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Mathematical Representation Ability in Terms of Students' Learning Independence in Project Based Learning Model Assisted by Google Sites

Inayah Wulandari[a,*], Isnarto[a]

[a] *Departement of Mathematics, Universitas Negeri Semarang , Semarang City, 50229, Indonesia*

** E-mail address: wulandariinayah06@students.unnes.ac.id*

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Abstract

The purposes of this study were to analyze the quality of learning mathematics in the Project Based Learning model assisted by Google Sites on mathematical representation ability, to analyze the effect of learning independence on mathematical representation ability, and to describe the mathematical representation ability in terms of learning independence in the Project Based Learning model assisted by Google Sites. The research used mixed method with sequential explanatory design. The population in this study were all grade VIII students of SMP N 22 Semarang in the 2022/2023 academic year. The sample selected in this study consisted of class VIII E as the experimental class and class VIII F as the control class. Data collection techniques used in this study were tests, questionnaires, observations, and interviews. The results of the study showed that: (1) mathematics learning with Project Based Learning model assisted by Google Sites is qualified in developing students' mathematical representation ability; (2) there is a positive effect of learning independent on mathematical representation ability in Project Based Learning model assisted by Google Sites; (3) the description of the mathematical representation ability in terms of learning independence is divided into 3 categories, namely (a) students with high learning independence are able to fulfill all indicators of mathematical representation ability; (b) students with moderate learning independence are quite able to fulfill indicators of mathematical representation ability; and (c) students with low learning independence tend to be able to fulfill indicators of mathematical representation. However, it is necessary to pay attention to students' mathematical representation abilities, one of which is that students with low learning independence should be given guidance in processing information to be able to represent problems well to facilitate better problem solving.

1. Introduction

Along with the times, improving the quality of human resources is important in the progress of a country. Efforts to improve the quality of human resources can be done through education. Education is a conscious and planned effort that aims to mature students. Based on Law of the Republic Indonesia number 20 of 2003 concerning the National Education System states that education is a conscious and planned effort to realize learning objectives, namely an active learning atmosphere. The creation of an active learning atmosphere will optimize students' potential and skills in students in every lesson.

In the Indonesian education system, mathematics is one of the compulsory subjects in every school that has a role in everyday life as well as in the development of science and technology. The great role of mathematics in life shows the great demand for mathematical abilities that must be possessed by students at school. The National Council of Teachers of Mathematics (2000) states that there are five basic mathematical abilities which are process standards in the curriculum standards for learning mathematics in

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schools. The process standards set by the NCTM refers to the process of: (1) problem solving, (2) reasoning and proof, (3) making connections, (4) communication, and (5) representation (Kusrianto et al., 2016).

Based on some of the mathematical abilities mentioned above, mathematical representation ability is one of the important abilities to be considered properly (Azkiah & Sundayana, 2022). NCTM (2000) emphasized that mathematical representation ability is very important for students to have to support learning. Widakdo (2017) argues that representation ability is the basis for understanding mathematical ideas. Mathematical ideas or ideas can be represented in the form of pictures, concrete objects, tables, graphs, numbers, or mathematical symbols in the form of writing. Mathematical representation abilities are needed by students to create ways of thinking in communicating mathematical ideas from abstract to concrete so that they are easy to understand (Lette & Manoy, 2019). Narulita (2013) also said that mathematical representation abilities are needed in mathematics so that students gain fluency in building mathematical concepts and ways of thinking. So, representation ability helps students to communicate and connect mathematical concepts in solving given problems.

However, the reality that occurs in the field shows that students' mathematical representation abilities in Indonesia are still low. Based on the results of an interview with one of the mathematics teachers at SMP Negeri 22 Semarang related to students' mathematical representation abilities, it shows that these abilities were still not optimally mastered by students. This is indicated by the results of solving contextual math problems or problems from students which have not been answered systematically. Students tend to work without using the correct work steps in representing the given problem. This certainly affects the representation abilities possessed by students if given contextual questions or problems that demand a systematic solution in accordance with the steps of the process. Suryowati (2015) revealed that students still do not understand how to present real-world problems into representative mathematical problems.

In connection with the low mathematical representation ability of students, educators as one of the success factors in learning must seek to improve the quality of learning to address existing problems. One alternative solution that can be done is through a meaningful, effective, and good quality mathematics learning process through a learning model that is applied in class. One of the learning models that is expected to improve students' mathematical representation abilities and emphasize student-centered learning to have an independent character is the Project Based Learning model. The Project Based Learning model is a cooperative learning model that emphasizes student participation and activities to find their own learning material (information) that will be studied through available materials. According to Trianto (2011), the Project Based Learning model has enormous potential to make the learning experiences more interesting and useful for students through the connection between mathematics and students' daily lives.

In this regard, the implementation of 21st century education is not only education that only focuses on students' cognitive abilities. However, strengthening character education (affective) is also needed in education. One of the affective domains that can affect student achievement is learning independence. Yusufhadi Miarso (Ismaniati et al., 2015) defines independence as an organized learning program arrangement so that students can choose and determine materials and their learning progress. The achievement of optimal learning achievement in schools can be obtained with the existence of student learning independence (Pratiwi & Laksmiwati, 2016).

