UJME 14 (1) 2025: 22-35
UNNES JOURNAL OF MATHEMATICS EDUCATION
https://journal.unnes.ac.id/journals/ujme
ISSN: 2252-6927 (print); 2460-5840 (online)

Students' Mathematical Critical Thinking Ability Reviewed from Learning Motivation in Problem Based Learning Model Assisted by Google Sites

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ARTICLE INFO

Article history:
Received 15 November 2024
Received in revised form 18 December 2024
Accepted 22 March 2025

Keywords:
Critical Thinking Ability; Google Sites; Learning Motivation; Problem Based Learning.

Abstract

This study aims to analyze students' critical thinking skills through the Google Sites Problem Based Learning (PBL) model, both from the aspect of classical completeness and its superiority compared to conventional models, as well as the effect of learning motivation on critical thinking skills. Research also describes students' critical thinking skills based on the level of learning motivation. The method used is a mixture with sequential explanatory design, where the quantitative approach uses the post-test only control group design. The research population is all students of class VIII of SMP Negeri 26 Semarang, with samples of class VIII A as an experimental and VIII B group as a control group. Research instruments in the form of a test of mathematical critical thinking skills, learning motivation questionnaires, and interviews, with data analysis using IBM SPSS 22. The results show that the PBL model assisted by Google Sites reaches classical completeness and is more effective than conventional models. Learning motivation has an influence of 38.5% on critical thinking skills. Further analysis shows that students with high motivation meet all indicators of critical thinking abilities, students with motivation are superior to indicators of interpretation, analysis, and evaluation, while students with low motivation are only superior to indicators of interpretation and analysis. This finding confirms that the PBL model assisted by Google Sites is effective in improving the ability of students' mathematical critical thinking, with learning motivation as one of the main supporting factors.

1. Introduction

Mathematics is an important part of the national curriculum taught at various levels of education. Mathematics is a discipline that teaches logic in the arrangement, shape, size, and concepts that have complex relationships with each other. In addition, mathematics is a science that can train critical thinking patterns and understand the close relationship between various different mathematical concepts (Reski, 2019). Mathematics is an important subject in the educational curriculum at various levels of school. However, many students still have difficulty understanding concepts in mathematics and how to apply them in everyday life. According to Nurazizah and Nurjaman (2018), mathematics is a discipline that prioritizes the thinking process, and it contains substantial aspects that guide students to think logically according to standard patterns and rules. Mathematics is a subject that is very much needed, especially in schools, as an effort to train students' critical thinking skills, as the important role of mathematics in life, mathematics has been studied from elementary school to college.

One of the important skills in learning mathematics according to the independent curriculum and the 21st century learning paradigm is critical thinking. Critical thinking skills help someone assess the reliability of information through the process of analyzing and evaluating information obtained from observations, experiences, reasoning, or communication, so that they can produce correct and rational

To cite this article:
Safaatullah, M.F., Pangestu, A. M., & Amidi (2025). Students' Mathematical Critical Thinking Ability Reviewed from Learning Motivation in Problem Based Learning Model Assisted by Google Sites. *Unnes Journal of Mathematics Education*, *14*(1), 22-35. https://doi.org/10.15294/ujme.v14i1.22151

conclusions (Purwati et al., 2016). Meanwhile, Siregar (2018) stated that critical thinking is a conscious thinking process that aims to reach a logical decision or solution to a problem.

Critical thinking skills in mathematics are essential to solving mathematical problems in the process of reasoning, proof, or problem solving. Based on an interview with one of the mathematics teachers at SMP Negeri 26 Semarang, it is known that students' critical thinking skills are still not optimal or it can be said that students still have difficulty in solving problems related to reasoning, proof or problem solving which are indicated by student learning outcomes. This occurs due to several factors, including the lack of student learning motivation caused by student learning habits during the pandemic and students' suboptimal use of their critical thinking skills, indicated by students not being able to solve problems on HOTS questions or questions that encourage students to think at a high level. So that improving students' critical mathematical thinking skills is essential to improve understanding of the material given and also improve the learning outcomes of students at SMP Negeri 26 Semarang. The material used in this study is the Pythagorean theorem.

The Pythagorean Theorem discusses the relationship between the lengths of the sides of a triangle calculated using the theorem formula. This material requires in-depth thinking skills because it requires logic and reasoning in solving problems. Therefore, the Pythagorean theorem can help develop and improve students' critical thinking skills, because it involves higher knowledge and cognitive levels. The researcher has conducted observations which aim to determine the level of critical thinking skills of students at SMP Negeri 26 Semarang before conducting further research to improve critical thinking skills in students at SMP Negeri 26 Semarang. The following is a description of the results of observations of students' critical thinking skills at SMP Negeri 26 Semarang on the Pythagorean material.

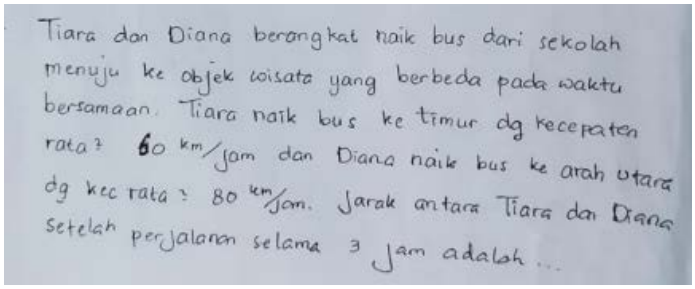
Tiara dan Diana berangkat naik bus dari sekolah menuju ke objek wisata yang berbeda pada waktu bersamaan. Tiara naik bus ke timur dg kecepatan rata2 60 km/jam dan Diana naik bus ke arah utara dg kec rata2 80 km/jam. Jarak antara Tiara dan Diana setelah perjalanan selama 3 jam adalah ...

