



The Relevance of Blended Learning to Students' Critical Thinking Skills

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Abstract

This research examines how blended learning affects students' ability to think critically. This kind of quantitative study uses A design for a time series and a Semi-Experimental method. This During the odd semester of 2023–2024, research was done at a Public Junior High School in Banyumas Regency. A total of 35 students were selected from two classes to be used as research samples. Essay questions, critical thinking variable surveys, Using HOTS in blended learning techniques, as well as field notes are the tools used. The research findings show that students' critical thinking skills increased when the blended learning approach is combined with the HOTS strategy. This conclusion is supported by the results of the ANOVA analysis, which shows an F value of 6.253 at a level of significance of 0.039. Because the calculated F exceeds the F table, The suggested hypothesis's findings are acknowledged. Specifically, $6.253 > 4.196$. The study's findings demonstrate that pupils' critical thinking abilities improve when the blended learning model and the HOTS approach are used simultaneously.

Introduction

In this advanced and contemporary age of globalization, education actively contributes to human survival (Fahrurrozi et al., 2021; Mohzana et al., 2021; Hashim et al., 2022). In this age of globalization, education encourages students to meet the demands of industry 4.0, which calls for the 21st century, or skill development (Komalasari, 2021; Rahmawati & Atmojo, 2021; Wiseman, 2022). Global market shifts, international competency, migration, the political climate, and technical advancements all require 21st century skills to succeed in the age of globalization (Angga et al., 2022; Aslamiah et al., 2021; Karpov & Karpova, 2020). Critical thinking abilities, digital literacy, media knowledge, and comprehension and proficiency with technology for information and communication are all considered 21st century talents (Abaniel, 2021; Mui et al., 2022; Tazijan et al., 2022).

Active observation, communication, data handling, and argument construction are all components of critical thinking, which includes the capacity to evaluate and analyze information. Furthermore, critical thinking allows for intelligent, autonomous, lucid, and logical scientific reasoning (Indrašienė et al., 2021; van der Zanden et al., 2020). Accordingly, Thinking critically is the capacity to use reason to solve issues, draw conclusions, consider multiple options, and choose the best course of action (Bangun & Pragholapati, 2021; Palavan, 2020). Critical thinking skills enable an individual to synthesize ideas from their experiences in order to analyze and resolve issues that affect both themselves and other people (Arisoy & Aybek, 2021; García-Moro et al., 2021; Anggraeni et al., 2023; Muthmainnah et al., 2022). Critical thinking is now regarded as a necessary life skill that must be cultivated. Research, analysis, and study of the subject matter require critical thinking skills from the students (Arisoy & Aybek, 2021; Lewis et al., 2022). One essential ability needed to handle the revolution is critical thinking. Critical thinking must therefore be a fundamental ability for

students at all educational levels in the industrial revolution (Lewis et al., 2022; Mena Araya, 2020).

According to surveillance conducted throughout the learning process, most teachers continue to use the teacher-centered, question-and-answer format of the (traditional) lecture style. Due to the teacher's dominance, pupils participate less actively in the learning process when using the teacher-centered learning pattern. Therefore, this approach is limited to in-person interactions between professors and pupils. Students' extremely poor critical thinking abilities are impacted by this. As a result, it might be claimed that the typical Indonesian student is incapable of critical thought. In line with recent advancements, contemporary approaches are required to foster pupils' critical thinking. The most recent technique for enhancing the process of learning is known as Higher Order Thinking Skills (HOTS) (Ballakrishnan & Mohamad, 2020). In order to address an issue that requires analysis, assessment, and creativity, HOTS refers to the capacity to critically and creatively manipulate or process information or ideas (Goik Leng et al., 2020; Jaenudin et al., 2020).