As an effort to support the achievement of the desired basic competencies, during the industrial revolution 4.0, information and communication technology that has developed rapidly is used as an interactive learning media to support education. One of the interactive learning media that can be used to fulfill the learning needs of students is web-based learning. One of the interactive web learning media that can be applied is Google Sites. According to Ferismayanti (2020) the benefits of using Google Sites optimally include: (1) uploading learning materials, (2) saving the syllabus, (3) giving assignments, (4) giving announcements, and (5) downloading and viewing student assignments. In this regard, the use of Google Sites interactive media can be combined with the Project Based Learning model so that the learning carried out is more interesting for students and more meaningful so that students can independently achieve the expected learning objectives.

In its use, Google Sites can be one of the learning media that supports the development of students' mathematical representation abilities. Kholis (2022) states that Google Sites enables collaboration in utilizing it. This collaboration allows Google Sites to be integrated with other Google Workspace features such as Google Slides, Google Drive, and Google Forms as material for feedback from students. Google Sites media also provides facilities to combine various information in one place including images, videos, presentations, attachments and text (Ferismayanti, 2020). Where through images, videos, and other things that can be added to Google Sites media, it can help students provide convenience in improving their mathematical representation abilities.

The formulation of the problems in this study are (1) how is the quality of learning mathematics with the Project Based Learning model assisted by Google Sites on the students' mathematical representation abilities; (2) whether there is an effect of independent learning on the students' mathematical representation abilities; (3) how is the description of students' mathematical representation abilities in terms of learning independence in the Project Based Learning model assisted by Google Sites. Based on this description, the research conducted aims to analyze the quality of learning mathematics in the Project Based Learning model assisted by Google Sites on the students' mathematical representation abilities, analyze the effect of independent learning on the mathematical representation abilities of junior high school students, and describe the mathematical representation abilities of junior high school students in terms of independence. learn on the Project Based Learning model assisted by Google Sites.

2. Methods

The research method used in this study was a combination/mixed methods research. The strategy used in this mixed methods research was a sequential explanatory design. The qualitative research design in this study focused on activities to describe and explore. Meanwhile, the quantitative research design used in this study used the Post-Test Only Control Group Design. The description of the quantitative research design according to Creswell (2012) can be illustrated in Table 1.

Table 1. Post-Test Only Control Group Design research design

Group	Treatment	Test
Experiment	X	Posttest
Control	Y	Posttest

Description:
X : Project Based Learning Model Assisted by Google Sites
Y : Discovery Learning Model

The population in this study were all grade VIII students of SMP N 22 Semarang in the 2022/2023 academic year, totalling 256 students and randomly divided into eight classes, namely VIII A to VIII H. The sample selected in this study consisted of two classes, namely class VIII E as the experimental class and class VIII F as the control class. The experimental class would be given the treatment of mathematics learning with the Project Based Learning model assisted by Google Sites, while the control class would be given the treatment of mathematics learning with the Discovery Learning model. The sampling technique used in this study was carried out using a simple random sampling technique. While the selection of research subjects used purposive sampling technique. The selected research subjects consisted of 2 students from the high learning independence group, 2 students from the moderate learning independence group, and 2 students from the low learning independence group based on experimental class students who were given a Project Based Learning model assisted by Google Sites.

Data collection techniques used in this study were tests, questionnaires, observations, and interviews. The test was used to obtain data on student learning outcomes regarding the mathematical representation abilities on flat-sided geometrical material through the Project Based Learning model assisted by Google Sites. The questionnaire technique was used to determine the level of student learning independence in learning mathematics. But before that, both test instruments and questionnaires that have been prepared must be tried out first in the trial class before being given to the sample class. After being given to the sample class, the results of the mathematical representation ability test would be obtained as quantitative data which would be analyzed using statistical tests to prove the truth of the research hypothesis. While the results of the independent learning questionnaire would be grouped based on three categories of learning independence, namely high, medium and low categories. Students who had been grouped into these three categories would be taken as many as two people in each category of independent learning as research subjects to conduct interviews with researchers. The interviews conducted in this study were structured interviews using guidelines that had been prepared by researchers using open-ended questions. During the research, observations were also made on teacher and student activities to find out the process of implementing learning with the Project Based Learning model assisted by Google Sites.

The data analysis techniques in this study were divided into two, namely quantitative data analysis techniques and qualitative data analysis techniques. Quantitative data analysis was carried out to determine the quality of the Project Based Learning model assisted by Google Sites on students' mathematical representation abilities. The analysis phase carried out in this study included the analysis of the initial and

final data. Initial data analysis was used as a prerequisite test to determine the initial condition of the population through the normality test, homogeneity test, and average similarity test. While the final data analysis used in this study was obtained through prerequisite tests, classical completeness tests, average completeness tests, average difference tests, and influence tests. The prerequisite test in the final data analysis included the normality test and homogeneity test. The initial data used was obtained from the final assessment scores for the odd semester of the 2022/2023 academic year for class VIII SMP Negeri 22 Semarang for the subject of mathematics, while the final data was obtained from data from the mathematical representation ability test results of students in class VIII E and VIII F. Prerequisite tests for both initial data and final data in this study used the help of the IBM SPSS application Statistics 21.

