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The Impact of Problem-Based Learning and HOTS Based Formative Tests on Critical Thinking

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Abstract

This research aims to examine the impact of the Problem-Based Learning (PBL) model and the use of formative tests designed to assess Higher Order Thinking Skills (HOTS) on students' critical thinking abilities. A quasi-experimental design with a Nonequivalent Control Group Design was used, involving two groups: the experimental group employing the PBL model and the control group using traditional teaching methods. Data were gathered through oral and essay tests to evaluate students' critical thinking skills. The findings indicate that the PBL model has a significant positive effect on improving students' critical thinking. Moreover, the use of HOTS-based formative tests was found to significantly enhance students' critical thinking abilities. The combination of the learning model and the type of formative test produced the most considerable improvement in critical thinking skills within the experimental group. The study recommends that teachers expand the use of the PBL model and incorporate HOTS-based assessments to foster critical thinking, which is vital for preparing students to tackle global challenges.

Keywords: Problem-Based Learning, Formative Tests, Higher Order Thinking Skills, Critical Thinking, Education

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INTRODUCTION

The Merdeka Curriculum, which is currently implemented in the Indonesian education system, focuses on empowering students' potential so that they not only gain knowledge but also develop skills that can contribute positively to the nation. A key competency highlighted in this curriculum is critical thinking, a vital skill for addressing global challenges (Utami et al., 2022).

Critical thinking involves the ability to assess, analyze, and solve problems in a logical and organized way. In today's information-driven world, it is not just a crucial life skill but also essential for enhancing individual competitiveness (Yulianto et al., 2019). There are several reasons for fostering critical thinking from an early age, such as: (1) the need for individuals to effectively choose and use information, (2) the fact that everyone faces challenges that require critical thinking to find creative solutions, and (3) that critical thinking aids individuals in competing healthily and collaborating effectively in diverse settings (Nurhayati et al., 2021).

Critical thinking is a component of Higher Order Thinking Skills (HOTS), which includes problem-solving and decision-making based on facts (Arifin et al., 2020). Experts like Azid *et al.* (2022) and Yu & Zin (2023), describe critical thinking as the process of filtering information to find truth and rational solutions. It involves several steps, starting from providing clear explanations to developing strategies for solving problems.

Religious Education and Character Education are subjects that can foster the development of critical thinking. In this process, the teacher's role is essential, especially in choosing the right teaching model. Problem-Based Learning (PBL) is one such model that can enhance critical thinking. PBL focuses on presenting real-world problems that prompt students to seek solutions, build analytical skills, and improve problem-solving abilities. It also emphasizes independent learning and social skills, which develop as students work together to find solutions.

Despite its advantages, some schools still face challenges in improving students' critical thinking abilities (Wiyaka et al., 2020). For example, at SMP PGRI 1 Denpasar, around 40% of students did not meet the minimum competency standard (KKM) in mid-term exams. One of the reasons for this is the lack of critical thinking skills in answering exam questions. An external factor contributing to this is the use of conventional teaching methods, which are often monotonous and do not encourage active student participation.

Therefore, there is a need for innovative teaching models like PBL, which can address the shortcomings of traditional methods. PBL not only makes learning more engaging but also more interactive and relevant to students' daily lives, thereby improving their critical thinking skills.

Assessments based on HOTS are also crucial in evaluating the development of students' critical thinking skills (Mudrika et al., 2024)Formative assessments conducted during the learning process can help track and enhance critical thinking abilities, offering insights into how well students understand the material (Launuru et al., 2021).

Critical Thinking Ability

Critical thinking ability refers to a person's mental process of evaluating situations, ideas, or issues by analyzing and questioning them deeply. It involves thinking not just generally or broadly, but deeply about the substance and content of a matter. According to Nor & Sihes (2021), Critical thinking refers to the ability to think logically and coherently about decisions or beliefs. It includes the process of examining information, recognizing biases, evaluating various viewpoints, and reaching logical conclusions. In a similar vein, Southworth (2022) defines critical thinking as "reasonable, reflective thinking focused on deciding what to believe or do." It is a cognitive process that includes various steps such as gathering, categorizing, analyzing, and evaluating evidence or information in a systematic way to solve problems.