Every HOTS element is a part of critical thinking abilities. The basis of HOTS is the ability to think critically, which is the foundation of addressing issues, the highest degree of HOTS (Jaenudin et al., 2020; Wilson & Narasuman, 2020). Because a classroom that is both interactive and activity-based instruction can develop Critical thinking skills of student's abilities, including problem-solving techniques, it can help them develop high-level thinking skills, or HOTS. The technology-based nature of the blended learning paradigm makes it appropriate for optimizing the effectiveness of HOTS learning techniques (Chaiyama, 2019).

Online and in-person instruction are combined in blend-based learning (Graham, 2015; Valiathan, 2002). Optimizing the utilization of spoken communication from in-person instruction and textual communication from online learning is the goal of the blended learning strategy. Conference calls, phone, email, online text animation, CD ROMs, online courses, multimedia technology, and video streaming are all components of blended learning. The traditional classroom simulation model incorporates all of this (Mystakidis, 2019; Sophonhiranrak et al., 2015). An educational approach known as in blended learning; conventional classroom education is combined with hands-on, experiential learning. Teachers and students can access online instructional resources through this means (Berga et al., 2021; Calderon et al., 2021; Sepriana et al., 2021; Wilson & Narasuman, 2020). Providing chances for learners to learn autonomously, sustainably, and acquire lifelong skills is the goal of blended learning (Graham et al., 2013; Mystakidis, 2019; Valiathan, 2002).

The main focus of the learner in mixed learning. It is desired that pupils would be able to learn on their own and responsibly. Students must actively engage in learning indoors and out the classroom to succeed in the blended learning environment (Berga et al., 2021; Finlay et al., 2022; McDonald et al., 2024; Tong et al., 2022). Blended education does not entirely replace in-person instruction in the classroom. Rather, it is utilized to finish and respond to assignments that were not covered in the classroom (Bouilheres et al., 2020; Fahrurrozi et al., 2021; Graham, 2015; Mohzana et al., 2022; Resien et al., 2020).

In order to encourage more engaging, successful, and efficient gaining knowledge, mixed learning is crucial. The drawbacks of online learning can be mitigated by utilizing the benefits of in-person instruction. However, the benefits of online education can offset the drawbacks of in-person instruction. The key to successful blended learning deployment is the appropriateness of strategy delivery between online and in-person learning (Ashraf et al., 2021; Bahri et al., 2020; Cannon et al., 2023; Chiu, 2022; Jost et al., 2021; Yin & Yuan, 2021). According to similar research, (1) students' critical thinking abilities improved notably, (2) the application

of learning proceeded smoothly, and (3) The HOTS model of Learning works well in enhancing both Critical thinking abilities of students abilities and gaining knowledge outcomes (Wahyunita & Subroto, 2021). Therefore, it Was determined that the HOTS learning paradigm successfully and significantly improves the critical thinking skills of pupils.

The effect Effects Combined learning on the Thinking critically of high school pupils about temperature and heat was the focus of other comparable research (Anggraeni et al., 2019). The findings demonstrate that pupils' critical thinking abilities in these areas are greatly impacted by blended learning. The study by Hamdani et al. (2022) investigates the efficacy of the HOTS-based problem-based learning strategy in enhancing pupils' capacity for critical thought. Considering the data gathered, the class that is being tested average the score was 75, whereas the class under control's was 65,5. The t-test disproves the null hypothesis. P-Value of 0.002. This illustrates how the ability to think critically of pupils who receive instruction based on the HOTS-based learning model as well as those who follow the regular learning paradigm differ greatly.

Considering this study, the researcher plans to investigate whether using a HOTS technique in blended learning might improve critical thinking abilities. The following is the hypothesis that could be developed: The critical thinking skills of students are successfully enhanced via employing a HOTS approach in blended learning.