Figure 1. Critical Thinking Skills Observation Questions

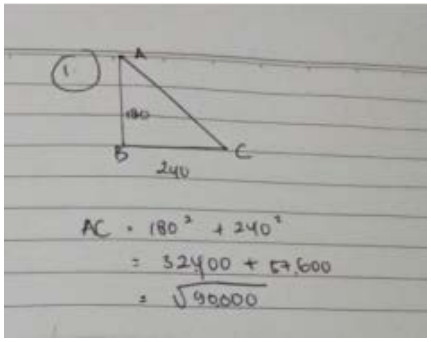

Figure 2. Results of Observations of Critical Thinking Skills

In Figure 2, it can be seen that student 1 is unable to write down the known information and questions from the problem, which indicates that the student has not met the critical thinking indicator, namely interpreting the problem. Meanwhile, in Figure 3, student 2 has been able to interpret the problem presented, but has not been able to solve it correctly. In addition, both students have not been able to analyze and evaluate the problem well, which means that they have not applied complete and correct strategies and calculations. Most students have difficulty when faced with mathematical problems that require high thinking to solve them. Students usually choose to use formulas or quick solutions. This is in accordance with the findings of Agoestanto et al. (2017), which found that junior high school students still have quite low critical thinking skills. Based on research by Nuryanti et al. (2018), it can be concluded that the low critical thinking skills of students are caused by students not being accustomed to maximizing the thinking potential presented in active learning at school. Thus, teachers must design more active learning in order to be able to grow and improve students' critical thinking skills.

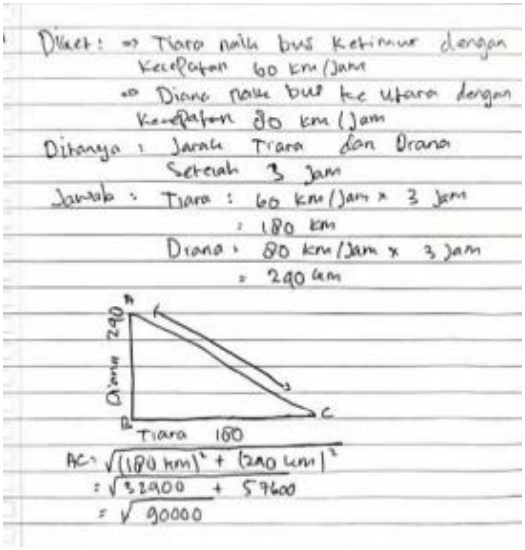

Figure 3. Results of Observations of Critical Thinking Skills

The development of students' critical thinking skills is in line with the new paradigm in mathematics learning, namely student-centered learning. Student-centered learning allows students to think innovatively and can improve critical thinking skills, while teachers or instructors act as facilitators who facilitate students in developing their critical thinking skills. After knowing the level of students' critical thinking skills, teachers can design learning using appropriate learning models and later develop or improve students' critical thinking skills. The Problem Based Learning (PBL) model is one of the learning models that can develop and improve students' critical thinking skills. According to Schettino (2016), Problem Based Learning (PBL) is an innovation that can be used to continuously refine, test, and develop students' critical thinking skills. This learning is used for curriculum and pedagogical approaches that are based on problems that will be solved in groups or discussions, where students' voices, experiences, and prior knowledge are valued in an environment that uses rational pedagogy.

Problem Based Learning (PBL) is a learning model that facilitates students to focus on conducting observations by linking science and practice where students practice knowledge and skills in solving problems with the best solutions that can develop problem-solving, critical thinking, communication, and cooperative work skills (Suparman, 2021). The Problem Based Learning (PBL) process consists of several stages, namely: (1) introducing students to the problem, (2) grouping students, (3) guiding investigations, (4) developing and presenting work, and (5) analyzing and evaluating problem solving (Suparman, 2021).

The role of technology is very important in the midst of today's society, especially in the field of education, namely as one of the supports for learning in schools. This is in line with the contents of the Republic of Indonesia Law Number 14 of 2005 which explains that improving teacher competence with science, technology, and art is very important because it will continue to develop rapidly to improve the quality of national education. The implementation of learning can be more effective and efficient if supported by the help of media or other applications that support learning and make students more focused on learning. Learning media can help improve students' critical thinking skills, one of which is through the use of Google Sites. Google Sites, a web platform from Google, has the advantage of being easy to manage and change by its users (Harsanto, 2014). Jubaidah & Zulkarnain (2020) explain that the use of Google Sites in mathematics learning makes it easier for teachers to deliver materials, video tutorials, assignments, and various other functions. With the help of Google Sites, the learning process becomes more focused, so that students' critical thinking skills in mathematics can develop. Lack of enthusiasm and motivation to learn affects students' critical thinking skills, which ultimately has an impact on learning outcomes. One of the reasons students have difficulty solving mathematics problems is low learning motivation. Therefore, teachers need to pay more attention to student motivation to achieve learning goals. Motivated students will be more enthusiastic in achieving the targets or goals set.

Learning motivation is one of the important factors that influences students' critical thinking skills, because with motivation, students are encouraged to be more active in learning, so that they can improve their critical thinking skills and learning outcomes. In line with the opinion of Wijaya & Bukhori (2017), learning motivation is a change in energy within students which is marked by the emergence of feelings

and reactions to achieve certain goals. Moh Ghoizi Eriyanto et al. (2021) also stated that learning motivation is a driving factor in achieving student learning outcomes, because motivation is a mental factor that drives the learning process. Research on critical thinking skills from a learning motivation perspective is very important, because the results can be used to develop models, strategies, and learning techniques that are useful for educators in creating a critical generation. Based on the formulation of the problem above, the objectives of this study are as follows: (1) to analyze students' critical mathematical thinking skills with the Problem Based Learning model assisted by Google Sites to achieve classical completeness, (2) to analyze students' critical thinking skills through the Problem Based Learning (PBL) model assisted by Google Sites is better than the Conventional model, (3) to analyze the influence of learning motivation on students' critical thinking skills, and (4) to describe students' critical thinking skills in terms of learning motivation through the Problem Based Learning (PBL) model.

