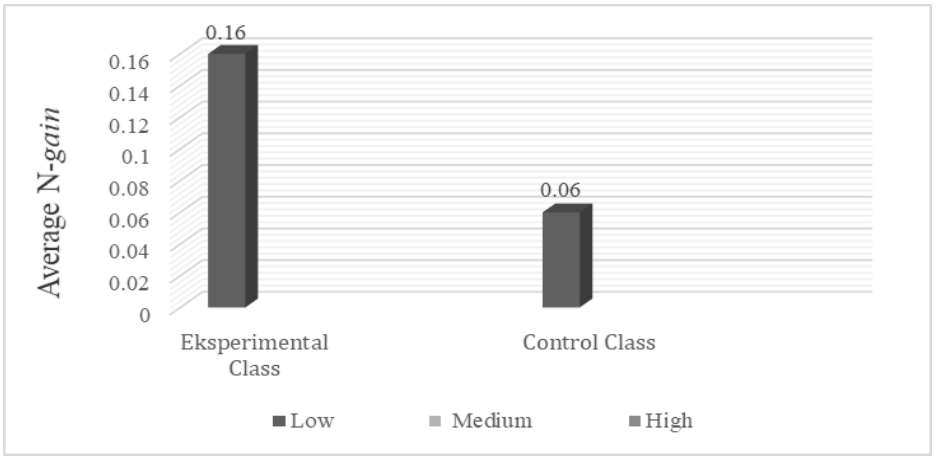


Fig. 2. N-*gain* scores

Figure 2 show the average N-*gain* scores for critical disposition in the experimental and control classes are observed after implementing the symposium and conventional discussion learning methods. In the experimental class, employing the symposium method, there is an increase with an average N-*gain* for critical disposition of 0.16, while in the control class, utilizing conventional discussion methods, the N-gain value reaches 0.06. Although there is improvement in both classes, these values are relatively low. However, the comparison between the two classes indicates that the experimental class experienced a greater increase in students' critical disposition compared to the control class. This suggests the potential of the symposium learning method in enhancing students' critical disposition, although the relatively low N-gain values indicate challenges in significantly improving students' critical disposition. Despite the low average N-gain values in both groups, both the experimental class employing the symposium learning method and the control class using conventional discussion methods show significant differences in the improvement of scores for each indicator between the two groups. The improvement per indicator of Critical Disposition in the experimental and control classes is illustrated in Figures 3 and 4.

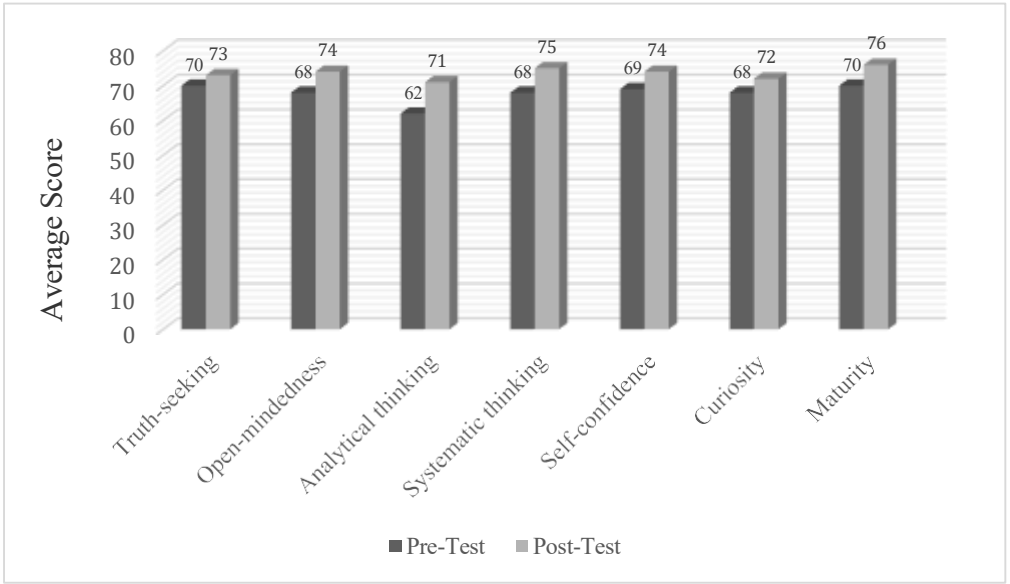


Fig. 3. The average score per indicator of students' critical disposition in the experimental class