In addition, the classical completeness test was conducted to find out whether the test results of students' mathematical representation ability in learning with the Project Based Learning model assisted by Google Sites achieved classical mastery with the proportion of students who achieved a minimum completeness criteria of 70%. The average completeness test was carried out to find out whether the average mathematical representation ability of students in learning the Project Based Learning model assisted by Google Sites reached the minimum completeness criteria or not. The average difference test was carried out to find out whether the average mathematical representation ability in learning the Project Based Learning model assisted by Google Sites was greater than the average mathematical representation ability in Discovery Learning model. The classical completeness test, the average completeness test, and the average difference test in this study used the help of the Microsoft Excel 2013 application. Meanwhile, the influence test in this study was conducted to determine whether there was an effect of independent learning on students' mathematical representation abilities obtained using assistance IBM SPSS Statistics 21 application.

Qualitative analysis techniques in this study included data reduction, data presentation, and drawing conclusions based on the description of the mathematical representation ability test results obtained. In addition, data validity techniques were carried out as an effort to be accountable for the research that had been carried out. In this study, researchers used data validity checking techniques through triangulation, which consisted of source triangulation and technical triangulation. Source triangulation was done by checking or comparing data obtained from various sources. While triangulation, the triangulation technique in this study was carried out by comparing the results of tests of mathematical representation abilities and data from interviews with research subjects.

3. Results & Discussions

3.1. Implementation of Project Based Learning Assisted by Google Sites

The research was conducted from April 4 2023 to May 26 2023 at SMP Negeri 22 Semarang with three stages in the research process, namely the planning stage, the implementation stage, and the learning evaluation stage. At the learning planning stage an assessment was made of the Project Based Learning model learning tools for mathematical representation abilities consisting of syllabus, lesson plans, mathematical representation ability tests, independent learning questionnaires, and guidelines for interviewing mathematical representation abilities. The assessment was carried out using a validation sheet provided by the researcher to the validators. The validators consisted of three people, namely one lecturer in the Bachelor of Mathematics Education study program, two mathematics teachers at SMP Negeri 22 Semarang, and one Counseling Guidance teacher at SMP Negeri 22 Semarang. A summary of the results of the validation of the Google Sites-assisted Project Based Learning model learning tool is shown in Table 2.

Table 2. Learning device validation results

No	Learning Media	Validation Result	Final Result	Criteria
1.	Syllabus	4.67	4.72	Very Good
2.	Lesson Plan	4.67		
3.	Mathematical Representation Ability Test	4.87		
4.	Learning Independence Questionnaire	4.67		
5.	Interview Guidelines	4.70		

Based on Table 2, it can be seen that the recapitulation of the validation of the Project Based Learning model learning tool for mathematical representation abilities obtained the final result of 4.72. Thus, it can be concluded that the learning tools developed by researchers are valid learning tools. In other words, the learning tools prepared by the researcher are ready to be used in learning activities in the target class.

At the learning implementation stage, an assessment is carried out on the implementation of learning. This assessment includes an assessment of observations of teacher activity and student activity in the Project Based Learning model assisted by Google Sites which was carried out for 4 meetings. Learning was observed by observers consisting of one math teacher and one undergraduate student to provide an assessment of the implementation of the Project Based Learning model assisted by Google Sites. Assessment was carried out using the instrument observation sheet of teacher activity and student activity sheets. A summary of the final results of the observational assessment of teacher and student activities is shown in Figure 1.

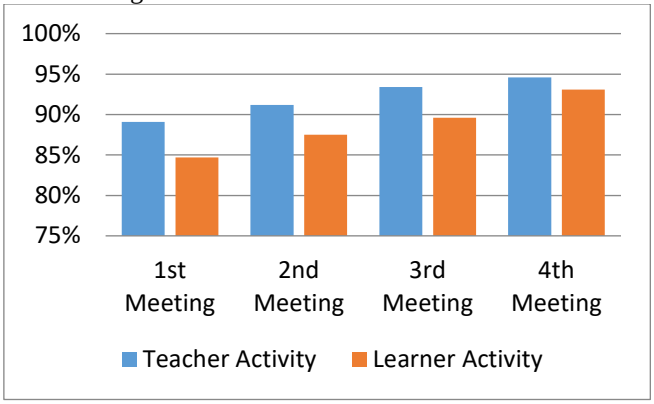

Figure 1. Observation results of teacher and student activity

Based on Figure 1, it can be seen that the average observation of teacher activity in learning the Project Based Learning model assisted by Google Sites for each meeting is 89.1%; 91.2% ; 93.4% ; 94.6%. These results indicate that there is an increase that occurs at each meeting on teacher activity in learning the Project Based Learning model assisted by Google Sites. While the average observation of student activity in learning the Project Based Learning model assisted by Google Sites for each meeting is 84.7% ; 87.5% ; 89.6% ; 93.1%. These results indicate that there is an increase that occurs in each meeting of student activity in learning the Project Based Learning model assisted by Google Sites.