2. Methods

The research method used in this study was a mixed method, which is combining quantitative and qualitative research. Mixed method research is a research methodology that combines or blends quantitative and qualitative research (Lestari and Yudhanegara, 2017). The mixed method design used in this study was sequential explanatory design. Sequential explanatory design was a combination method strategy that involves a two-phase research project in sequence where in the first phase quantitative data is collected, then in the second phase the results of the qualitative data that have been obtained will be analyzed (Creswell, 2014).

This study used Post-Test Only Control Group Design as its quantitative research design. Two randomly selected groups are included in this research design model; the first group, referred to as the experimental group, the group that receives treatment, while the second group, referred to as the control group, does not receive treatment (Sugiyono, 2016). Table 1 below displays the Post-Test Only Control Group Design research design.

Table 1. Research Design Post-test Only Control Group Design

Group	Treatment	Post-test
Experimental group	Problem Based Learning Model Assisted by Google Sites	Post-test
Control group	Conventional learning	Post-test

The population in this study were students of class VIII of SMP Negeri 26 Semarang in the 2024/2025 academic year spread across eight classes, namely VIII A to VIII H. The sampling technique was taken using the random sampling technique. Random sampling is a technique for taking samples from a population randomly without considering the strata or levels in the population (Sugiyono, 2016). In this study, this technique was used to determine one experimental group and one control group. Class VIII A students were selected as the experimental group that received treatment using the Problem Based Learning model assisted by Google Sites and class VIII B students as the control group using conventional learning models. The subjects in qualitative research were students from the class selected as the experimental group. The selection of research subjects in qualitative research in this study used purposive sampling. Purposive sampling is a sampling technique with certain considerations (Sugiyono, 2016). The selection of subjects was carried out by considering students' learning motivation which was then classified into three class groups. The determination of this subject is based on the results of the experimental class student learning motivation questionnaire. The results of the student learning motivation questionnaire are grouped into three groups, namely students with high learning motivation, students with moderate learning motivation, and students with low learning motivation. Based on the number of students in each motivation category, the researcher chose 6 subjects proportionally to represent each category, namely: 2 students with high motivation representing the group with high learning motivation, 2 students with moderate motivation representing the group with moderate learning motivation and 2 students with low motivation representing the group with low learning motivation.

The independent variables in this study are learning motivation and the Google Sites-assisted Problem Based Learning model. While the dependent variable is a variable that is influenced by the independent variable. The dependent variable used in this study is students' critical mathematical thinking skills. Data

collection techniques used in this study were tests, learning motivation questionnaires, interviews, and documentation. Tests were used to collect data on students' critical mathematical thinking skills after learning using the Google Sites-assisted Problem Based Learning model. Questionnaires were used to measure students' learning motivation in the experimental group which was then used to group students into high, medium, and low groups. Interviews in this study were conducted in an unstructured manner which was used to obtain data on students' critical mathematical thinking skills in terms of learning motivation. Documentation was used to obtain an overview of students' critical mathematical thinking skills in terms of learning motivation. The instruments used in this study consisted of a mathematical critical thinking ability test instrument, a learning motivation questionnaire, and an interview guideline instrument.

Data analysis techniques in this study consist of quantitative data analysis and qualitative data analysis. Quantitative data analysis consists of initial data analysis of mathematical critical thinking skills and analysis of students' mathematical critical thinking skills test data. Initial data analysis of mathematical critical thinking skills consists of normality tests, homogeneity tests, and two-average similarity tests. Data analysis of mathematical problem-solving skills tests consists of normality tests, homogeneity tests, hypothesis test 1, namely proportion tests, hypothesis test 2, namely two-average difference tests, and hypothesis test 3, namely simple linear regression tests. Qualitative data analysis includes data reduction, data presentation, and drawing conclusions. The validity test of qualitative data used in this study is a credibility test using triangulation techniques.

3. Results & Discussions

3.1. Hypothesis Test 1

This hypothesis test was conducted to determine whether students' critical mathematical thinking skills in learning with Problem Based Learning (PBL) mode assisted by Google Sites achieved classical completeness. The test conducted was the z test (proportion) to determine classical completeness of 75% of the number of students who achieved the Minimum Completion Criteria (KKM) of 75. This test was conducted to determine the percentage of students who completed in the experimental group meeting the classical completeness limit.

Table 2. Results of Hypothesis Calculation 1

No.	Description	Results
1	Observed proportion ($\hat{\pi}$)	0.906 or 90.6%
2	Proportion in the hypothesis	0.75 or 75%
3	Z_{count} value	2.0414
4	Z_{Table} value ($\alpha = 0.05$)	1.645
5	Test criteria	$Reject\ h_0\ if\ z_{count} \geq z_{(0.5-\alpha)}$
6	Results	H_0 is rejected

Based on the calculation, obtained $z_{count} = 2.0414 > z_{0.5-\alpha} = 1.645$. So H_0 is rejected, so the proportion of students who completed the class given learning with the Problem Based Learning model assisted by Google Sites is more than 0.75. The results of the study showed that learning with the Problem Based Learning (PBL) model assisted by Google Sites on the Pythagorean Theorem material in class VIII succeeded in improving students' critical mathematical thinking skills. More than 75% of students in the experimental group scored above the Minimum Completion Criteria (*KKM*), indicating the success of the Problem Based Learning model assisted by Google Sites in improving classical understanding and completion. Google Sites facilitates the learning process by presenting materials in interactive and easily accessible forms, such as text, images, and practice questions. This media increases students' engagement and motivation to learn, so that they are more enthusiastic in understanding the material being taught. A study by Kusuma et al. (2021) shows that digital platforms can increase students' interaction with the material, thus supporting a better understanding of mathematical concepts. The Problem Based Learning model combined with Google Sites also presents contextual problems in it, so that students can connect the concepts learned with applications in everyday life. In line with research by Nuha et al. (2022) found that the use of digital media such as videos and online worksheets supports the achievement of classical completion in Problem Based Learning because it increases student engagement and gives them flexibility in learning. Similar findings were found in this study, where Google Sites makes it easier for students to

learn independently through access to materials anytime and anywhere. Based on these findings, the application of the Problem Based Learning model assisted by Google Sites has been proven effective in helping students achieve classical completion and improve critical thinking skills, which is supported by various studies that have been mentioned.