Problem-Based Learning (PBL)

Problem-Based Learning (PBL) is an educational approach that uses real-world problems as a context for students to acquire and apply knowledge and skills (Yew & Goh, 2016). This learning model encourages active learning where students explore and solve complex, real-world issues, requiring them to employ various cognitive skills and approaches. PBL is a student-centered approach that emphasizes collaboration and critical thinking, enabling students to learn through problem-solving. According to Suradika *et al.* (2023), PBL allows students to engage in deep learning by confronting real-life issues, and through the process, they develop skills such as problem-solving, critical thinking, and self-directed learning.

PBL is closely associated with the scientific approach, which involves five stages often referred to as 5M in Indonesian education: Mengamati (observing), Menanya (questioning), Mengumpulkan informasi (collecting information), Menalar (reasoning), and

Mengkomunikasikan (communicating). This approach encourages students to observe a problem, ask questions, gather relevant information, analyze the situation, and communicate their findings and solutions (Ardianti et al., 2021). According to Wang (2021), the primary goal of PBL is to develop students' ability to tackle complex problems by thinking critically and creatively while integrating knowledge from multiple disciplines.

Through the process of PBL, students are not only involved in solving problems but also gain the ability to reflect on their own learning process, ask insightful questions, and develop solutions that are applicable to real-world contexts. This method is particularly effective in enhancing critical thinking skills because it challenges students to think deeply, evaluate different perspectives, and find solutions that are well-supported by evidence.

This study aims to analyze how learning models and types of formative assessments influence students' critical thinking skills. Specifically, it compares the effectiveness of the Problem-Based Learning (PBL) model and conventional learning, as well as the impact of oral and essay formative tests on the development of critical thinking skills. Additionally, this research explores the interaction between learning models and types of formative assessments, including the effectiveness of each combination, such as PBL with oral or essay tests, and conventional learning with the same assessment types. The findings are expected to provide valuable insights for enhancing teaching strategies that effectively foster students' critical thinking abilities.

METHODS

This research employs a quantitative experimental approach aimed at investigating cause-and-effect relationships. As noted by Sugiyono (2014), the experimental method is used to assess the impact of a treatment on another variable under controlled conditions. The study utilizes a Quasi-Experimental Design, specifically the Nonequivalent Control Group Design. In this design, the experimental and control groups are not selected randomly. Both groups first undergo a pre-test. The experimental group receives the Problem-Based Learning (PBL) approach, while the control group follows the conventional learning method. An end-test is then conducted to assess the results from both groups.

Table 1. Statistic Descriptive

Learning Model / Formative Test Type	Learning Model	
	Problem-Based Learning (PBL) Model based on HOTS (A1)	Conventional Learning Model (A2)
Oral (B_1)	A_1 B_1	A_2 B_1
Essay (B_2)	A_1 B_2	A_2B_2

Explanation :

A1 : Group of students using the Problem-Based Learning (PBL) model.

A2 : Group of students using the Conventional Learning Model.

B1 : Group of students given the Oral Test.

B2 : Group of students given the Essay Test

A1B1 : Group of students using the Problem-Based Learning (PBL) model and given the Oral Test.

A1B2 : Group of students using the Problem-Based Learning (PBL) model and given the Essay Test.

A2B1 : Group of students using the Conventional Learning Model and given the Oral Test.

A2B2 : Group of students using the Conventional Learning Model and given the Essay Test.

