

Penerapan Model Project Based Learning Berbasis DGMATH untuk Meningkatkan Motivasi Belajar Siswa Sekolah Dasar

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Abstrak

Pembelajaran matematika pada siswa jenjang sekolah dasar merupakan pembelajaran yang penting untuk diperhatikan. Siswa jenjang sekolah dasar merupakan siswa generasi z yang sudah melek dan bersahabat erat dengan teknologi, model pembelajaran yang baik digunakan adalah model pembelajaran yang terpusat pada siswa. PBL berbasis DGMATH merupakan model pembelajaran yang terpusat pada siswa dan menggunakan suatu aplikasi DGMATH dengan pokok bahasan operasi bilangan. Tujuan penelitian ini adalah untuk menguji efektivitas pembelajaran PBL berbasis DGMATH dan mengukur seberapa besar pengaruh motivasi belajar siswa terhadap hasil belajar dari penerapan pembelajaran PBL berbasis DGMATH ini. Metode yang digunakan adalah metode kuantitatif untuk menguji efektivitas dan uji regresi motivasi belajar terhadap pembelajaran PBL berbasis DGMATH dengan subjek siswa kelas satu (1) SD Islam Insan Cendekia sejumlah 60 siswa. Instrumen yang digunakan berupa perangkat pembelajaran, soal *pre test*, *post test* dan kuesioner motivasi belajar siswa. Adapun hasil penelitian diperoleh bahwa pada uji ketuntasan diperoleh hasil 82,83 pada pembelajaran PBL berbasis DGMATH dan pada uji beda rata-rata dengan nilai sig $0,015 < 0,05$ yang artinya terdapat perbedaan hasil belajar yang signifikan antara kelas eksperimen dengan kelas control. Sehingga dapat disimpulkan bahwa pembelajaran PBL berbasis DGMATH terbukti efektif dan motivasi belajar mempunyai pengaruh yaitu sebesar 76% terhadap hasil belajarnya.

Kata Kunci: aplikasi DGMATH, motivasi belajar, project based learning

Implementation of DGMATH-based Project Based Learning Model to Improve Elementary School Students' Learning Motivation

Abstract

Learning mathematics for students at the elementary school level is an important lesson to be concern. learning model to use is a student centered learning model. DGMATH-based PBL is a student centered learning model and uses a DGMATH application that contain main subject is elementary arithmetic. The purpose of this study was to test the effectiveness of DGMATH-based PBL learning and measure how much influence student motivation had on learning outcomes from the implementation of DGMATH-based PBL learning. The method used is a quantitative method to test the effectiveness and regression test to learning motivation on DGMATH-based PBL learning with the subject of first grade students (1) SD Islam Insan Cendekia with a total of 60 students. The instruments used were learning tools, pre-test questions, post-test questions and student learning motivation questionnaires. The research results showed that in the completeness test the results were 82.83 in DGMATH-based PBL learning and in the average difference test with a sig value of $0.015 < 0.05$, which means that there is a significant difference in learning outcomes between the experimental class and the control class. So it can be concluded that DGMATH-based PBL learning has proven effective and learning motivation has an influence of 76% on learning outcomes.

Keywords: *DGMATH application; motivation to learn; project based learning*

INTRODUCTION

Education is one of the main indicators of development and the quality of human resources. Therefore, the quality of human resources is highly dependent on the quality of education. One of the basic skills that every elementary school student must have is mathematics. Mathematics is the foundation of science, hence it is often referred to as the mother of knowledge (Ariani Finda Yuniarti et al., 2022).

Mathematics taught in elementary school must have a strong foundation so that students' understanding of concepts mature. Mathematics, which is often a difficult subject for students, must be conveyed through enjoyable learning, as elementary school students need to be guided and given meaningful learning experiences that feel like play. Student-centered learning is a form of learning where the teacher only acts as a facilitator or mentor, but the overall role in the learning process becomes the main task for the students.