3.2. Hypothesis Test 2

The test of the difference between the two average critical thinking skills was conducted to determine whether the average critical thinking skills of students after the implementation of the Problem Based Learning model assisted by Google Sites were more than, less than, or the same as students who were given the conventional learning model. The test of the similarity of the two averages used the Independent Sample t test. The test criteria were to accept H_0, if Sig. (2-tailed) > (α) 0.05 or accept H_0, if the value of $t_{count} < t_{1-a}$.

Table 3. Results of Mathematical Calculation of Hypothesis 2

Groups	Average value	The highest score	Lowest value	Number of passes	Number of not graduating
Experimental group	80.99	90.48	71.43	29	3
Control group	77.57	88.10	65.05	21	11

Table 4. Results of Statistical Calculation of Hypothesis 2

Test statistics	T_{Count} value	Value (sig. 2-tailed)	df	Value $(t_{(1-\alpha)}$
Independent Samples Test	2.751	0.008	62	1.998

In the Independent Sample Test table, the Sig. (2-tailed) value is 0.008 and t_{count} is 2.751. so that the Sig. (2-tailed) value is 0.008 <0.05 and $t_{count} > t_{1-\alpha}$ is 2.751 > 1.998.This means that H_0 is rejected, meaning that the average score of the final test of students' mathematical critical thinking skills in the Google Sites-assisted Problem Based Learning (PBL) model is better than the conventional learning model. This study shows that the Google Sites-assisted Problem Based Learning (PBL) model is better at improving students' critical thinking skills compared to the conventional model on the Pythagorean Theorem material. The results of the statistical test showed a significant difference between the experimental group using Problem Based Learning assisted by Google Sites and the control group using conventional methods. This is supported by the results of the tests that have been carried out, namely the two-mean difference test produced a value of t_{count} = 2.751 which is greater than $t_{1-\alpha}$= 1.998. The results of this study indicate that the Problem Based Learning (PBL) model with the help of Google Sites is better than the conventional model. This supports the hypothesis that the Problem Based Learning model assisted by Google Sites is better at improving critical thinking skills than the conventional model. In the control group, students only relied on material from textbooks available at school. However, on the contrary, the experimental group had more access to various learning resources through Google Sites, such as learning videos, problem illustrations, and practice questions. This facility helps students understand the material better and solve problems independently, which has an impact on strengthening their critical thinking skills. This finding is in line with the results of research by Ainiyah (2018) which states that learning with the Problem Based Learning model assisted by multimedia is more effective in improving student understanding than conventional models without multimedia, where the media used is smart points. Research by Saputra and Indah (2021) supports that Google Sites is effective in problem-based mathematics learning. They found that students in the experimental group who used Google Sites had higher critical thinking skills than the control group. Google Sites' interactive features allow students to learn more independently and gain a deeper understanding of the material being taught.

Based on the results of this study, it can be concluded that the Problem Based Learning model assisted by Google Sites provides a significant contribution to improving students' critical thinking skills. The application of Google Sites as an interactive digital learning media not only facilitates access to information, but also increases student involvement in learning. In line with previous studies, the results of this study recommend that teachers utilize media such as Google Sites in learning, especially in learning with the Problem Based Learning model, to support deeper and more active learning.

3.3. Hypothesis Test 3

a. Linearity Test

In hypothesis test 3, the researcher used simple linear regression. This simple linear regression test was conducted to determine whether there was an influence between learning motivation and students' mathematical thinking skills, where students' learning motivation was the independent variable and mathematical critical thinking skills were the dependent variable

Table 5. Anova Table

			Sum of Squares	df	Mean square	F	Sig.
Critical thinking skills * Learning motivation	**Between Groups**	**(Combined)**	612.042	18	34.002	2.810	.032
		Linearity	16.509	1	16.509	1.364	.264
		Deviation from Linearity	595.533	17	35.031	2.895	.029
	Within Groups		157.330	13	12.102		
	Total		769.372	31			

Based on the output of SPSS 22 software, the value of F_{count} = 2.895 is distributed F with a significance level of 5% $df1 = k - 1 = 2 - 1 = 1$. While $df2 = k = 32 - 2 = 30$. So that F_{table} = 4.171 is obtained. It is clear that F_{count} = 2.895 < 4.171 = F_{table} then H_0 is rejected, meaning that there is a linear relationship between learning motivation and students' mathematical critical thinking skills.

b. Regression Significance Test

The significance test of the regression equation aims to determine the level of significance of the influence of independent variables together on the dependent variable. Based on Table 5 the output of SPSS 22 software, the Sig. value is obtained. In the ANOVA table = 0.029, it is clear that 0.029 < 0.05 then reject H_0. So it can be concluded that the relationship between the learning motivation variableand the value of students' mathematical critical thinking ability is significant.

c. Test of significance of Correlation Coefficient

The significance test of the Correlation Coefficient in this study aims to test whether the coefficient is significant or not.