At the learning evaluation stage, an assessment was carried out on the test results of students' mathematical representation abilities in the experimental and control classes. The test results for the mathematical representation ability of the experimental class and the control class are shown in Figure 2.

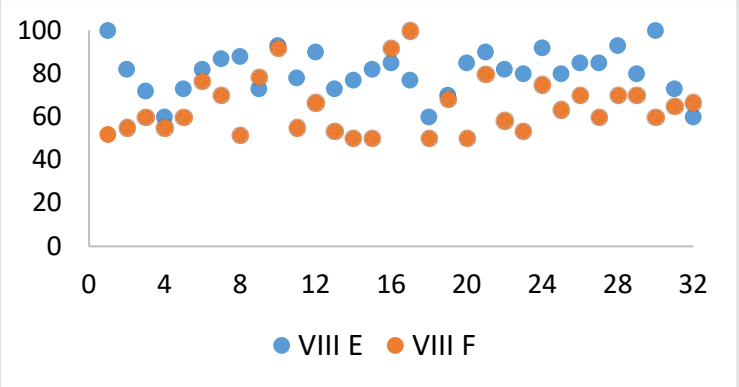

Figure 2. Results of mathematical representation ability of experimental class and control class

In Figure 2 it can be seen that with a minimum completeness criteria of 70, the number of students who completed the minimum completeness criteria in class VIII E (experimental class) was more than in class VIII F (control class). Based on these results, the highest score for the experimental class and the control class was 100, while the lowest score for the experimental class was 60 and the lowest score for the control class was 50. Meanwhile, the average test scores for the ability of mathematical representation for the experimental class and control class respectively respectively are 80.84 and 64.90. Testing the effectiveness

of learning on the Project Based Learning model assisted by Google Sites is carried out through normality tests, homogeneity tests, and classical completeness tests, average completeness tests, and average difference tests.

The normality test is used to determine whether the samples taken in the study come from normally distributed populations or not. The normality test was carried out with the help of IBM SPSS Statistics 21 with the Kolmogorov-Smirnov test. Based on the results of the calculations that have been carried out, the value for the experimental group is $sig = 0.375 > \alpha = 0.05$, then H_0 is accepted. Thus it can be concluded that the data from the two samples come from populations that are normally distributed.

The homogeneity test is used to determine whether the samples taken in the study have the same (homogeneous) variance. The homogeneity test was carried out with the help of IBM SPSS Statistics 21 with the Levene Statistical Test. Based on the calculation results obtained $sig = 0.160 > \alpha = 0.05$, then H_0 is accepted. Thus it can be concluded that the two sample groups have the same (homogeneous) variance.

The classical completeness test is used to find out whether the mathematical representation abilities of students who receive learning with the Project Based Learning model assisted by Google Sites are classically complete. In other words, the students in the class had scores on the test of mathematical representation abilities that reached the minimum completeness criteria of more than 70% of the number of students in the class. Based on the calculation results obtained $z_{count} = 2.59$ and $z_{table} = 1.64$. Because the value is $z_{count} \geq z_{table}$, H_0 is rejected. Thus, it can be concluded that many experimental class students complete learning more than 70%. In other words, the test scores for the mathematical representation ability of the experimental class have finished studying classically.

The average completeness test was used to see whether the average test scores for the students' mathematical representation abilities in the experimental class were more than or equal to the minimum completeness criteria or not. The minimum completeness criteria used in this study was 70 and the average test score for students' mathematical representation abilities in the experimental class was 80.84. Based on the calculation results, the value of $t_{count} = 6.25$ and $t_{table} = 1.67$ is obtained. Because the value of $t_{count} \geq t_{table}$, H_0 is rejected. Thus, it can be concluded that the average mathematical representation ability of the experimental class students is more than the minimum completeness criteria. In other words, the test scores of the students' mathematical representation ability in the experimental class completed the minimum completeness criteria.

The average difference test was used to find out whether there was a difference in the average mathematical representation abilities of the experimental class students with the average mathematical representation abilities of the control class students. The results of the mathematical representation ability tests that were carried out in the experimental class and the control class showed that the average values obtained for each class were 80.84 and 64.90, respectively. Based on the calculation results, the value of $t_{count} = 5.40$ and $t_{table} = 1.67$ is obtained. Because the value of $t_{count} \geq t_{table}$, H_0 is rejected. Thus, it can be concluded that the average mathematical representation ability of the experimental group is more than the average mathematical representation ability of the control group. In other words, the average ability of students' mathematical representations in learning the Project Based Learning model assisted by Google Sites is more than the average ability of students' mathematical representations in learning the Discovery Learning model.