One learning model that can be used by students in learning mathematics is the Project-Based Learning (PBL) model, where PBL is one of the learning methods that is student-centered. PBL uses projects or activities as a medium, where students explore, assess, interpret, synthesize and process information to produce various forms of learning outcomes (Lesnowati & Hafifi, 2021). This learning model is also one of the forms of innovative learning models that emphasizes students to learn contextually through complex activities (Kristiyanto, 2020). As of now, with the increasing advancement of technology, it is easier for students to learn anytime and anywhere. Generation Z students are already very familiar with the use of android or other smartphones because they are very tech-savvy (Kusumaningtyas et al., 2020). It is a challenge for teachers to provide meaningful learning so that generation Z students have an enjoyable learning experience that is acceptable to them. The implementation of learning that is suitable for generation Z students is certainly technology-based learning. Nowadays, students are much more interested in finding literature or learning resources through the internet and social networks (Nasution, 2020), compared to searching for books as a learning resource. Just like Nawawi (2020) stated, there is an influence of providing attractive technology-based learning media, where in his research, motion graphics were used to motivate learning. So, students' learning motivation is greatly influenced by the implementation of learning.

Learning motivation is the most important indicator of success in learning implementation. High learning outcomes are influenced by how big the learning motivation is (Idzhar, 2016; Warti, 2018). Students' learning motivation can also be fostered by the application of learning media that can attract their interest, such as Saragih (2019) who used cards to increase learning motivation, in addition to Wuryanti & Kartowagiran (2016) who used animated video media to increase students' learning motivation. In addition, the use of mathematical props can also be used as a learning media that can increase students' learning motivation (Murdiyanto & Mahatama, 2014).

Aligned with Lesnowati & Hafifi (2021) who used PBL to improve student learning motivation, where their study was a class action research with an 85% increase in the second cycle. Similar research was conducted by Hapsari & Airlanda (2018) who used PBL to increase student learning motivation and obtained an 83% increase in the second cycle. On the other hand, Zaeriyah (2022) used Tik-Tok-based PBL to improve student learning motivation, but this research was conducted in the field of sports. Sunita et al. (2019) applied PBL to measure the impact of PBL on student learning interest. Many studies have been conducted on the application of PBL in learning, even to determine the extent of its influence on learning outcomes, but PBL in mathematics that implements technology, especially a learning application specifically designed as a media for mathematics learning called DGMATH, is rarely found.

This study aims to measure the effectiveness and extent of the influence of PBL-based DGMATH learning on student learning motivation. The PBL model applied in this study is integrated with a technology-based learning media called DGMATH. DGMATH is an Android application in the form of an educational game that contains material on number operations for elementary school students. DGMATH serves as a learning media in the PBL learning model, so in this study, students with PBL-based DGMATH can increase their learning motivation and ultimately obtain maximum learning outcomes.

METHOD

This study is an experimental research using quantitative method. The subjects of this study were first-grade students of SD Islam Insan Cendekia in the even semester of academic year 2021/2022. The population of this study was all first-grade students of SD Islam Insan Cendekia. Using random sampling technique, two classes were selected as the samples: the experimental class, which implemented PBL based on DGMATH, and the control class, which used conventional learning. The instruments used in this study consisted of a pre-test for both classes, a PBL-based DGMATH learning tool for the experimental class, a post-test for measuring student learning outcomes, and a questionnaire for measuring student motivation towards learning. As with most quantitative studies, the procedure of this research is depicted in Figure 1. (Abdullah, 2015).