Methods

This research was conducted during the odd semester of 2023-2024 at junior high schools in Banyumas Regency. This study used a quasi-experimental research design to test the effect of a blended learning model with a HOTS (Higher Order Thinking Skills) approach on students' critical thinking skills. This study used a research design that was not entirely experimental. Although described as non-experimental, the use of a pre-test-post-test format in one group is more in line with a quasi-experimental design. This design allows for the investigation of causal relationships even in the absence of a control group, although the absence of such a group limits the ability to conclusively attribute observed changes to the intervention due to potential external influences. Before starting therapy, the experimental group took a pretest. Then, they received treatment with the HOTS method blended learning paradigm, which was followed by a posttest. The indicators used to measure the critical thinking capacity of the blended learning model are (a) how students react to the learning paradigm, (b) how active students are, (c) the implementation of learning by the instructor, and (d) student learning outcomes. The population of this study was 65 people from one class. The sampling method used in sampling is a non-probability sampling method, namely area or cluster sampling. To ensure that each homogeneous class has an equal chance of becoming a research sample, sampling is done by lottery. Where one class is taken randomly from a larger population consisting of 65 students. Although random sampling aims to ensure equal opportunities among homogeneous classes, the limited sample size and narrow geographic focus may limit the generalizability of the findings.

Although the design provides initial insights into the relationship between blended learning and critical thinking, the absence of a control group and limited measurement instruments may affect internal validity. Furthermore, the operationalization of critical thinking and the specific pedagogical features of blended learning that foster these skills are not fully explained. The experimental class will be the class that appears first in the lottery. To assess the impact of the blended learning approach on students' critical thinking skills, a post-test is given in the experimental class after the lesson. The sample in this study will then be the group whose name

appears, consisting of a total of 35 students. The independent variable of this study is blended learning. However, the dependent variable of this study is critical thinking.

Test tools and surveys were employed to collect data for this investigation. There were 35 question questions on the used questionnaire. Each questionnaire item offers four possible responses on a Likert scale, ranging from very positive to very negative. In this study, achievement tests were used as a more direct measure of learning outcomes. However, although these tests contribute to the overall evaluation of student performance, the instrument focuses explicitly on critical thinking such as problem-solving scenarios or open-ended tasks.

The Pearson Product Moment formula will be used to examine the validity of the study's questionnaire and test instrument. Reliability test In this study, the researcher will use the KR-20 formula to determine the reliability of the test which is suitable for dichotomous data to assess internal consistency. The difficulty level of the items and the discriminatory power were also analyzed. Among the 12 main items related to blended learning, four were categorized as "easy," three as "moderate," and five as "difficult." Items with higher discriminatory power were considered better at distinguishing between high and low-ability students.

For data analysis, the study used the Kolmogorov-Smirnov test to check the normality of the data. In addition, the Bartlett test was applied to evaluate the homogeneity of variance, and For hypothesis testing, the Simultaneous Significance Test (F-statistic) was used, which is usually part of the ANOVA procedu.

Results and Discussion

Table 1. Pretest data for critical thinking

Variabel	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Critical Thinking	35	55.00	90.00	69.0000	1.276763	7.20312
Valid N (listwise)	35					

The pretest scores ranged from 55 to 90, with a mean of 69 and a standard deviation of 7.20. This wide range indicates a notable spread in students' initial critical thinking abilities. A closer look at this variability suggests that the distribution may be moderately skewed, with some students demonstrating relatively high critical thinking skills even before the intervention, while others were well below the minimum standard (KKM = 75). The standard deviation of 7.20 reflects a relatively high level of dispersion, pointing to heterogeneous baseline skills among students.

Table 2. the critical thinking post-test

Variabel	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Critical Thinking	35	79.00	98.00	88.1000	.97715	5.73219
Valid N (listwise)	35					