Based on the calculations above, it can be concluded that the learning model of Project Based Learning assisted by Google Sites fulfills the indicators of research effectiveness, namely: (1) learning mathematics using the Project Based Learning model assisted by Google Sites on the mathematical representation abilities of students who have completed classical learning, (2) the average the average ability of students' mathematical representations in classes that receive learning using the Project Based Learning model assisted by Google Sites is more than or equal to the minimum completeness criteria, (3) the average ability of students' mathematical representations in learning using the Project Based Learning model assisted by Google Sites is more than the average ability mathematical representation of students in learning with the Discovery Learning model. Based on the results at the learning planning stage, learning implementation, and learning evaluation, it can be concluded that learning using the Project Based Learning model assisted by Google Sites is of high quality for developing students' mathematical representation abilities.

3.2. The Effect of Learning Independence on Mathematical Representation Ability

Testing the effect of independent learning on the mathematical representation abilities of students who received learning using the Project Based Learning model assisted by Google Sites was conducted to find out how much the learning independence variables were able to influence the mathematical representation ability variables.

The normality test is used as a prerequisite test for influence data to determine whether the samples taken in the study come from populations that are normally distributed or not. The normality test was carried out with the help of IBM SPSS Statistics 21 with the Kolmogorov-Smirnov test. Based on the results of the calculations that have been carried out, the value for the experimental group is $sig = 0.957 > \alpha = 0.05$, then H_0 is accepted. Thus it can be concluded that the data from the two samples come from populations that are normally distributed.

The homogeneity test is used as a prerequisite test for influence data to determine whether the samples taken in the study have the same (homogeneous) variance. The homogeneity test was carried out with the help of IBM SPSS Statistics 21. Based on the calculation results obtained $sig = 0.119 > \alpha = 0.05$, then based on the kurtosis value shown it can be assumed that the data tends to be homogeneous. Thus it can be concluded that the data comes from a homogeneous population.

The effect test was carried out using the help of IBM SPSS Statistics 21 with a Simple Linear Regression test. Based on the data in the study, the researcher labeled the independent variable with the name "Learning Independence" and the dependent variable with the name "Mathematical Representation Ability Test Score". Based on the calculation results, the regression equation is $\hat{Y} = 0.503X + 46.988$. The significance value in the ANOVA table is 0.001. Because the value of $sig = 0.001 < 0.05$, then H_0 is rejected. So, it can be concluded that there is an influence of independent learning on mathematical representation ability. While the value of $R = 0.542 = 54.2\%$ and $R^2 = 0.294 = 29.4\%$. Thus, it can be concluded that there is an effect of independent learning on students' mathematical representation abilities of 29.4%.

3.3. Results of the Learning Independence's Classification Questionnaire

The learning independence questionnaire was given to 32 students of class VIII E as an experimental class. The questionnaire contains 20 statement items presented with five answer choices for each statement item. The data obtained from filling out the learning independence questionnaire will then be analyzed according to the learning independence questionnaire assessment guidelines and are classified into three classification criteria, namely high, medium, and low. Data on the results of classifying student learning independence are presented in Table 3.

Table 3. Results of Classification of Student Learning Independence

Learning Independence	Many Students	Percentage
Height	12	37,5%
Moderate	16	50%
Low	4	12,5%
Total	32	100%

Based on the results of the classification of learning independence, then 2 subjects were selected for each category of learning independence. Students who were selected as subjects for the high learning independence category were E-01 and E-30, the moderate learning independence category was selected were E-10 and E-28, and the low learning independence category was selected were E-03 and E-05.

3.4. Mathematical Representation Ability Based on Student Learning Independence

Description of mathematical representation abilities based on student learning independence according to indicators of mathematical representation abilities which include: (A) Making geometric shapes to clarify problems and facilitate solving; (b) Create mathematical equations or models from the given representations; (C) Solving problems involving mathematical expressions; and (D) Writing down the interpretation of a representation will be described as follows.

The results of students' work with high, medium, and low learning independence on the mathematical representation ability test item number 2.

(1) Students with high learning independence

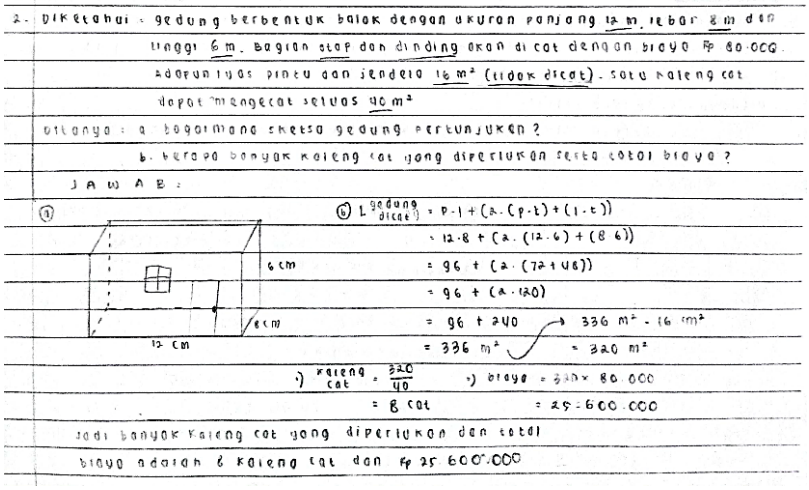

Figure 3. Student work results with high learning independence

Based on the results of student work and analysis of the results of interviews with subjects with high learning independence, it was found that according to the indicator aspect of high learning independence (A) the subject was able to draw geometric shapes to clarify problems and facilitate problem solving. In the aspect of the representation indicator (B), the subject is able to make an equation or a mathematical model from the representation given and can write down what is known in the problem correctly and completely, namely a description of the length, width and height of the building, including the exception conditions contained in the problem. In the aspect of representation indicators (C) the subject is able to solve problems involving mathematical expressions by determining the surface area of the building and determining the number of cans of paint needed to paint the building and the total cost of painting that needs to be incurred; and aspect (D) the subject is able to write conclusions regarding the number of cans of paint needed and the total cost that needs to be spent correctly. Thus, in question number 2 the subject is able to fulfill all representation indicators (A), (B), (C), and (D).