Figure 3 provides a comprehensive visualization of the notable advancements observed across all critical disposition indicators, with particularly remarkable progress evident in the dimensions of open-mindedness and analytical thinking. These substantial enhancements not only underscore the effectiveness of the symposium learning method but also highlight its pivotal role in cultivating students' receptivity to diverse perspectives and honing their abilities in analytical problem-solving. The discernible improvements across these critical dimensions affirm the method's capacity to instill a robust and well-rounded critical disposition among students, thereby equipping them with the essential skills for navigating complex issues and arriving at informed conclusions.

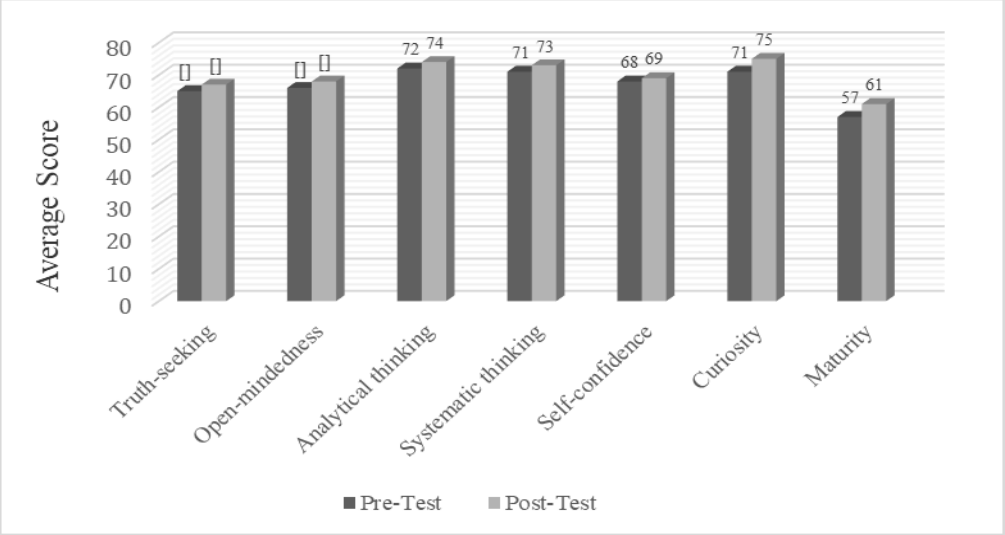


Fig. 4. The average scores of the critical disposition indicators for the control group students

Figure 4 show there is an improvement in all critical disposition indicators. However, the most significant improvement is observed in the curiosity and maturity indicators[10]. This indicates that despite using conventional discussion-based teaching methods, students in the control group are able to develop their interest in seeking further information and their ability to understand situations more maturely. Thus, these results depict the potential of conventional discussion-based teaching methods in enhancing students' critical disposition, particularly in fostering a desire for further learning and maturity in understanding situations.

3.2. Utilization of Symposium Learning Method in Enhancing Students' Critical Thinking Skills

Critical thinking skills represent an organized process enabling individuals to solve problems effectively. These skills comprise six indicators: interpretation, analysis, evaluation, inference, explanation, and self-regulation [11]. A summary of the research findings and statistical tests on students' critical thinking skills are presented in Table 2, with an illustration of the improvement in critical thinking skills shown in Figure 5.