The research design employed in this study is a 2x2 Factorial Design, selected to investigate the impact of two independent variables on the dependent variable, as well as their interaction. According to Sutikno (2020), interaction occurs when the effect of one independent variable on the dependent variable changes depending on the level of the second variable. The population for this study consists of all seventh-grade students at SMP PGRI 1 Denpasar, located in Tegal Harum Village, West Denpasar District, with a total of 220 students for the 2023/2024 academic year. The sample includes the entire student population, grouped by ability levels (high, medium, and low), without randomization, and based on pre-existing class formations. This method was chosen for its practicality in terms of time, effort, and cost.

Data for the study were collected using Oral and Essay Tests to evaluate students' critical thinking skills. The Oral Test was specifically designed to assess how students apply critical thinking in problem-solving, either individually or in groups, according to predefined standards. The research was conducted over a period of two months, from July to August 2024, allowing sufficient time to implement the interventions and gather comprehensive data.

RESULTS

Statistic Descriptive

Table 2. Statistic Descriptive

Kelompok		*Statistics*				
		Mean	Standar Deviasi	MAX	MIN	Range
A1	*Post-test*	78,58	4,56	91	70	21
A2	*Post-test*	76,40	5,95	86	61	25
B1	*Post-test*	83,62	4,78	93	73	20
B2	*Post-test*	83,25	5,39	95	70	25
A1B1	*Post-test*	80,99	3,32	93	75	18
A1B2	*Post-test*	82,98	3,75	93	75	18
A2B1	*Post-test*	80,27	4,10	88	68	20
A2B2	*Post-test*	80,08	5,30	90	70	20

Sources: Data Processed, 2024

The table presents statistical data of post-test results from several groups based on the mean, standard deviation, maximum (MAX), minimum (MIN), and range of scores. Group A1 has an average post-test score of 78.58 with a standard deviation of 4.56, indicating that the scores in this group are relatively more consistent compared to A2, which has a lower mean of 76.40 and a higher standard deviation of 5.95. Groups B1 and B2 show nearly identical average scores, 83.62 and 83.25 respectively, with similar score dispersion (standard deviation of 4.78 for B1 and 5.39 for B2).

For the combined groups, A1B2 has the highest average score of 82.98 with the lowest standard deviation of 3.75, indicating the most stable and consistent results compared to other groups. On the other hand, A2B2 has a slightly lower average of 80.08 with a higher standard deviation of 5.30, reflecting more variability in the scores. These data reveal differences in post-test outcomes across groups, both based on individual factors and the interaction of factors, with A1B2 emerging as the group with the best performance and the lowest score variability. This suggests that the combination of factors in A1B2 was the most effective in enhancing students' performance.

Test Of Normality

Table 3. Test of Normality

Sample Group	*Kolmogorov – Smirnov*		
	Statistic	**Sig.**	**Conclusion**
A1	0,93	0,21	Normal
A2	0,92	0,20	Normal
B1	0,67	0,20	Normal
B2	0,75	0,06	Normal
A1B1	0,10	0,07	Normal
A1B2	0,60	0,20	Normal
A2B1	0,73	0,17	Normal
A2B2	0,10	0,06	Normal

Sources: Data Processed, 2024

Based on Table 3 above, the distribution of critical thinking skills data and the type of formative test for students who followed the Problem-Based Learning model as well as those who followed the Conventional Learning model shows a significance value (sig) > 0.05. This indicates that the entire data set follows a normal distribution.

Hypothesis Testing

This research seeks to examine whether there are differences in critical thinking abilities between students participating in Problem-Based Learning (PBL) and those following traditional learning methods. The study adopts a quasi-experimental design using a Posttest-Only Control Group Design, with data analysis conducted through two-way

Analysis of Variance (ANOVA). The data are grouped into several categories: (1) Critical thinking skills of students in PBL, (2) Critical thinking skills of students in conventional learning, (3) Critical thinking skills of students assessed with a formative oral test, (4) Critical thinking skills of students assessed with a formative essay test, (5) Critical thinking skills of students in PBL with an oral test, (6) Critical thinking skills of students in conventional learning with an oral test, and (7) Critical thinking skills of students in conventional learning with an essay test. This study explores how both the learning methods and types of assessments impact the development of students' critical thinking abilities, providing insights into how different instructional strategies and evaluation formats affect cognitive growth in educational contexts.