Table 6. Coefficients

	Unstandardized		Standardizer		
Model	**B**	**Std.Error**	**Coefficients**	**t**	**Sig.**
1 (Constant)	70.487	8.941		5.053	.000
Learning motivation	.12	.106	.211	3.913	.247

a. Dependent Variable: Critical thinking skills

Based on the output of SPSS 22 software, the value of t_{count} of the learning motivation variable is 3.913 and t_{table} = 2.042, it is known that t_{count} = 3.913 > 2.042 = t_{table} so that H_0 is rejected. This means that the correlation coefficient means, it is concluded that there is a significant correlation between the learning motivation variable and the student's mathematical critical thinking ability variable.

d. Coefficient of Determination

The determination coefficient aims to measure the large percentage of the dependent variable (critical mathematical thinking ability) explained by the independent variable (learning motivation).

Table 7. Modal Summary

Model	R	R Square	Adjusted R Square	Std Error of the Estimate
1	.433[a]	.384	.160	4.97851

Based on the output of SPSS 22 software, the R Square value is 0.384. This shows that the percentage of the contribution of the independent variable (learning motivation) to the dependent variable (mathematical critical thinking ability value) is 38.5% through the regression equation $Y\hat{} = 70.487 + 0.125X$, while the remaining 61.5% is influenced by other factors not studied by the researcher. Based on

the results of the study, it was found that there is a significant influence between learning motivation and students' mathematical critical thinking abilities. This is evidenced by the R^2 (R Square) value of 0.384 from the results of a simple linear regression analysis, which shows that 38.4% of students' mathematical critical thinking abilities are influenced by their learning motivation. The rest, 61.6%, is influenced by other factors not studied in this study. This relatively large R^2 value indicates that learning motivation plays an important role in students' mathematical critical thinking skills, although there are other variables that may also contribute. Critical thinking skills are complex and are influenced by various other factors, such as students' cognitive abilities, the learning methods used, and environmental influences, which can include family, teachers, and peers. So that most of the factors that influence students' critical thinking skills can come from other aspects that cannot be fully explained by motivation alone. These results are consistent with the theory that learning motivation can encourage students to be actively involved in the learning process, strengthen their attention, and increase their resilience in facing learning challenges. With high learning motivation, students tend to be more active and enthusiastic in understanding mathematical concepts, and are more motivated to solve problems that require critical thinking skills. This is in accordance with the results of research conducted by Pertiwi (2019), which also found a positive correlation between learning motivation and students' critical thinking skills. In Pertiwi's study, students' learning motivation contributed 34.9% to critical thinking skills, while the remaining 65.1% was influenced by other factors not examined in the study. This comparison shows the consistency between the two studies that learning motivation plays an important role in shaping students' critical thinking skills. The results of this study show the importance of the role of learning motivation in developing students' critical mathematical thinking skills. High learning motivation encourages students to be more diligent and active in facing learning challenges, increasing their perseverance in solving problems, and ultimately, enriching the critical thinking skills needed to face more complex mathematical problems. Thus, strengthening learning motivation can be an effective strategy in improving students' critical thinking skills, especially in the context of learning mathematics.

3.4. Description of Students' Mathematical Critical Thinking Skills

In this study, the selection of subjects was carried out by considering the category of student learning motivation obtained from the results of filling out the questionnaire. The aim is to obtain a better representation of the population in the experimental class based on the level of learning motivation. Based on the number of students in each motivation category, the researcher selected 6 subjects proportionally to represent each category, namely: 2 students with high motivation representing the group with high learning motivation, 2 students with moderate motivation representing the group with moderate learning motivation and 2 students with low motivation representing the group with low learning motivation. The research subjects used were 6 students from the experimental group based on the student learning motivation questionnaire scores. The following are the research subjects that will be studied in this study.

Table 8. Research Subjects

No	Subject	Code	Category
1	PD-22	T-1	High learning motivation
2	PD-14	T-2	High learning motivation
3	PD-8	S-1	Medium learning motivation
4	PD-29	S-2	Medium learning motivation
5	PD-24	R-1	Low learning motivation
6	PD-30	R-2	Low learning motivation

To strengthen the data from the results of the mathematical critical thinking ability test, interviews were conducted with the predetermined research subjects. The interviews were conducted in a structured manner with prepared questions. The interviews were carried out after the experimental group students had completed the mathematical critical thinking ability test. In the qualitative discussion of the interview results, the students' mathematical critical thinking ability in each group of student learning motivation was described as follows.

a. Students' Critical Mathematical Thinking Ability in High Learning Motivation

Based on the research results, it was obtained that subjects with high learning motivation were able to fulfill all indicators of mathematical critical thinking skills, namely interpretation, analysis, evaluation, and inference. Subjects T-1 and T-2 were able to write down what was known and asked according to the problem, create mathematical models and provide appropriate explanations of a problem, were able to use complete and appropriate strategies and calculations, and were able to draw conclusions appropriately according to the context of the problem. Students' mathematical critical thinking skills are greatly influenced by their level of learning motivation. In this study, students with a high learning motivation category, namely subjects T-1 and T-2, showed very good mathematical critical thinking skills.

