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ENHANCING STUDENTS' MATHEMATICAL CRITICAL THINKING SKILLS THROUGH GOOGLE SITES-ASSISTED PROBLEM BASED LEARNING ON JUNIOR HIGH SCHOOL

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ABSTRACT

The prevalence of students experiencing difficulties in applying mathematics in their daily lives can be attributed to the predominant approach of learning mathematics as a means of applying concepts, rather than as a foundation for learning. This research aims to improve students' mathematical critical thinking skills whose learning is based on Problem-Based Learning assisted by Google Sites. This research used a quasi-experimental research method with a quantitative approach which was carried out at SMPN 2 Cilaku Cianjur with a sample of 30 students in the experimental class and 31 students in the control class on Statistics material. The testing requirements for data analysis used consist of a normality test using Kolmogorov-Smirnov assisted by SPSS software. In this research, it was found that the average score of students in the experimental and control classes was 73.76 and 64.72 on the test before learning was carried out. Then 77.87 and 68.69 on the test after learning. So the average value of N-Gain in the experimental and control classes is 0.20 and 0.10. So, inferential statistical testing shows that the improvement that occurs in students' mathematical learning in the process of critical thinking skills with the Problem-Based Learning learning model assisted by Google Sites is very optimal when compared with conventional learning. Thus, for further research, it is hoped that an analysis of the Problem-Based Learning model can be carried out in comparison with other learning models to see whether some differences and interactions occur using the Analysis of Variance test.

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INTRODUCTION

The prevailing perception among students of mathematics as an abstract and unintuitive subject is a consequence of the limited opportunities they have to engage with the subject as a science

that can cultivate creative thinking skills (Al Ayyubi & Rohmatulloh, 2023). The prevailing approach to learning mathematics is to present students with a series of exercises designed to reinforce the memorization of mathematical techniques and procedures, with minimal opportunity for students to apply their understanding in a creative manner. These learning activities are referred to as rote learning, which is a learning activity that only makes students memorize without understanding or without understanding what is being taught. Educators are often unaware of this, which causes students to experience difficulties in understanding mathematics lessons (Mulyono & Hapizah, 2018; Sari et al., 2022). It has been posited that the difficulty in understanding mathematics lessons is related to teaching methods that fail to engage students emotionally and cognitively with mathematics (Harefa et al., 2020). Additionally, the approach taken is often limited in its variety and tends to be monotonous (Fatimah & Puspaningtyas, 2022).

A learning strategy based on the constructivist view is characterized by the ability to engage students in the learning process, the application of discussions in small groups in a larger context, the presentation of abstract concepts in a more concrete manner, and the presentation of non-routine problems to arouse curiosity and optimize thinking abilities (Al Ayyubi et al., 2024). So, students need to pay attention to critical thinking skills in mathematics to minimize problems that occur such as singularity in the context of thinking and lack of criticism in problem solving. This will have an impact on the bottlenecks that occur in responding to macro-based matters which can have implications for problem-based learning. The solution that can be oriented in problem-based learning is flexibility in the perspective of looking at mathematical problems, which can be seen from a macro perspective to have various solutions that can be seen from various directions. Learning similar problems can provide improvements in the context of mathematical critical thinking in research that has been conducted previously (Datreni, 2022; Firdaus et al., 2021; Prayoga & Setyaningtyas, 2021; Ruli & Indarini, 2022; Winoto, 2020). Although problem-based learning requires the integration of supporting facilities and infrastructure, this can be minimized by critically maximizing students' abstraction abilities. Thus, this research offers novelty with a learning process that is integrated with the problem-based learning model assisted by the Google site. Routine problems are employed to stimulate curiosity and enhance cognitive abilities, with the objective of expanding understanding and developing higher-level thinking skills (Saidah, 2021; Sofiah et al., 2020). One of the approaches to learning mathematics that is consistent with the constructivist perspective is problem-based learning (PBL) (Setiyaningsih & Subrata, 2023). This type of learning environment is based on the presentation of problems, which can be connected to the existence of learning support through Google Sites.

One method for enhancing students' mathematical critical thinking abilities is to utilize pedagogical techniques, methodologies, and approaches that necessitate students' mastery of the subject matter without relying on a teacher-centric approach (Al Ayyubi et al., 2018). Instead, these methods prioritize a student-centered approach or an approach that can "teach" students (Bukhori et al., 2023). The prevalence of students experiencing difficulties in applying mathematics in their daily lives can be attributed to the predominant approach of learning mathematics as a means of applying concepts, rather than as a foundation for learning. Additionally, the perceived lack of meaningfulness associated with mathematics learning contributes to the challenge students face in mastering mathematical concepts (Fitrah & Kusnadi, 2022; Ilmiyah et al., 2018; Nisa et al., 2022). The context of everyday life as an experience or prior knowledge that has been owned by students is rarely associated with learning in the classroom (Ruli & Indarini, 2022; Sukmawarti et al., 2022; Zainal, 2022). In addition, teachers lack opportunities for students to reinvent and construct their own mathematical ideas (Meke et al., 2020; Sukmawati, 2020; Winoto, 2020). Prior to this, one of

the reasons students are deficient in mathematics is because they lack the capacity to comprehend or discern fundamental mathematical principles pertinent to the subject matter under discussion (Bayu & Dian, 2022; Farhana et al., 2023; Hermuttaqien et al., 2023; Husnidar & Hayati, 2021; Ruli & Indarini, 2022).