(2) Students with moderate learning independence

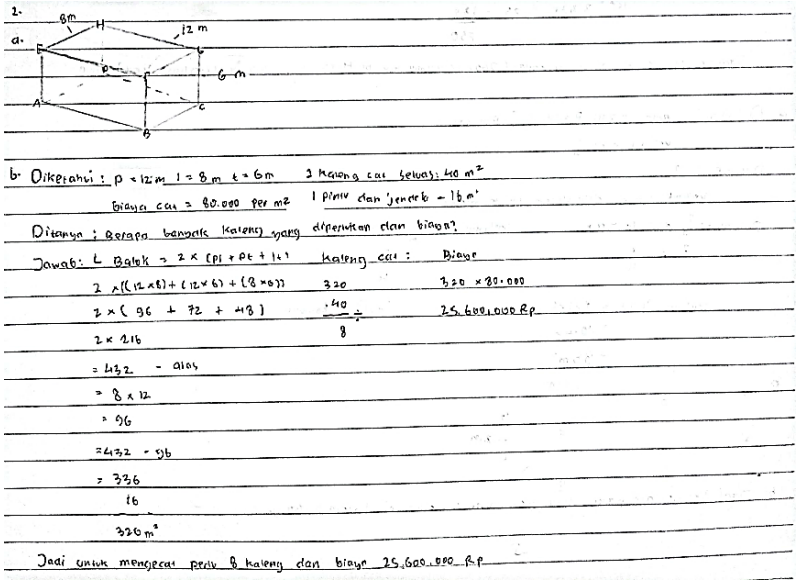

Figure 4. Student work result with moderate learning independence

Based on the results of student work and analysis of the results of subject interviews with moderate learning independence, it was found that according to the moderate learning independence indicator aspect (A) the subject was able to draw geometric shapes to clarify problems and facilitate problem solving. In the aspect of the representation indicator (B), the subject is able to make an equation or a mathematical model from the representation given and can write down what is known in the problem correctly and completely, namely a description of the length, width and height of the building, including the exception conditions contained in the problem. In the aspect of representation indicators (C) the subject is able to solve problems

involving mathematical expressions by determining the surface area of the building and determining the number of cans of paint needed to paint the building and the total cost of painting that needs to be spent even though it is not complete; and aspect (D) the subject is able to write conclusions regarding the number of cans of paint needed and the total cost that needs to be spent correctly. Thus, in question number 2 the subject is able to fulfill all representation indicators (A), (B), (C), and (D).

(3) Student with low learning independence

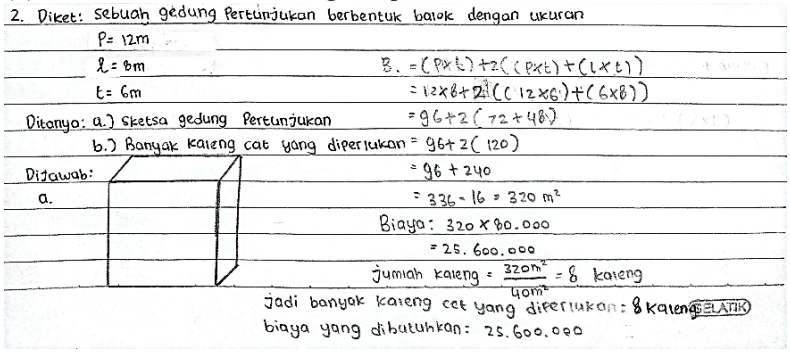

Figure 5. Student work result with low learning independence

Based on the results of student work and analysis of the results of interviews with subjects with low learning independence, it was found that according to the indicator aspect of low learning independence (A) the subject was unable to make geometric shapes to clarify problems and facilitate problem solving. In the aspect of the representation indicator (B) the subject is able to make an equation or a mathematical model from the given representation and can write down what is known in the problem correctly, namely the description of the length, width and height of the building but is incomplete to include the exception conditions contained in the problem. In the aspect of representation indicators (C) the subject is able to solve problems involving mathematical expressions by determining the surface area of the building and determining the number of cans of paint needed to paint the building and the total cost of painting that needs to be spent even though it is not complete; and aspect (D) the subject is able to write conclusions regarding the number of cans of paint needed and the total cost that needs to be spent correctly. Thus, in question number 2 the subject is able to fulfill the representation indicators (B), (C), and (D), and is unable to fulfill indicator (A).