Table 3. Scheffe Test

Tests of Between-Subjects Effects

Dependent Variable: Berfikir

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1645.255[a]	3	548.418	33.326	.000
Intercept	1444392.164	1	1444392.164	87770.861	.000
Model	1248.073	1	1248.073	75.841	.000
TES	204.291	1	204.291	12.414	.001
Model * TES	192.891	1	192.891	11.721	.001
Error	3554.582	216	16.456		
Total	1449592.000	220			
Corrected Total	5199.836	219			

a. R Squared = .316 (Adjusted R Squared = .307)

Sources: Data Processed, 2024

The table above presents the results of an ANOVA analysis for the dependent variable "Thingking". The corrected model explains 31.6% of the variance in "Thingking" as indicated by the R-squared value of 0.316. The intercept, which represents the mean value of "Thinking" when all predictors are zero, is highly significant (p = 0.000) and has the largest contribution to the total variance. Among the predictors, the variable Model has a significant effect (F = 75.841, p = 0.000), as does TES (F = 12.414, p = 0.001). Additionally, the interaction between Model and TES is also significant (F = 11.721, p = 0.001), indicating that the combined effect of these variables influences "Berfikir." The

error term accounts for the variance not explained by the model, with a Mean Square value of 16.456. Overall, the analysis demonstrates that Model, TES, and their interaction significantly impact the dependent variable, suggesting that these factors are important in understanding variations in "Thinking."

DISCUSSION

The Difference in Critical Thinking Skills Between Students Engaging in Problem-Based Learning and Conventional Learning Models

The research results indicate that the critical thinking skills of students who participated in learning through the Problem-Based Learning (PBL) model are higher than those who engaged in conventional learning methods. Based on hypothesis testing, it was found that the critical thinking skills in the group using conventional learning methods were lower, with an F value of 75.841 and a significance level of 0.000. Since this significance level is less than 0.05, it can be concluded that there is a significant difference in the critical thinking abilities of students between the two learning models. Furthermore, the analysis revealed that students in the experimental class implementing the PBL model had higher average critical thinking scores compared to the control class that employed conventional learning methods. Although both classes had the same Minimum Mastery Criteria (MMC) of 68, the experimental class showed more satisfactory results, while the control class only slightly surpassed the MMC threshold.

The application of the PBL model has been proven to enhance students' critical thinking skills in various dimensions, including: (1) providing basic explanations of problems, (2) developing fundamental problem-solving skills, (3) drawing conclusions based on problem-solving, (4) offering in-depth explanations to further explore the problem, and (5) organizing strategies and tactics for solving problems. Through this process, students are trained to think more critically and deeply, as well as to formulate alternative solutions. The difference in critical thinking performance between the two groups can be explained theoretically by the characteristics of the two learning models. The PBL model focuses on presenting real-world problems as the central learning theme, encouraging students to develop problem-solving skills and self-regulation. Steps in PBL, such as problem orientation, facilitating independent investigation, and analyzing solutions, contribute significantly to sharpening students' critical thinking abilities.

In contrast, conventional learning tends to be teacher-centered, emphasizing symbolic knowledge transfer through resources like textbooks or lectures. While effective in organizing information, this method is less capable of actively engaging students in critical thinking and problem-solving processes (Ghani et al., 2021). Conventional learning relies on applying general principles to specific situations without involving direct problem-solving experiences. This study aligns with other research findings, such as those by Prasad (2022), which also demonstrated that the PBL model is effective in enhancing students' critical thinking skills and learning outcomes. Their study emphasized that PBL provides students with opportunities to address real-life problems, thereby improving their understanding of the material and their critical thinking abilities.