The posttest scores showed a significant increase with a range of 75 to 100, a mean of 88, and a standard deviation of 5.7. The average increase of 19 points from the pretest score indicates substantial development of critical thinking skills in the application of the learning model. and quite significant. The fact that all students achieved or exceeded the KKM score indicates the effectiveness of this intervention. The decrease in standard deviation from 7.20 to 5.7 also reflects a decrease in the variation in results between students, indicating greater uniformity

in post-intervention results. This may mean that students who initially struggled gained more significant benefits, potentially closing the performance gap. In other words, the reduced standard deviation indicates a narrowing of the performance differences among students. This implies that the intervention not only improved overall performance but also helped standardize learning outcomes across classes. To further support the significance of this increase, a paired t-test was conducted. The results yielded an F-count of 6.253, which exceeded the F-table value of 4.196 at the 0.039 level of significance. This indicates that the improvement is statistically significant. To better measure the magnitude of this increase, Cohen's d was calculated assuming a pooled SD of 6.5 as follows:

$$\text{Cohen's } d = (M_{\text{post}} - M_{\text{pre}}) / \left[\frac{SD_{\text{pooled}}}{\sqrt{2}} \right]$$

$$d = (88-69) / 6,5 = 2,92$$

An effect size above 0.8 is considered large, so a value nearing 3 indicates an exceptionally strong impact of the intervention.

Table 3. Data for Blended Learning

Variabel	N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Critical Thinking	35	68.00	95.00	88.1000	76.00	11.57409
Valid N (listwise)	35					

Tables 3 demonstrate a substantial difference between the pretest and post-test findings, with the minimal student score of 68 being larger than the previously established 75 KKM. The highest possible scores on the post-test of 95 indicates that students were successful in enhancing their critical thinking skills following the implementation of The HOTS strategy in conjunction with the mixed knowledge paradigm. However, the mean score of 76 suggests that students' critical thinking abilities have generally improved. Nonetheless, the standard deviation of 11.5 indicates that the use of the HOTS technique in conjunction using the idea of mixed learning has improved Critical thinking skills of student's abilities.

Table 4. Frequency Data for the Pretest and Post-test

No	Pretest		Posttest	
	Value Interval	Frequency	Value Interval	Frequency
1	50-59	2	75-79	4
2	60-69	13	80-84	12
3	70-79	11	85-89	8
4	80-89	6	90-94	7
5	90-99	3	95-99	4
	Total	35	Total	35

Four students scored between 75 and 79 as shown in Table 4. A total of twelve the scores of the students varied from 80 to 84. Seven students received scores between 90 and 94, and eight students received scores between 85 and 89. Four pupils, though, received scores in the 95–99 range. Combining a blended learning paradigm with the HOTS method allowed 85% of students to improve their critical thinking abilities, and the average student's score was higher than the KKM of 75.

Table 5. Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized
N		35
Normal Parameters.	Mean	.7692600
	Std. Deviation	6.48232457
Most Extreme Differences.	Absolute	182
	Positive	182
	Negative	082
Test Statistic.		182
Aseem. Sig. (2-tailed)		137c
a. Test distribution is Normal		
b. Calculated from data		
c. Lilliefors Significance Correction		

Table 5 indicates that the significance threshold is 0.137 and the Kolmogorov-Smirnov Z is 0.182. The data distribution in this study can be considered normal since the significant result is bigger than 0.05 ($0.137 > 0.05$). The Levene approach was employed in this investigation to evaluate the data's uniformity. The information is deemed homogeneous Should the significance value be higher than 0.05; if it is lower than 0.05, the data is regarded as inhomogeneous. The outcomes of the data processing for the homogeneity test are shown in Table 6.

Table 6. Homogeneity Test

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Critical Thinking	Based on Mean	1.065	3	28	396
	Based on Median	676	3	28	592
	Based on Median and with. adjusted do	676	3	20.964	595
	Based on trimmed mean	1.009	3	28	427

Table 6 demonstrates that the students' critical thinking abilities post-test results are greater than 0.05 and have a significant value of 0.396, indicating that H_0 has been approved. This indicates that the both groups are members of a populace that is homogeneous and has comparable variances. Once these prerequisites for analysis have been met, the f test can be used to test hypotheses and determine whether they are accepted or rejected.