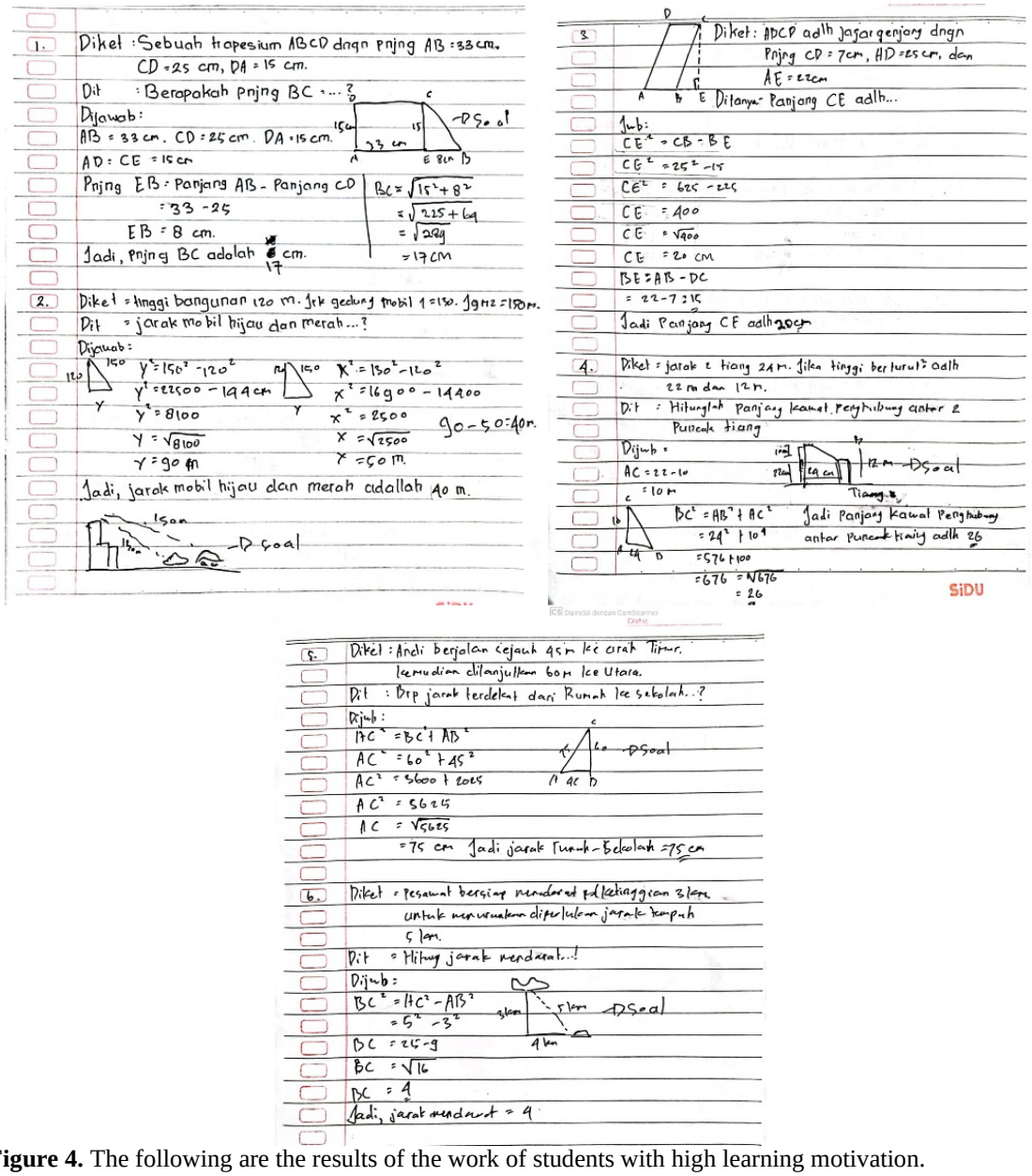

Figure 4. The following are the results of the work of students with high learning motivation.

This is reflected in the results of the critical thinking ability test which showed higher scores compared to students with moderate and low learning motivation. This finding is in line with the theory that intrinsic motivation plays an important role in improving students' conceptual understanding and persistence in solving problems (Deci & Ryan, 2000). Subjects T-1 and T-2 were able to fulfill all indicators of mathematical critical thinking skills at the stage interpretation, analysis, evaluation, and inference. They can identify relevant information from the given problem, create a mathematical model, and provide an

appropriate explanation for the solution found. In the interview, subjects T-1 and T-2 stated that they could understand the meaning of the problem and the solution strategies used sequentially. This finding is supported by the results of research by Akbari et al. (2019) which shows that students with high motivation are more likely to be involved in an active and independent learning process, so that they are able to achieve better results in critical thinking skills. In the context of the Problem Based Learning (PBL) model assisted by Google Sites, the high motivation of students such as T-1 and T-2 allows them to utilize this media effectively. Research by Rofiah and Sukardi (2021) shows that the Problem Based Learning model can increase students' learning motivation, which in turn affects the development of critical thinking skills. Students' high motivation also increases their persistence in going through each stage of critical thinking, from identifying problems to drawing conclusions, which is an important element in Problem Based Learning. The conclusion of this analysis is that students with high motivation are not only able to solve mathematical problems well, but can also undergo critical thinking processes very well. This shows that the Problem Based Learning approach is very suitable to be applied to students who have high motivation, because it can support in meeting the indicators of critical thinking skills.

b. Students' Critical Mathematical Thinking Ability in Medium Learning Motivation