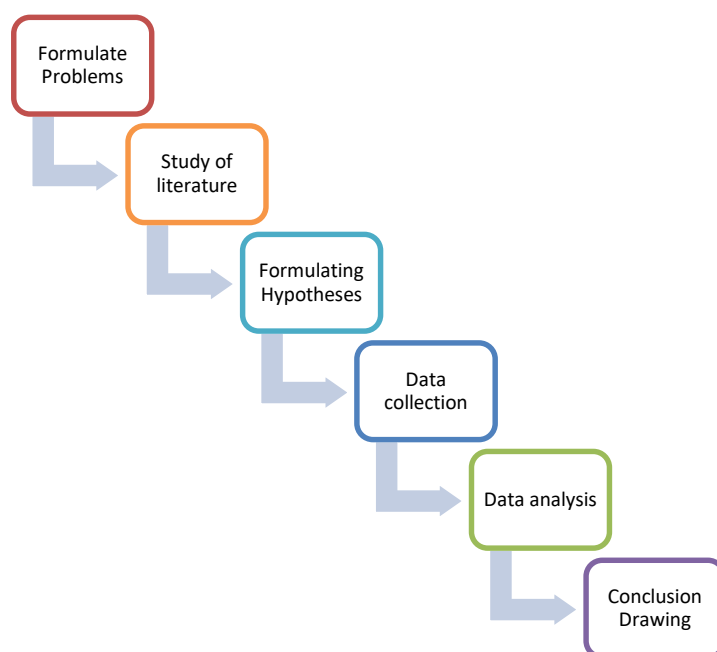


Figure 1. Research Flow

The problem formulation of this research are (1) how effective is PBL learning based on DGMATH and (2) what is the impact of PBL learning based on DGMATH on students' learning motivation. To address these issues, the researcher conducted a literature review to find relevant references and developed a learning tool to support the implementation of PBL learning based on DGMATH. The hypotheses of this research are (1) PBL learning based on DGMATH is effective and (2) there is a positive impact of the implementation of PBL learning based on DGMATH on students' learning motivation. The data collection process includes collecting initial data, conducting the experiment or research implementation, and collecting final data. In the initial data collection technique, two classes were selected as samples, namely the experimental class and the control class, both of which were given a pre-test instrument related to the topic of arithmetic operations. After the pre-test, the research was conducted, where the experimental class was taught using the PBL model based on

DGMATH, while the control class was taught using conventional learning by the teacher. The research was conducted in four meetings covering arithmetic operations, including the introduction of symbols, addition and subtraction, and finally, addition and subtraction in composition. After both classes were given different treatments, a post-test was administered as a measure of students' ability in arithmetic operations. In addition to the post-test, another instrument given to the students was a questionnaire on learning motivation. After the data were collected, data analysis techniques were applied to measure the effectiveness and impact of the implementation of PBL learning based on DGMATH on students' learning motivation. Therefore, the data analysis techniques used in this research include:

Effectiveness Test

In this study, a learning method is considered effective if (1) PBL-based DGMATH learning can achieve the minimum mastery level, and (2) student learning outcomes in PBL-based DGMATH learning are better than those in the control group. The effectiveness test is conducted using the SPSS application. Prior to conducting the mastery level test and mean difference test, preliminary tests are performed, namely: (1) normality test and (2) homogeneity test. The normality test is used to determine whether the data is normally distributed as a prerequisite for ANOVA (Sianturi et al., 2020), using the Liliefors method. Then, testing is performed using the statistical test: $L = \text{Max}|F(z_i) - S(z_i)| \dots \dots (1)$. with the critical region: $dk = \{L | L_{obs} > L_{\alpha;n}\}$ where n is the sample size. The decision criteria for the test are: H_0 accepted if $L_{obs} \notin DK$ dan H_0 is rejected if $L_{obs} \in DK$. The homogeneity test is conducted to determine whether the variances of several populations are equal or not (Sianturi et al., 2020), using the F test (Sardin, 2016). After confirming that the two classes are normal and homogeneous, the mastery level test and mean difference test are conducted.

- a. Mastery Level Test
- b. Mean Difference Test

Regression analysis

Regression analysis in this study is used to measure the extent of the influence of PBL-based DGMATH learning on student learning motivation. The data analysis technique for this regression analysis also uses SPSS software. The simple linear regression equation used is as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + \varepsilon_i ; i = 1, 2, 3, \dots n \dots \dots (2)$$

- With
- β_0 = constant
 - β_1 = regression coefficient
 - Y_i = dependent variable
 - X_i = independent variable
 - ε_i = Error

By applying the method of least squares, good estimates for the regression parameters β_0, β_1 . can be obtained. If there are two independent variables, the regression equation becomes $\hat{Y} = \beta_0 + \beta_1 X_1$, where each observation satisfies the relationship $\hat{y} = \beta_0 + \beta_1 X_1$ (Bunga et al., 2015).

RESULTS

This study is a research on the implementation of PBL learning based on DGMATH, where the phases of PBL learning based on DGMATH are used as a guideline for the implementation of learning as shown in Table 1.

The results of students' learning achievement and learning motivation in both the class with the implementation of PBL-based DGMATH and the control class were analyzed using SPSS software. The first step was to test the normality and homogeneity of the two sample classes.