Table 7. Simultaneous test results (Anova)

Anova						
Model		Sum of Squares	Do	Mean Square	F	Sig.
1	Regression	25.716	1	25.716	6.253	.039b
	Residual	809.187	33	24.520		
	Total	834.903	34			
a. Dependent Variable: critical thinking						
b. Predictors:(Constant), Blended Learning						

A computed F value is displayed in Table 7 as 6.253 with a significance level of 0.039. Thus, we need to check the F count against the F table to see if the suggested the theory is either

accepted or rejected. The F table of 4.196 can be found by applying the equation $df = n - k - 1$. or $df = .35 - 1 - 1 = .33$. This means that $F_{count} > F_{table}$ or $6.253 > 4.196$.

The purpose of this study was to determine how the blended learning model with HOTS techniques affects students' critical thinking skills with reference to employment material. Assessment of students' critical thinking skills was carried out based on their performance on the pretest and posttest. This instrument consists of five descriptive questions. First, the validity, reliability, discriminatory power, and challenge level of the test tool were examined. The data met the requirements with the correlation values of validity and reliability. This demonstrates the validity and reliability of the question for evaluating critical thinking abilities of the pupils. The sample studied consisted of one class of thirty students, each of whom received a pretest question after it was determined that many of them still did not meet the KKM. Each class XI student then received Four (four) meeting sessions are used to treat the paradigm of mixed learning using The HOTS approach, and A follow-up test with the same question is then administered to assess the students' level of understanding.

Considering the outcomes of the initial test (pretest), Critical thinking abilities among kids remain comparatively low. The average student pretest score was 68, which indicates that 68% of the possible score of 100 is still below the average pretest score. On this study's pretest, the least student the result was 55, and the greatest was 90. Given that they are still far from the established KKM of 75, this suggests that pupils' starting talents can be regarded as low. A number of variables contribute to each student's low starting ability, and a lack of comprehension of the concepts in the learning materials is one of them. Students' inability to focus leads to a lack of seriousness in their study and a diminished comprehension of the subject matter, which in turn causes a low comprehension of these concepts. This hinders the development of critical thinking abilities.

According to pretest findings on critical thinking components, students' critical thinking abilities are categorized as low. The average student that gets the answer right is 60% when it comes to elementary clarification. Students' inadequate capacity for critical thought in the elementary clarification domain is caused by their inability to understand the relevance of the questions related to the subject being taught. The percentage of pupils who properly answered the basic support (developing basic skills) question was 55%. Students' poor critical thinking skills in the domain of basic support (the development of fundamental skills) are a result of their inability to understand the results of labour-related observations. Thirty-five percent of pupils correctly answered the inference question. The percentage of students who properly answered the question about advance clarification (offering additional explanation) was 55%. Students' critical thinking skills are deficient in this area because they find it difficult to discern between assumptions related to labour and those that do not. Forty percent of pupils correctly answered the strategy and tactics question. Students' inability to decide how best to divide up the work is the cause of their poor critical thinking skills in the strategy and tactics domain.

According to the pretest findings, elementary clarification had the greatest percentage (60%) of any facet. The inference component had the lowest proportion (35%). This is consistent with the inference component of Dewi Anggraini's findings, which is 44%. According to the post-test results, pupils' critical thinking abilities have improved overall. With an average score of 88.00, the critical thinking skill's final ability that were treated using the paradigm of mixed learning and the HOTS method is highly. The highest score of 98 demonstrates this. The increase happened as a result of pupils being accustomed to receiving questions with important details, making the task of answering them feel easier than when they were originally presented with them. Students will also get more knowledge by utilizing The HOTS

technique used with the mixed learning model, which is investigated through extra resources including learning videos and deeper materials. This is consistent with a 2022 study by Hamdani that found students in the experimental class had superior critical thinking skills.

The average percentage of pupils who properly answered the question about elementary clarification was 85.00%. The let me stage (practice/practice) is when primary clarification (giving basic explanations) takes place. At this point, students engage in dialogues and attempt to investigate their foundational understanding of labour by responding to the teacher's package book. Since pupils only paid attention to the question and failed to understand the significance of the picture in the pretest, many students at this point gave accurate answers. This illustrates the children's capacity to define work. Furthermore, it is because they are accustomed to responding to inquiries by recognizing images, diagrams, and symbols in accordance with the details in the query.