Overall, the findings of this research confirm that Problem-Based Learning is a highly effective model for developing students' critical thinking skills. The implementation of PBL in the learning process not only enhances critical thinking abilities but also has the potential to improve students' overall academic achievement.

The Difference in Critical Thinking Skills Between Students Given Oral Formative Tests and Essay Formative Tests

This study aims to examine the impact of test formats oral-based tests versus essay-based tests on students' critical thinking skills. Based on the results of hypothesis testing, a significant main effect was found, indicating differences in critical thinking abilities between students given oral-based tests and those given essay-based tests. A two-way ANOVA analysis showed an F-statistic score of 6.995 with a significance value of 0.009, which is less than 0.05 ($p < 0.05$), confirming a significant difference in critical thinking skills between the two groups. Descriptively, the results also indicate that the group given oral-based tests scored higher in critical thinking skills compared to the group tested with essay-based assessments. These findings suggest that the test format indeed influences students' critical thinking abilities.

Oral-based tests typically assess students' ability to apply learned concepts in real-world situations. Tasks in these tests often involve problem-solving, experiments, or product creation, requiring students to demonstrate their skills in practical contexts. In contrast, essay-based tests emphasize analytical skills, organizing ideas, and constructing persuasive arguments. In essay tests, students are asked to answer structured written questions where they apply knowledge and skills to develop strong arguments.

Various studies have shown that tests directly assessing critical thinking skills, such as oral-based tests, are more effective in improving students' critical thinking abilities than essay-based tests. For instance, research by Sajidan *et al.* (2022), involving 180 middle school students found that oral-based tests led to significantly greater improvements in critical thinking skills compared to essay tests. Similar findings were reported in a meta-analysis by Dochy *et al.* (2003), which concluded that oral-based tests consistently outperform essay tests in enhancing critical thinking. A study by Gao *et al.* (2022), also reported similar results, emphasizing that oral-based tests enable students to apply their knowledge in real-world contexts, significantly contributing to the development of their critical thinking skills. Furthermore, a long-term study by Zhao *et al.* (2024), revealed that sustained use of oral-based tests encourages students to continually hone their critical thinking abilities in practical situations, leading to long-term skill improvement.

Oral-based tests have several advantages over essay-based tests, including:

1. Demonstrating Real Abilities: Oral-based tests allow students to showcase their skills in more realistic contexts, resembling real-life or workplace situations.
2. Immediate Feedback: Oral-based tests enable students to receive instant feedback, allowing them to quickly identify their weaknesses and make improvements.
3. Developing Practical Skills: These tests help students build practical skills, such as communication, teamwork, creativity, and problem-solving, which are valuable in various life situations.
4. Higher Objectivity: Oral-based tests often exhibit greater objectivity compared to essay tests, as they are evaluated using clear rubrics and frequently incorporate technology for more precise assessment.
5. Task Variety: Oral-based tests can be designed with diverse and engaging tasks, providing students with opportunities to showcase their skills in different ways and avoiding monotony.

The Interaction Difference Between Learning Models and Formative Test Formats on Critical Thinking Skills

This study aims to examine the simultaneous differences in critical thinking skills and learning outcomes between students who participated in the Problem-Based Learning (PBL) model and those who participated in conventional learning. The analysis, conducted

using MANOVA with IBM SPSS Statistics 26.00, revealed an F-value of 142.793 with a significance level of < 0.05 across all multivariate tests (Pillai's Trace, Wilks Lambda, Hotelling's Trace, and Roy's Largest Root), indicating a significant effect of the PBL model on both variables. The average critical thinking skills and learning outcomes for students in the experimental class (PBL) were 80.28 and 82.85, respectively, compared to 68.24 and 64.62 in the control class (conventional learning). These findings demonstrate that the PBL model significantly improves the critical thinking skills and learning outcomes of students in Grade V of Gugus I Tampaksiring.