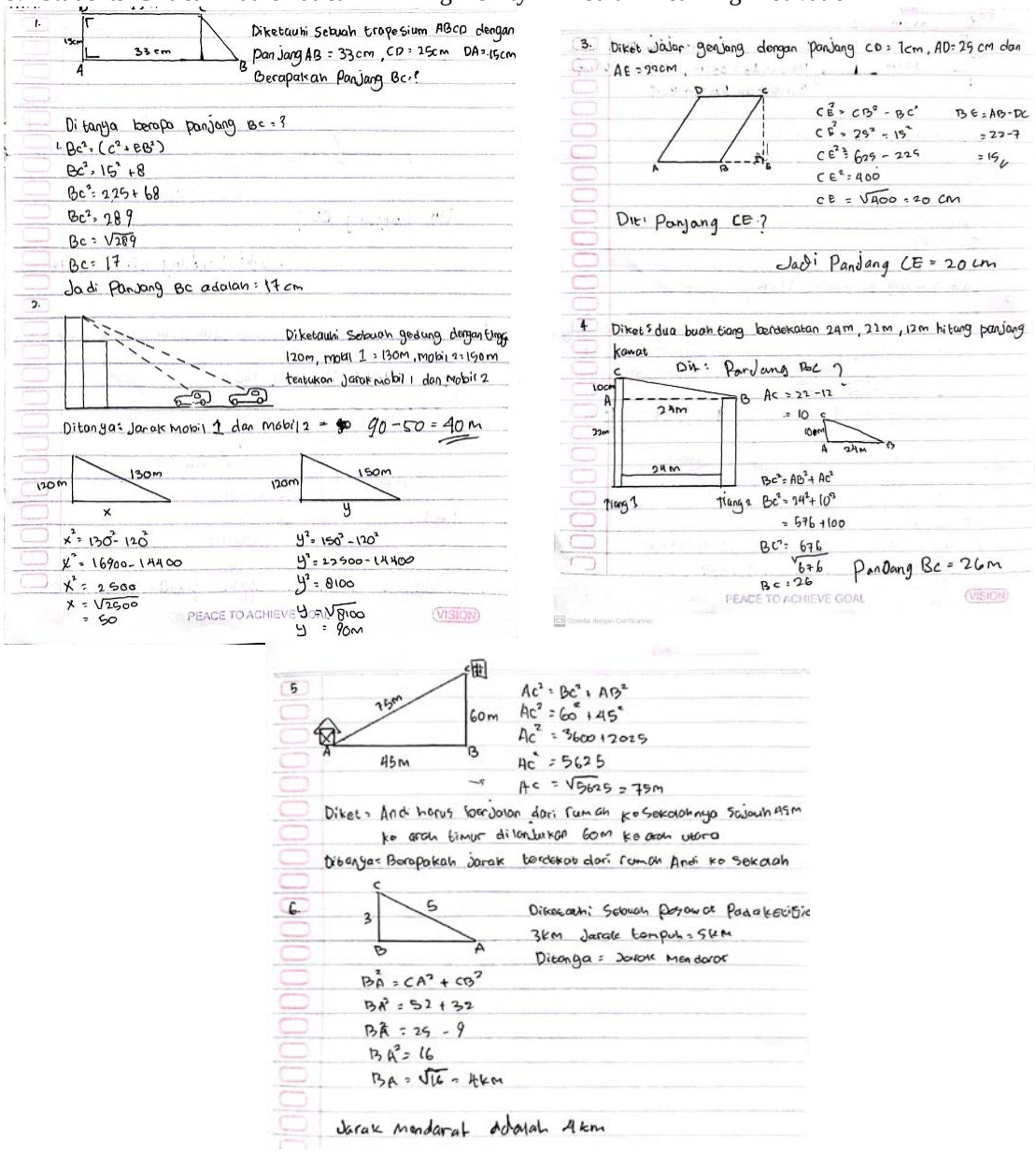

Figure 5. The following are the results of students' work with medium learning motivation.

Based on the research results, the critical thinking ability of students in the moderate learning motivation category showed performance that was between students with high and low learning motivation. The subjects of the study in the moderate learning motivation group, namely S-1 and S-2, had higher critical thinking ability test scores compared to students with low motivation, but lower than students with high motivation. The S-1 and S-2 subjects were able to fulfill some of the indicators of critical thinking ability, especially at the interpretation, analysis, and evaluation stages. They were able to write down the information that was known and asked in the problem correctly, and to compile a mathematical model that was in accordance with the problem faced. Their ability to use problem-solving strategies was also good, as seen from the calculations that were carried out completely and correctly. However, they were not yet fully able to fulfill the indicators at the inference stage, especially in making conclusions that were correct and relevant to the context of the problem given. In addition, interviews with S-1 and S-2 subjects revealed that although their understanding of the mathematical concepts and ideas needed to solve problems was quite good, they experienced several obstacles in applying these strategies to certain problems. The subjects showed a good understanding of the intent of the problem and the steps needed to solve it, but had difficulty drawing the right conclusions. This shows that although their learning motivation is moderate, their critical thinking skills are quite developed, although not optimal in all indicators. This finding is supported by other studies, such as that put forward by Ennis (2011), which states that the level of learning motivation affects critical thinking skills. Good learning motivation, although not optimal, still makes a positive contribution to the development of critical thinking skills (Setiawati & Corebima, 2017). In addition, in a study conducted by Lestari and Yuniarsih (2020), students with moderate learning motivation showed adequate critical thinking skills, especially at the analysis and interpretation stages, but generally experienced difficulties at the more complex inference and final evaluation stages. These findings support the research results which show that students in the moderate motivation group tend to able to complete most of the critical thinking stages, although not fully optimal in drawing the right conclusions. The mathematical critical thinking skills obtained through the Problem Based Learning (PBL) approach assisted by Google Sites show that the Problem Based Learning method can have a positive impact on students with varying levels of motivation. However, some difficulties experienced by students with moderate motivation indicate that there may be a need for additional approaches, such as guidance at the inference stage, to help them develop their comprehensive critical thinking skills

c. Students' Critical Mathematical Thinking Ability in Low Learning Motivation

Based on the research results, the analysis of students' mathematical critical thinking skills showed differences in critical thinking skills among students with various levels of learning motivation. In the group of students with low learning motivation, there were two subjects analyzed, namely subjects R-1 and R-2. Both subjects showed that low learning motivation tends to correlate with low critical thinking skills. This can be seen from the results of the mathematical critical thinking skills test where the scores obtained by subjects R-1 and R-2 were lower than those of students in the high and medium learning motivation groups. In the qualitative analysis of mathematical critical thinking skills, it was found that the two subjects with low motivation, R-1 and R-2, were only able to meet the critical thinking indicators at the interpretation and analysis stages. They can write down information that is known and asked according to the problems given, and are able to create mathematical models and provide explanations related to the problems. However, in the critical thinking indicators at the evaluation and inference stages, subjects R-1 and R2 experienced difficulties where they were not yet able to apply the strategies or steps used to solve the problems and were not yet able to draw conclusions from the problems. This finding is supported by research by Sari and Nugroho (2019) which found that students with low motivation are less than optimal in completing tasks that require deep thinking stages due to the lack of encouragement to explore problem-solving strategies. In addition, according to research conducted by Haryanto and Dewi (2021), low learning motivation often causes students to be less enthusiastic in solving challenging problems, so that they are not trained in critical and analytical thinking. On the other hand, students who have high motivation tend to be more active in exploring alternative ways and are better able to face challenges. In this study, students in the high motivation group showed better abilities at the evaluation and inference stages compared to low-motivated students, in line with research by Handayani and Susilo (2020) which stated that students with high learning motivation are able to achieve more complete critical thinking ability indicators because they are more diligent and have a strong commitment to achieving full understanding. The results of interviews