The preceding descriptions demonstrate a clear correlation between the capacity to engage in critical thinking in mathematics and the utilization of the Problem-Based Learning approach, facilitated by Google Sites. This approach is anticipated to be an efficacious methodology for the education of students, with the objective of enhancing their intellectual potential and fostering their ability to cope with non-routine problems and apply them in their daily lives. The approach, integrated with Google Sites, can be used as an alternative in learning mathematics in schools. It can be developed with other approaches according to problems in mathematics. Furthermore, there are still many studies that have not been done with Google Sites. This research offers a novel approach to improving students' mathematical critical thinking skills, which are typically developed through Problem-Based Learning (PBL) assisted by Google Sites.

METHOD

This study employed a quasi-experimental research methodology with a quantitative approach, conducted at SMPN 2 Cilaku Cianjur. The instrument utilized in this study was a written test in the form of an essay, which had been previously validated, reliable, and demonstrated the ability to distinguish between students with varying levels of ability. The population in this study consisted of all students at SMPN 2 Cilaku Cianjur, with a sample size of 30 students in the experimental class and 31 students in the control class on statistical material. The objective of this study is to enhance the mathematical critical thinking abilities of students who are engaged in Problem Based Learning (PBL) assisted by Google Sites. The data analysis requirements were tested using a normality test with the Kolmogorov-Smirnov statistical software.

RESULTS AND DISCUSSION

Results

The results of the learning process, which employed the Problem Based Learning approach with the assistance of Google Sites as the experimental class and the conventional approach as the control group, are presented in the following descriptive statistics.

Table 1. Descriptive data output for the Experimental Group and Control Group

Statistic Data	Experiment Class			Control Class		
	Pretest	Postest	N-Gain	Pretest	Postest	N-Gain
Mean	73.76	77.87	0.2024	64.72	68.69	0.1004
Std. Dev	3.42	3.01	0.1131	4.41	4.358	0.1761

Table 1 above indicates that the experimental class statistical data is greater than the control class. However, this does not permit the research hypothesis to be answered. Therefore, inferential statistical tests are carried out as follows.

Table 2. Output of Pre-test Data Normality Test

Class		Kolmogorov-Smirnov[a]		
		Statistic	Df	Sig.
Score	Experiment	.168	30	.021
	Control	.257	31	.000

Table 2 above indicates that the significance value for the experimental class and control class is 0.021 and 0.000, respectively. Given that the significance value is smaller than 0.05, it can be concluded that the pre-test data of the experimental class and control class are not normally distributed.

Table 3. Output of Pre-test Data Homogeneity Test

Levene Statistic	Sig.
0.358	.536

As indicated in Table 3, the significance value of student learning outcomes is 0.536 or greater than 0.05. This indicates that the data variance of the two classes is homogeneous.

Table 4. Mean Rank Output

	Class	N	Mean Rank
Score	Experiment	30	45.87
	Control	31	16.49

Table 4 indicates that the mean rank value for the experimental class is greater than that of the control class. However, these results require further investigation to determine their statistical significance.

Table 5. Mann-Whitney Test Output for Pre-test Data

	Hasil Belajar
Asymp. Sig. (2-tailed)	.000

Table 5 indicates that the Asymp. Sig. (2-tailed) value is less than 0.05, indicating that the null hypothesis (H0) is rejected. This suggests that there is a difference in the average initial ability of experimental class students and control class students.

Table 6. Output of Post-test Data Normality Test

Class		Kolmogorov-Smirnov[a]		
		Statistic	Df	Sig.
Score	Experiment	.102	30	.200*
	Control	.107	31	.200*

Table 6 above indicates that the significance value for the experimental and control classes is 0.200. This data suggests that the significance value is greater than 0.05, which implies that the posttest data for the experimental and control classes are normally distributed.

Table 7. Output of Post-test Data Homogeneity Test

Levene Statistic	Sig.
4.206	.041

Table 7 indicates that the significance value of student learning outcomes is 0.045 or less than 0.05. This suggests that the data variance between the two classes is not homogeneous.

Table 8. Output of Post-test Data Mean Equality Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Score	Equal variances assumed	9.201	59	.000
	Equal variances not assumed	9.248	53.701	.000

Table 8 above indicates that the Asymp. Sig. (2-tailed) value is less than 0.05, which suggests that the average final critical thinking ability of experimental class students is significantly higher than that of control class students. To ascertain the significance of this difference, the N-Gain test was conducted.