Further findings showed a positive correlation between critical thinking skills and learning outcomes, with a correlation strength of 0.349. This indicates that the higher the students' critical thinking skills, the better their learning outcomes. Critical thinking, which involves the ability to think logically, reflectively, and analytically, plays a significant role in influencing learning outcomes. According to Yunita *et al.* (2020), critical thinking is the attitude of deeply reflecting on problems, understanding logical examination methods, and applying these methods to reach valid conclusions. Critical thinking skills are closely related to learning outcomes, which include changes in the cognitive, affective, and psychomotor domains of students.

The PBL model has been proven effective in enhancing students' critical thinking skills. Through the problems presented, students are encouraged to think critically to find appropriate solutions. This improvement in critical thinking skills directly influences students' learning outcomes. The higher the level of critical thinking, the better their learning outcomes. This highlights the importance of a well-planned learning process that focuses not only on conceptual understanding but also on the development of thinking skills and students' character.

According to Asmiyunda & Hardeli (2023), learning outcomes encompass changes in students across cognitive, affective, and psychomotor aspects as a result of the learning process. In this context, the role of educators is crucial in facilitating, guiding, and fostering critical thinking skills and active participation among students in the classroom. The PBL model allows students to learn more deeply and meaningfully, ultimately enhancing their learning outcomes.

Comparison of Critical Thinking Skills of Students Using the Problem-Based Learning Model and the Conventional Model in Oral Tests

The results of hypothesis testing in this study indicate a significant main effect, suggesting that the critical thinking skills of students using the Problem-Based Learning (PBL) model are better than those of students following the conventional learning model, particularly among those taking oral-based tests. The Scheffe test analysis revealed a significance value of 0.020 with a Mean Difference of 5.59. Since the significance value is less than 0.05, it can be concluded that there is a significant difference in critical thinking skills between students using the PBL model and those using the conventional model in oral-based tests. Students in the PBL model showed an average critical thinking score of 83.31, which is higher than the average score of 77.60 for students using the conventional model. The Scheffe test further confirmed a significant difference between the two groups.

These findings are consistent with research conducted by Saif *et al.* (2024), which found that students using the PBL model demonstrated better critical thinking skills compared to those following the conventional learning model, especially in oral-based tests. This can be attributed to the interactive and engaging nature of the PBL model, which helps students better understand the material and develop their critical thinking skills. Research by Suparman *et al.* (2021), also supports this conclusion, showing that students involved in problem-based learning exhibited a better understanding of the material and enhanced critical thinking skills compared to those in the conventional model. The PBL model encourages active student participation in the learning process, allowing them to think more deeply and critically.

The advantages of the PBL model in improving critical thinking skills can be explained by several factors, including: (1) PBL focuses students' attention on a more in-depth learning process; (2) it encourages them to think, communicate, seek, and manage data effectively; (3) it develops critical and creative thinking skills; (4) it enhances students' motivation to learn; and (5) it helps them transfer acquired knowledge into real-world contexts. Thus, the Problem-Based Learning model not only enhances students' critical thinking skills but also provides a more comprehensive and meaningful learning experience compared to the conventional learning model, which tends to be monotonous. This model facilitates the development of higher-order thinking skills, which are essential for students in the 21st century.

Comparison of Critical Thinking Skills of Students Using the Problem-Based Learning Model and the Conventional Model in Essay Tests

The results of the hypothesis test in this study show a significant main effect, indicating that the critical thinking skills of students using the Problem-Based Learning (PBL) model are better than those of students using the conventional model, particularly for students who participated in the essay-based test. The Scheffe test analysis revealed a significance value of 0.000 with a Mean Difference of 11.13, meaning this significance value is less than 0.05 and indicates a significant difference in critical thinking skills between students using the PBL model and those using the conventional model in the essay test.

The group of students who took the essay test with the PBL model showed an average critical thinking score of 82.73, which is higher than the average score of 71.60 for students following the conventional model. The Scheffe test also confirmed a significant difference in the average critical thinking scores between the two groups.