Table 2. Summary of Pretest and Posttest Scores, and Statistical Tests on Students' Critical Thinking Skills

Component	**Eksperimental class**		**Control class**	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Number of Students	27	27	27	27
Mean Score	68	73	67	70
Minimum Score	44	57	47	53
Maximum Score	69	78	72	75
Standard Deviation	5.419	5.413	5.373	4.880
N-*gain*	0.16		0.05	
Normality Test	0.362 (Normal)	0.208 (Normal)	0.08 (Normal)	0.09 (Normal)
Homogeneity Test	0.05 (Non-homogeneous)	0.19 (Non-homogeneous)	0.05 (Non-homogeneous)	0.19 (Non-homogeneous)
Mean Difference (*t-Test*") with significance at 0.05	Pretest : *Sig.* Value (2-*tailed*) = 0.000 Postest :*Sig.* Value (2-*tailed*) = 0.000			

Table 2 show the results of the Posttest for critical thinking skills of students in the experimental and control groups differ significantly. The t-test results show a *Sig.* value (2-*tailed*) of 0.000, which is smaller than 0.05, indicating that H_0 is rejected or H_a is accepted. In other words, the implementation of the Symposium learning method can enhance students' critical thinking skills. The average Pretest and Posttest scores for critical thinking skills in the experimental and control groups are presented in Figure 5.

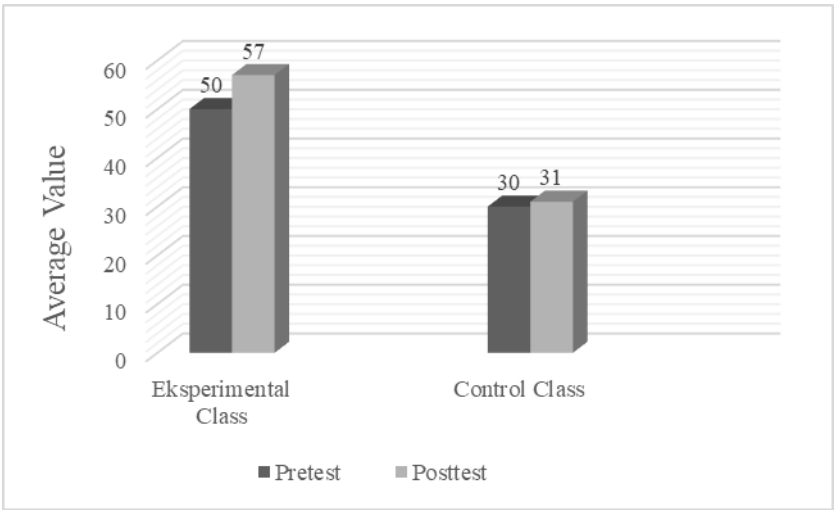


Fig. 5. The average scores of Pretest and Posttest for critical thinking skills in the experimental class and the control class.

Based on Figure 4.5, it is evident that before the instructional program, the average pretest score for critical thinking skills in the experimental class was 50, while in the control class it was 30. After the instructional program, there was an increase in the average posttest score for critical thinking skills, with the experimental class rising to 57 and the control class to 31. The increase in critical thinking skills was more significant in the experimental class, indicating the higher effectiveness of the symposium learning method in enhancing students' critical thinking skills[12].This is supported by significantly different average N-gain values, as shown in Figure 6.

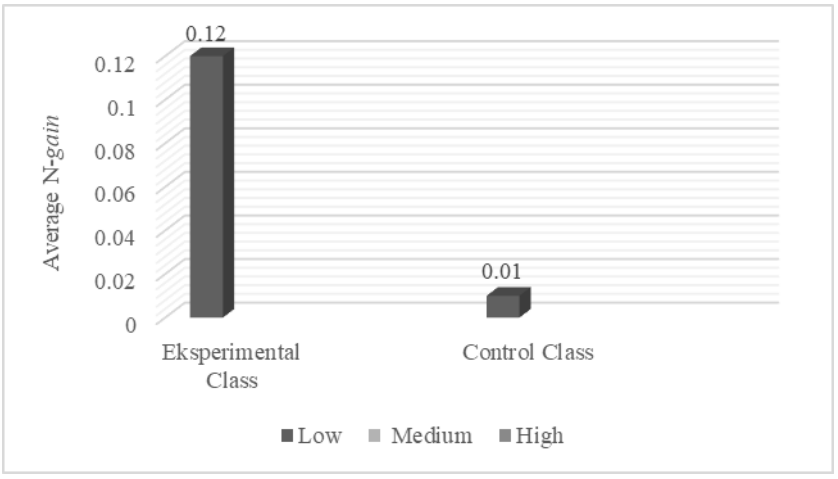


Fig. 6. The average N-*gain* values for Critical Thinking Skills in the experimental class and the control class.