The summary of the results of the analysis of students' mathematical representation abilities in terms of learning independence in each student category is shown in Table 4.

Table 4. Summary of the analysis of students' mathematical representation abilities based on learning independence

Question Items	Indicator	Learning Independence Category					
		Height		Moderate		Low	
		S-01	S-02	S-03	S-04	S-05	S-06
1	A	✓	✓	✓	✓	✓	✓
	B	✓	✓	✓	✓	-	✓
	C	✓	✓	-	-	-	-
	D	✓	✓	-	-	-	-
2	A	✓	✓	-	✓	-	✓
	B	✓	✓	✓	✓	✓	✓
	C	✓	✓	✓	✓	✓	-
	D	✓	✓	✓	✓	✓	-
3	A	✓	✓	✓	✓	✓	✓
	B	✓	✓	✓	✓	✓	✓
	C	✓	✓	✓	✓	-	✓
	D	✓	✓	✓	✓	✓	-
4	A	✓	✓	✓	✓	-	✓
	B	✓	✓	✓	✓	-	-
	C	✓	✓	✓	✓	-	-
	D	✓	✓	✓	✓	-	-

Description: S-01 = E-01 S-02 = E-30 S-03 = E-10 S-04 = E-28 S-05 = E-03 S-06 = E-05

Based on the summary of subjects with high learning independence in Table 4 above, it was found that students who had high learning independence were able to complete the mathematical representation ability test questions, explain in detail the completion of the mathematical representation ability test questions, and were able to fulfill all indicators of representation ability mathematics in research on learning the Project Based Learning model assisted by Google Sites. Based on the results that have been presented, it can be seen that students who have high learning independence are able to fulfill all indicators of mathematical representation abilities, namely making geometrical images to clarify problems and facilitate their resolution, making equations or mathematical models from other representations given, solving problems by involving mathematical expressions, and write down the interpretation of a representation. Thus, it can be concluded that students with high learning independence are able to master mathematical representation abilities.

Students with high learning independence tend to easily participate in learning mathematics because it is based on a high sense of responsibility and self-desire in learning. This can be seen from the students' responses when receiving Project Based Learning model learning assisted by Google Sites, students are able to process information well, are able to formulate problems correctly, use mathematical formulas and symbols correctly, construct problem solving according to the right steps of completion and write a conclusion from solving the problem that has been made. This is in line with Wahyuni's statement (2012) which states that a student who has high independence will be more mature and more responsible in making decisions that arise in his group so as to contribute to improving student achievement.

Based on the summary of the subjects with moderate learning independence in Table 4 above, it was found that students who had learning independence who were being able to complete the mathematical representation ability test questions, were able to explain the completion of the mathematical representation ability test questions, and were able to fulfill the indicators of mathematical representation ability in research on learning the Project Based Learning model assisted by Google Sites. Based on the results that have been presented, it can be seen that students who have moderate learning independence are able to fulfill all the indicators of mathematical representation ability, namely making geometric shapes to clarify problems and facilitate their solution, make equations or mathematical models from other representations given, solve problems by involving mathematical expressions, and write down the interpretation of a representation. Thus, it can be concluded that students with moderate learning independence are able to master mathematical representation abilities.

Students with moderate learning independence tend to be quite capable of participating in mathematics learning because it is based on a sense of responsibility and their own desire to learn. This can be seen from the students' responses when receiving Project Based Learning model learning assisted by Google Sites, students are able to process information quite well, are able to formulate problems correctly even though they have not been done systematically, use formulas and mathematical symbols correctly even though they have not been done systematically, construct solving problems in accordance with the appropriate settlement steps even though they have not been carried out systematically and writing a conclusion from solving the problems that have been made. This is in line with Sigia's statement (2020) which states that students' mathematical representation abilities will be better if students have better independence.

Based on the summary of subjects with low learning independence in Table 4 above, it was found that students who had low learning independence tended to be less able to complete the mathematical representation ability test questions and tend to be less able to explain the completion of the mathematical representation ability test questions correctly, completely, and precise and tend to be less able to fulfill all indicators of mathematical representation ability in research on learning the Project Based Learning model assisted by Google Sites. Based on the results that have been presented, it can be seen that students who have low learning independence are able to fulfill indicators of mathematical representation abilities, namely making geometric shapes to clarify problems and facilitate their solution, make equations or mathematical models from other representations given, but tend to be less able fulfill the indicators solve the problem by involving mathematical expressions, and write down the interpretation of a representation. Thus, it can be concluded that students with low learning independence tend to be less able to master mathematical representation abilities.

Students with low learning independence tend to be less able to follow mathematics learning well because it is based on a reluctance to learn independently. This can be seen from the responses of students when receiving Project Based Learning model learning assisted by Google Sites, students are less able to process information properly, are only able to formulate problems correctly but not yet systematically, use formulas and mathematical symbols correctly but not yet systematically, and construct the solution to the problem is not in accordance with the appropriate settlement steps and is less able to write a conclusion from solving the problem that has been made correctly. This is in line with Sigia's statement (2020) which

reveals that students with learning independence in the low category tend to experience more difficulties because students are more silent and passive only accept answers from students who have learning independence in the high category.