with subjects R-1 and R-2 showed that they were able to understand the problem, but had not mastered and applied strategic skills that were coherent and correct in solving the problem. This condition is supported by the findings of Wulandari and Putra (2018), which stated that students with low learning motivation tend to stop at the initial steps and do not utilize in-depth problem-solving strategies. This finding confirms the importance of learning motivation as a driver to achieve more optimal critical thinking skills.

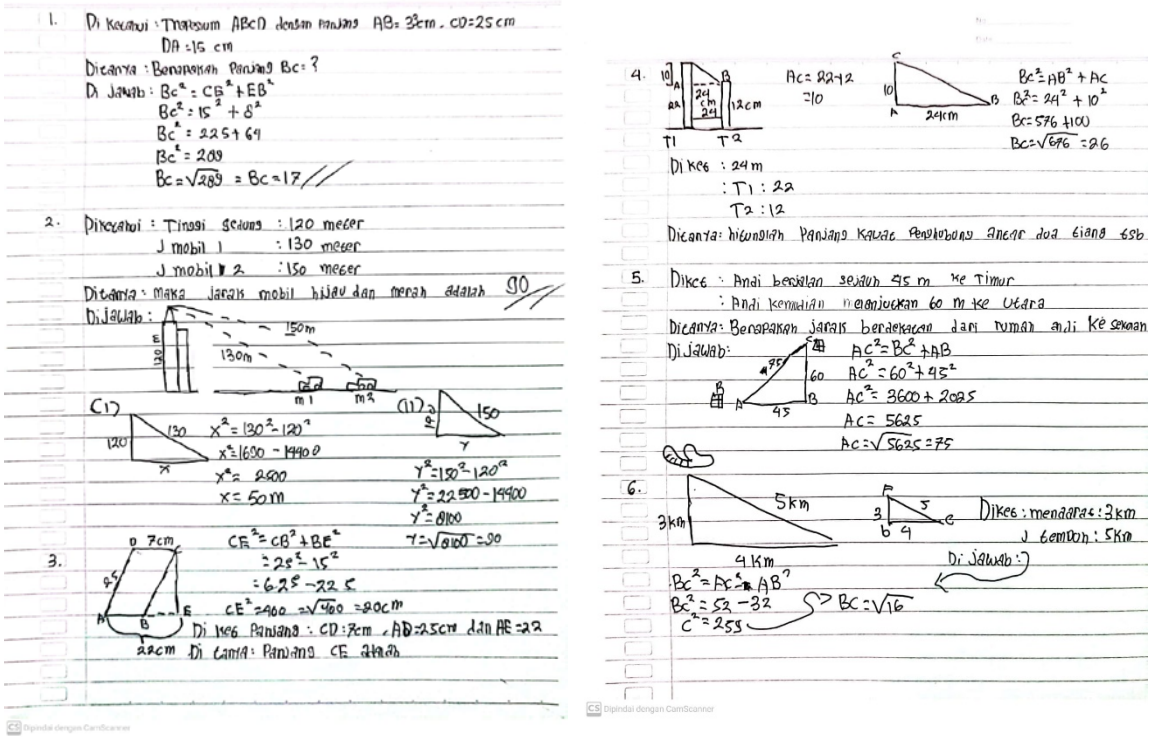

Figure 6. The following are the results of the work of students with low learning motivation.

4. Conclusion

The following are the conclusions of the research and discussion on critical mathematical thinking skills reviewed from the learning motivation with the Problem Based Learning (PBL) model assisted by Google Sites on the Pythagorean Theorem material for class VIII SMP Negeri 26 Semarang: (1) Students' critical mathematical thinking skills with the Problem Based Learning (PBL) model assisted by Google Sites achieved classical completeness, (2) students' critical thinking skills through the Problem Based Learning (PBL) model assisted by Google Sites are better than conventional learning models, (3) there is an influence of learning motivation on students' critical thinking skills, (4) based on the results of the analysis of critical mathematical thinking skills reviewed from learning motivation, the following conclusions were obtained: (a) Students with high learning motivation as a whole are able to meet the indicators of critical mathematical thinking skills, (b) students with moderate learning motivation are able to meet the indicators of critical mathematical thinking skills at the interpretation, analysis and evaluation stages, but are still not optimal in the indicators of critical thinking skills at the inference stage, (c) students with low learning motivation are only dominant on the indicator of mathematical critical thinking ability at the interpretation and analysis stage, but still not optimal on the indicator of mathematical critical thinking ability at the evaluation and inference stage. Based on the results of the research and discussion of this study, the researcher recommends several suggestions that can be applied, including the following: (1) Teachers are advised to consider using the Problem Based Learning (PBL) model supported by Google Sites in mathematics learning, especially for materials that require deep understanding and critical thinking skills. The Google Sites feature allows interactive and structured presentation of materials that can support student involvement in learning, (2) teachers are expected to pay more attention to the level of student learning motivation, especially in the application of the Problem Based LearningG model. For students with low motivation, teachers can provide additional support, such as guidance or praise that can increase their self-confidence and learning

motivation, (3) other researchers are advised to develop similar research by considering variables other than learning motivation, such as self-confidence level, learning style, or the influence of the family environment on students' critical thinking skills.

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