Based on Figure 6, the analysis reveals that the average N-gain for Critical Thinking Skills in the experimental class is 0.12, while in the control class it is 0.01. Despite the improvements, both values are relatively low, indicating that the enhancement in critical thinking skills for both groups did not reach the expected level. Further evaluation is necessary to understand the factors contributing to the limited improvement and to enhance the effectiveness of the teaching methods in the future[13].

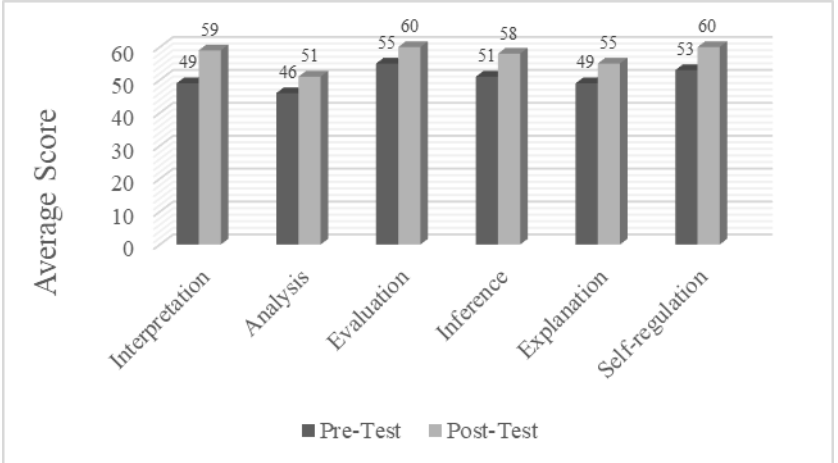


Fig. 7. the average scores of each indicator of students' critical thinking skills in the experimental class.

Although the average N-gain values are low for both groups, significant differences in improvement are observed across various indicators between the experimental and control classes, as depicted in Figures 7 and 8. Upon meticulous scrutiny of the insights gleaned from Figure 7, it becomes palpably evident that a discernible improvement permeates across the entire spectrum of critical thinking skills indicators. Although the overarching trend underscores a positive trajectory across all facets, the discerning eye is immediately drawn to the conspicuous surge in proficiency discernible within the interpretation and analysis indicators. Such an observation serves as a clarion call to delve deeper into the pedagogical alchemy at play within the realm of the symposium learning method. It becomes apparent that the symposium format serves as a crucible wherein students are not merely passive recipients of information but are rather catalyzed into active agents of comprehension and analysis. This seminal revelation lays bare the transformative potential encapsulated within the symposium learning milieu, wherein students are galvanized to traverse the labyrinthine corridors of information with an unparalleled depth and acuity of understanding. Thus, these empirical findings underscore the incontrovertible efficacy of the symposium teaching paradigm in engendering a cohort of students endowed with the metacognitive prowess requisite for navigating the exigencies of the contemporary knowledge landscape.