4. Conclusion

Based on the results of research and discussion, the following conclusions are obtained. (1) The Project Based Learning model assisted by Google Sites is qualified to students' mathematical representation abilities. This is indicated by the fact that in the preparatory stage, the results of the Project Based Learning model assisted by Google Sites can be said to be valid with a very good category for mathematical representation ability. At the implementation stage, the results of the implementation of the Project Based Learning model assisted by Google Sites are said to be implemented with a very good category for mathematical representation ability. At the learning evaluation stage, it was found that the learning outcomes of the Project Based Learning model assisted by Google Sites were effective for mathematical representation abilities characterized by students' mathematical representations ability in Project Based Learning model assisted by Google Sites classically complete, the average of students' mathematical representation ability in Project Based Learning models assisted by Google Sites is more than or equal to minimum completeness criteria, and the average mathematical representation ability of students in Project Based Learning assisted by Google Sites is more than the average ability of students' mathematical representation in Discovery Learning model. (2) There is an effect of learning independent on students' mathematical representation abilities of 29.4%. This means that there are other factors that have more influence on the ability of mathematical representation in learning of Project Based Learning model assisted by Google Sites.

Based on the analysis of mathematical representation ability in terms of learning independence in Project Based Learning model learning assisted by Google Sites, the following descriptions are obtained (a) students with high learning independence are able to fulfill the indicators of making geometric shapes to clarify problems and facilitate their resolution; create mathematical equations or models from other representations given; solve problems by involving mathematical expressions; and write down the interpretation of a representation, (b) students with moderate learning independence are able to fulfill the indicators of making geometric shapes to clarify problems and facilitate their resolution; create mathematical equations or models from other representations given; solve problems by involving mathematical expressions; and write down the interpretation of a representation, (c) students with low learning independence are able to fulfill the indicators of making geometric shapes to clarify problems and facilitate their resolution; create mathematical equations or models from other representations given; but tend to be less able to fulfill the indicators of solving problems involving mathematical expressions; and write down the interpretation of a representation.

References

Azkiah, F., & Sundayana, R. (2022). Middle School Student Mathematical Representation Ability Based on Student Self-Efficacy. Plusminus: Journal of Mathematics Education, 2(2), 221–232. https://doi.org/10.31980/plusminus.v2i2.1829

Creswell, J. W. (2012). Research Design Approaches Qualitative, Quantitative, and Mixed (Prints to). Student Library.

Ferismayanti. (2020). Optimizing the Utilization of Google Sites in Distance Learning.

Ismaniati, C., Sungkono, S., & Wahyuningsih, D. (2015). BLANDED LEARNING MODELS TO INCREASE LEARNING INDEPENDENCE AND ATTRACTION IN LECTURES. Journal of Education Science Research, 8(2).

Kholis, N. (2022). Development of project based learning teaching materials "geometry mosaic" with the help of a website on geometry transformation material. Thesis.

Kusrianto, S. I., Suhito, S., & Wuryanto, W. (2016). The Effectiveness of the CORE Learning Model Assisted by Pop Up Books on the Ability of Grade VIII Students in the Aspect of Mathematical Representation. Unnes Journal of Mathematics Education., 5(2), 154–162.

Lette, I., & Manoy, J. T. (2019). Representation of Middle School Students in Solving Mathematical Problems in View of Mathematical Ability. MATH Dunesa, 8(3), 569–575.

Narulita, A. A., Multono, M., & Sunarmi, S. (2013). THE EFFECTIVENESS OF DESIGNED STUDENT-CENTERED INSTRUCTIONAL LEARNING MODEL ON STUDENTS' REPRESENTATIONAL ABILITY. Unnes Journal of Mathematics Education, 2(3).

NCTM. (2000). Principles and standards for school mathematics.

Pratiwi, I. D., & Laksmiwati, H. (2016). Self-Confidence and Learning Independence in SMA Negeri "X." Journal of Theoretical and Applied Psychology, 7(1), 43–49. https://doi.org/10.26740/jptt.v7n1.p43-49

Sigia, S. (2020). The Effect of Problem-Based Learning Model (PBM) and Independent Learning on High School Students' Mathematical Representational Ability. Essay: Journal of Education, Learning and Development, 2(02), 14-25.

Suryowati, E. (2015). Errors of Elementary School Students in Representing Fractions on Number Lines. AKSIOMA Journal of Mathematics Education, 4(1), 38–52. https://doi.org/10.24127/ajpm.v4i1.67

Trianto. (2011). Integrated Learning Model. Script Earth.

Wahyuni, E. T. (2012). Learning Biology with a Contextual Teaching and Learning Approach Through Laboratory Observation Methods and the Environment in View of Curiosity and Student Learning Independence (Doctoral dissertation, UNS (Sebelas Maret University)).

Widakdo, W. A. (2017). Mathematical Representation Ability by Using Project Based Learning on the Topic of Statistics. Journal of Physics: Conference Series, 895(1). https://doi.org/10.1088/1742-6596/895/1/012055