Sixty percent of students gave correct answers when asked about the development of fundamental abilities (basic support). Students' inability to comprehend the material at the Check me stage was one of the challenges that led to this. At this point, the teacher assesses the pupils using the examined content, but the results are not very noteworthy because some students do not comprehend, resulting in subpar basic skills.

The percentage of pupils who properly answered the inference (concluding) question was 65% in the Support me level. Seventy percent of the students gave accurate answers when requested to elaborate (also known as advance clarification). Students can be self-sufficient at the Coach Me stage, but they still require the teacher's input on the matter of advance clarification. Seventy percent of students correctly answered the question on strategy and tactics (organizing strategies and tactics). The Connect me stage is where strategy and tactics are discussed. This study's primary focus is elementary clarification, which includes offering straightforward justifications as well as techniques and approaches. This is consistent with Ingrain's research findings.

The results showed that the students' test scores instruction using the HOTS technique in blended learning was different before and after. Due to the fact that students might pose and respond to questions during the discussion and give a basic explanation of work, there was the greatest rise in rudimentary clarification in terms of components. According to the explanation, a person with critical thinking abilities is able to express themselves clearly and has a good concept because it is supported by logical arguments.

Basic support (basic ability) was the critical thinking component that increased the least. This occurs because the gain is not too great due to the initial capacity of pupils who only half absorbed the material or assumptions presented. Another element is the absence of comprehension of the problem's information; many students still struggle with information analysis and comprehension, and a lot of them are accustomed additionally, many of them are merely obtaining data from the instructor. As a result, some students struggle when asked to explain a problem in greater detail. Interest of students in the mixed learning approach aligns with previous study (Anggraeni et al., 2019), which shows that blended learning employing the HOTS technique affects critical thinking abilities of the pupils.

This is demonstrated by the students' post-test results after using the blended learning model and the HOTS technique; they are higher than the KKM, which ranges from 77 to 98. This implies that there were differences in the mean cognitive capacities of the pupils between the pretest and post-test. This difference arises as a result of being exposed to a blended learning model using a HOTS technique both before and after. It is also clear based on the ANOVA

test findings that the calculated F value was 6.253 with an ANOVA value of 6.253 at a significance level of 0.039. To ascertain if the suggested hypothesis is either accepted or rejected. Therefore, we must compare the F table and the F count. 4.196 is then displayed within the F table. Consequently, F count > F table or $6.253 > 4.196$. This illustrates how Combined learning employing the HOTS technique improves pupils' critical thinking abilities in an efficient manner.

Students' flexibility to study the content independently using online resources and their capacity to participate in conversations with educators or fellow pupils outside of class hours are two advantages of the blended learning strategy used in this study. This implies that students can politely ask researchers questions about learning materials outside of the classroom. Additionally, researchers can use the internet's resources to add enrichment materials. The following are some of the several disadvantages of the blended learning paradigm and HOTS approach were applied in this study: The Blended Learning paradigm is primarily supported by stable and sufficient internet; students' mobile phones must have sufficient storage, and autonomous asynchronous tasks aren't strictly regulated, merely highlighting their integrity

Conclusion

The outcomes of the post-test demonstrated that the pupils' critical thinking abilities had at last improved. With an average score of 88.00, the critical thinking skill's final ability that were treated using the blended learning model and HOTS approach is high. The post-test results show how effective the integrated learning paradigm and the HOTS technique work together to develop students' critical thinking abilities. A level of significance of 0.039 with an expected F value of 6.253 were obtained using the Anova test. The F count and F table must be compared in order to decide whether the hypothesis put forth is accepted or rejected. subsequently found the F table at 4.196. This means that $F \text{ count} > F \text{ table}$, or $6.253 > 4.196$.

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