Table 9. Output of N-Gain Data Normality Test

Class		Kolmogorov-Smirnov[a]		
		Statistic	Df	Sig.
Score	Experiment	.107	30	.200*
	Control	.102	31	.200*

Table 9 above indicates that the significance value for the experimental and control classes is 0.200. This data suggests that the significance value is greater than 0.05, which implies that the posttest data for the experimental and control classes are normally distributed.

Table 10. Output of N-Gain Data Homogeneity Test

Levene Statistic	Sig.
5.539	.019

Table 10 above indicates that the significance value of student learning outcomes is 0.019 or smaller than 0.05. This suggests that the data variance between the two classes is not homogeneous.

Table 11. Output of N-Gain Data Mean Equality Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Score	Equal variances assumed	2.641	59	.009
	Equal variances not assumed	2.668	51.131	.009

Table 11 above indicates that the Asymp. Sig. (2-tailed) is 0.009 or less than 0.05. This suggests that the enhancement in critical thinking abilities of students in the experimental class is superior to that of students in the control class.

Discussions

The aforementioned description of problem-based learning suggests that this pedagogical approach is founded upon the notion of problem-based learning as a learning environment centered upon problem-based tasks (Lestari et al., 2020; Nuraini et al., 2020; Widayanti & Nur'aini, 2020). Educational activities can be designed to facilitate learning by centering them on tasks or problems that are authentic, contextual, and relevant. This approach requires students to engage in a process of problem interpretation, information gathering, alternative solution evaluation, and the presentation of solutions that they believe to be the most appropriate (Eismawati et al., 2019; Pamungkas & Franita, 2019; Wardana & Rifaldiyah, 2019). The results demonstrated that the average score of students in the experimental and control classes increased from 73.76 and 64.72 to 77.87 and 68.69, respectively, on the test after learning. Consequently, the average value of N-Gain in the experimental and control classes was 0.20 and 0.10, respectively. This finding aligns with the inferential statistical hypothesis testing using SPSS, which indicates a notable enhancement in students' critical thinking abilities when engaged in Problem-Based Learning facilitated by Google Sites.

The average value of the experimental and control classes in the pretest shows that the distribution of data on the average value reviewed based on the standard deviation value shows that in the pretest the experimental class is closer to the average value than the control class.

Then in the posttest, the experimental and control classes also showed the same thing, because the standard deviation value in the experimental class was smaller than the control class. Apart from that, the N-Gain value in the experimental class and control class shows that although the average value in the experimental class is greater than the control class, the data distribution is closer to the experimental class compared to the control class which is based on the standard deviation value.

The following problem-based learning formats can be applied in learning: (1) Problems are presented at the outset of learning, prior to preparation or during the learning process. (2) Problem situations are presented to learners in a manner that reflects the real world. (3) Learners are provided with problems that align with their current level of knowledge, enabling them to reason and apply knowledge to address challenges and to be assessed. (4) Learning areas are expressed as The necessity for problems is evident, as they are explored and utilized as guides in individualized study. Furthermore, the skills and knowledge gained in individualized study are applied in problems to evaluate the effectiveness of learning and to reinforce learning. Finally, the learning gained through working with problems and independent learning is summarized and integrated in the knowledge and skills possessed by learners (Firdaus et al., 2021).

From the comprehensive description of the implementation of problem-based learning, it becomes evident that the role of the teacher as a facilitator is of paramount importance (Ruli & Indarini, 2022). While students are encouraged to learn independently, teachers as facilitators must refer to the implementation of approaches that can eliminate obstacles and restore the learning process to a more effective and efficient state. In addition, teachers must engage in rigorous monitoring of their students' activities, activation of the learning process, and stimulation of learning through the use of questions. This is necessary to ensure that students' physical activity and mental engagement in learning are integrated with Google Sites as a tool for more effective and efficient visualization of students' problems. This approach is designed to foster optimal curiosity in students.

CONCLUSION

This study has demonstrated that the problem-based learning model is an effective approach for developing students' critical thinking skills. This conclusion is supported by the significant increase in the average value of students on the pretest and posttest conducted. The average value of students in the experimental and control classes increased from 73.76 and 64.72 on the test before learning to 77.87 and 68.69 on the test after learning. The average value of N-Gain in the experimental and control classes was 0.20 and 0.10, respectively. Inferential statistical testing revealed that the increase in students' mathematical learning in the process of critical thinking skills with the Problem Based Learning learning model assisted by Google Sites was optimal when compared to conventional learning. Therefore, further research should analyze the Problem Based Learning model in conjunction with other learning models to ascertain whether there are discernible differences and interactions. This can be achieved through the use of the Analysis of Variance test.

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