The application of the PBL model allows students to actively engage in the learning process, thanks to its interactive design. This model also integrates various learning methods that help students better understand and retain the material. In contrast, the conventional learning model tends to present information passively, potentially leading to less student engagement in the learning process. This model is often monotonous and does not provide enough interactive stimuli to enhance students' critical thinking skills (Zhang et al., 2022).

In the context of essay tests, students using PBL have better critical thinking skills because they are accustomed to the critical thinking approach applied during the learning process. Additionally, the use of various arguments in the PBL model helps students formulate stronger arguments and present more convincing evidence in writing. Therefore, this study reinforces the idea that Problem-Based Learning not only enhances students' critical thinking skills but also promotes active engagement that enriches their understanding of the material and writing abilities.

Comparison of Critical Thinking Skills of Students Given Oral Tests and Essay Tests in the Problem-Based Learning Model

Based on the hypothesis testing results conducted on the research data, a main effect was found indicating that the critical thinking skills of students given oral tests were

not significantly better than those given essay tests, among students who followed the Problem-Based Learning (PBL) model. The analysis of the Scheffe test showed a significance value of 0.995 with a Mean Difference of 0.45, meaning the significance is greater than 0.05. This indicates that there is no significant difference between students who were given oral tests and those who were given essay tests in terms of critical thinking skills in PBL-based learning.

The group of students using the PBL model and given oral tests had an average critical thinking score of 83.31, which was slightly higher than the group given essay tests, with an average score of 82.73. However, the Scheffe test showed that this difference was not significant. Therefore, this study concludes that the type of test, whether oral or essay, does not significantly affect the critical thinking skills of students following PBL-based learning. Both test formats had a similar impact on the critical thinking skills of students using PBL learning materials.

Although this difference was not statistically significant, a difference in critical thinking scores between the two groups may still occur, and certain factors need to be considered in the learning context (Aprila et al., 2023). Some factors that could affect these results include: (1) individual factors, such as initial student abilities, interests, motivation, preparedness, experience, and self-confidence in using technology and certain learning materials; (2) learning environment factors, including available facilities, support from family and peers, and students' psychological conditions such as anxiety and stress; (3) learning material factors, including clarity and usefulness of the material, presentation methods suitable for the students' characteristics, and the ease of use and accessibility of the materials.

This study is also relevant to findings from Chusni *et al.* (2020), who compared critical thinking skills between students given oral and essay tests in PBL-based learning. Their research showed no significant difference in critical thinking skills between the two student groups, whether they were given oral or essay tests, in PBL-based learning. Both groups showed similar improvements in critical thinking skills. Another study by Amelia *et al.* (2024), also stated that the PBL model could enhance students' critical thinking skills, both on oral and essay tests. However, for oral tests, the improvement in critical thinking skills of students using PBL was more significant compared to those using conventional learning models. Meanwhile, for essay tests, while there was an improvement in critical

thinking skills for both groups, no significant difference was found between the PBL and conventional model groups.

This research supports the understanding that PBL provides a more interactive, varied, and engaging learning experience, which can enhance students' critical thinking skills. The use of PBL also allows students to be more innovative in exploring new things around them, thus enriching the learning process and the outcomes achieved.

Comparison of Critical Thinking Skills Between Students Given Oral Tests and Essay Tests in Conventional Learning

Based on the hypothesis testing results conducted on the research data, a significant main effect was found, indicating that the critical thinking skills of students given essay tests are better compared to those given oral tests, among students participating in conventional learning. The Scheffe test analysis shows a significance value of 0.012 with a Mean Difference of 6.00. Since the significance value is less than 0.05, the difference between students given oral tests and essay tests in conventional learning is proven to be significant.

Students participating in conventional learning and given oral tests had an average critical thinking score of 77.60, while those given essay tests had an average score of 71.60. The Scheffe test confirms that the difference between these two groups is significant. In general, oral tests require students to demonstrate skills in applying the material learned, while essay tests require students to construct written answers with good language and a systematic structure. This influences how students process and organize information to answer questions or solve problems.