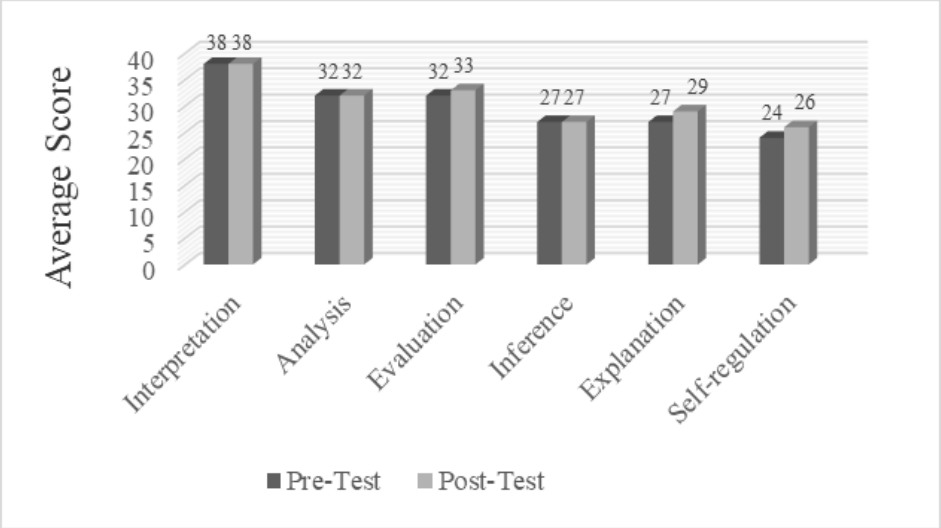


Fig. 8. The average the average scores of each indicator of students' critical thinking skills in the control class.

Figure 8 illustrates the average score of each indicator of students' critical thinking skills in the control group using the conventional discussion-based learning method. It is observed that only two indicators, namely explanation and self-regulation, show improvement, while the others remain stable or unchanged. This underscores that although the conventional discussion-based learning method may enhance some aspects of students' critical thinking skills, not all indicators exhibit positive changes[14]. Therefore, further evaluation of the teaching method is necessary to identify the factors influencing the improvement of critical thinking skills.

3.3. Application of the Symposium Method to Cultivate Students' Critical Disposition

The symposium method has emerged as a powerful pedagogical tool for nurturing students' critical disposition, encompassing their inclination and ability to think critically about complex issues. This method is characterized by its interactive and participatory nature, providing students with structured opportunities to engage in group discussions, debates, and reflective sessions. Through these activities, students are not only encouraged to analyze information critically but also to evaluate arguments and consider diverse perspectives[15]. By immersing themselves in collaborative learning environments, students develop open-mindedness and hone their analytical thinking skills, essential components of critical disposition. Moreover, the symposium method fosters a culture of respectful discourse and intellectual inquiry, enabling students to explore contentious topics and engage in meaningful dialogue. In this way, the symposium method serves as a catalyst for cultivating students' critical disposition and preparing them for the complexities of the modern world.

3.4. Application of the Symposium Method to Enhance Students' Critical Thinking Skills

The symposium method has garnered widespread recognition for its effectiveness in enhancing students' critical thinking skills, which are essential for success in academic, professional, and personal contexts. This pedagogical approach provides students with opportunities for active engagement in group discussions, debates, and reflective exercises, thereby stimulating their analytical thinking and fostering intellectual curiosity. Through collaborative learning experiences, students learn to construct well-reasoned arguments, consider alternative viewpoints, and communicate their ideas effectively. Moreover, the reflective aspect of symposium learning allows students to assess their own thinking processes and identify areas for improvement, thereby promoting metacognitive awareness. As a result, the symposium method not only enhances students' critical thinking skills but also instills in them a disposition for lifelong learning and intellectual growth. By equipping students with these essential cognitive abilities, the symposium method prepares them to navigate the complexities of the modern world and make informed decisions in an increasingly interconnected and dynamic global society.

4. Conclusion

The study concludes that the application of the symposium method significantly enhances students' critical thinking skills compared to traditional lecture-based methods. Students in the experimental group demonstrated greater improvements in critical thinking, as evidenced by pretest and posttest results. The symposium format, comprising group discussions, debates, and reflections, proved instrumental in fostering various aspects of critical thinking, including interpretation, analysis, and evaluation. Furthermore, students engaged in debates exhibited enhanced analytical skills and effective communication. Overall, the findings suggest that symposium learning offers a holistic approach to developing critical thinking skills and is more effective than traditional methods in preparing students to navigate complex issues and diverse perspectives in modern education and beyond.The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section

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Author Contributions

The first author is responsible for writing the research articles and conducting the research. The second and third authors, serving as thesis advisors, provided substantial support and guidance throughout the research process. The fourth author, acting as the thesis examiner, contributed by offering feedback and suggestions for improvement. All authors have reviewed and approved the final version of the manuscript for publication.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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