In oral tests, students tend to process information more concretely and directly because they must apply learned concepts in real-world or simulated situations. For example, in an oral math test, students are required to apply formulas to solve problems, which demands understanding and precise application of the formulas. Meanwhile, in essay tests, students are expected to develop critical reading and analysis skills. They must understand and interpret the information in the learning materials and organize it into writing with strong arguments.

Previous research also supports this statement, such as Senturk (2018), who found that oral-based tests can significantly enhance students' critical thinking skills compared to written tests like essays. However, Wardani *et al.* (2024), found that essay tests had a greater influence on improving critical thinking skills than oral tests. Several factors affect the differences in critical thinking skills between students given oral and essay tests in conventional learning. These factors include: (1) student characteristics, such as interest, motivation, and previous experience, which can influence how they think and solve problems; (2) the type of question, as essay tests encourage students to organize and develop arguments based on evidence, while oral tests emphasize completing real tasks that require quick analysis and evaluation; (3) the learning materials, where fact-based materials are more suitable for oral tests, while problem-solving materials are better for essay tests.

This study encountered several challenges that should be noted, including: (1) data collection, which involved coordination with various parties, including teachers and students, and ensuring the data collection procedure followed the plan; (2) control variables, as external factors like previous experience, educational background, and the learning environment could affect the research results; (3) time and resources, which posed challenges in effectively managing the research in terms of time required and limited resources. Overall, despite the challenges faced, this study provides valuable insights into how test formats can affect students' critical thinking skills, particularly in conventional learning.

CONCLUSION

Based on the results of the study, it can be concluded that there are significant differences in critical thinking skills between students who use the Problem-Based Learning (PBL) model and those who use the conventional learning model. Furthermore, the type of formative test, whether oral or essay, also has a distinct impact on students' critical thinking abilities.

The interaction between learning models and types of formative tests indicates that certain combinations, such as PBL with essay tests, are more effective in enhancing critical thinking skills compared to other combinations. Specifically, students exhibited higher levels of critical thinking when taught using the PBL model and assessed with essay-based formative tests.

These findings suggest that selecting an appropriate learning model, combined with suitable evaluation methods, can significantly improve students' critical thinking skills. Therefore, the implementation of Problem-Based Learning and the use of essay-based formative tests are recommended to support more effective and meaningful learning experiences.

Recommendations based on this research include:

1. Enhancing the Use of Problem-Based Learning Models

   Given the findings showing the success of problem-based learning in improving student outcomes, it is recommended that educators optimize the use of this model. Properly structured PBL implementation can help students develop critical thinking and problem-solving skills more effectively. Therefore, training and workshops for teachers related to PBL should be conducted to ensure its proper and maximum use.

2. Focus on Improving Students' Self-Efficacy

   Based on the research showing the significant influence of self-efficacy on learning outcomes, it is important for teachers to pay special attention to developing students' self-efficacy. Providing a supportive environment, giving positive feedback, and creating opportunities for students to experience success will enhance their confidence in learning. As a result, students will be more motivated and engaged in the learning process.

3. Personalizing Learning Approaches

   Given the differences in learning outcomes related to student characteristics, it is advised that teachers adopt a more personalized and flexible approach to learning. By gaining a deeper understanding of individual students' characteristics, teachers can adjust the methods, media, and learning strategies that are appropriate for each student.

4. Long-Term Learning Planning

   It is recommended to design and implement problem-based learning models over a longer period to maximize their impact. Consistent implementation over a certain period will provide students with opportunities to gain deeper and more meaningful learning experiences, as well as develop more mature critical thinking and problem-solving skills.

5. Further Research in the Development of Learning Models

Further research is needed to examine the effectiveness of problem-based learning models in various educational contexts. This will provide broader insights into how this learning model can be applied effectively in different subjects and educational levels.

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