Table 1. Phases of DGMATH-Based PBL Learning

Fase	Activities
Reflection	Bringing students into the context of the problem and inspiring them to start investigating. This phase also aims to connect what is known and what needs to be learned.
Research	Learning process occurs more during this stage, the students' learning progress obtained from the use of digital math media DGMATH. Students try to construct their thinking with the material presented in the DGMATH application.
Discovery	Together with their groupmates, students are challenged to complete educational games on the DGMATH application and complete group project assignments given by the teacher.
Application	Students test the products made from the predetermined criteria, the results obtained are used to improve the previous steps.
Communication	Students present the results of their discussion with their groupmates in front of the class

Normality test

Using SPSS 17.0, data was obtained as shown in Table 2.

Table 2. Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AWAL_EKS_KONTROL	.109	60	.074	.976	60	.277

a. Lilliefors Significance Correctio

In Table 2, the Normality Test using the Kolmogorov-Smirnov test shows a sig. value of 0.200 = 20.0% > 5%, which means that Ho is accepted or the data distribution is normal.

Homogeneity test

Next, the homogeneity test was conducted to determine whether the two sample classes came from the same variances. The SPSS calculation results are shown in Table 3: Test of Homogeneity of Variances.

Table 3. Test of Homogeneity of Variances

AWAL_EKS_KONTROL				
Levene Statistic	df1	df2	Sig.	
.250	1	58	.619	

The results presented in Table 3 indicate a homogeneity significance of 0.619, where sig > 0.05, indicating that the initial test variable of both sample classes is homogenous or originated from the same variance.

Efficiency Test

Efficiency in PBL learning based on DGMATH was conducted as supporting data for the application of previously developed DGMATH. The efficiency referred to in this study is:

Mastery Test

Mastery test was conducted to measure whether the students' learning outcomes in PBL learning based on DGMATH were above the minimum mastery limit of 72. The results of the calculation using SPSS can be seen in Table 4.

Table 4. One-Sample Test

	Test Value = 72					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Nilai_Akhir_DGMATH	7.673	29	.000	10.83333	7.9458	13.7209

Based on Table 4. One-Sample Test, the t-value is 7.673, the degree of freedom (df) is 29, and the significance value for a two-tailed test is 0.000. According to the output in the "One-Sample Test" table above, the value of sig < 0.05, which leads to the rejection of H₀ and acceptance of H₁, indicating that the learning outcomes of the class using the PBL-based DGMATH learning model are not equal to 72.

Table 5. One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Nilai_Akhir_DGMATH	30	82.8333	7.73297	1.41184

In Table 5, the calculation shows that the mean score of the class consisting of 30 students who received PBL-based DGMATH learning is 82.83, indicating that the class has reached or exceeded the minimum passing grade.

Mean Difference Test

To support the effectiveness of the learning method, another statistical test that can be conducted is a test of the difference in means. This test is used to determine the difference between the learning outcomes of the experimental group using PBL-based DGMATH learning and the control group using conventional learning. The results of the analysis using SPSS are presented in Table 6.

Table 6. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower		Upper
Nilai_Akhir_DGMATH_Kontrol	Equal variances assumed	.166	.685	2.495	58	.015	4.83333	1.93699	.95603	8.71063
	Equal variances not assumed			2.495	57.774	.015	4.83333	1.93699	.95571	8.71096

In Table 6. Independent Samples Test, it was found that the sig value (2-tailed) is 0.015 < 0.05, which means that there is a significant difference in learning outcomes between the class with PBL-based DGMATH learning and its control class. The average value of student learning outcomes with PBL-based DGMATH learning obtained by the students can be seen in Table 7. Group Statistics, which is 82.833 in the mean column.

Table 7. Group Statistics

	VAR00002	N	Mean	Std. Deviation	Std. Error Mean
Nilai_Akhir_DG	1.00	30	82.8333	7.73297	1.41184
MATH_Kontrol	2.00	30	78.0000	7.26351	1.32613

Regression test

Next, to measure the effect of implementing DGMATH-based PBL on student motivation, a regression analysis was conducted. In this study, the regression analysis was performed using SPSS. The results of the regression analysis using the SPSS software are presented in Table 8.

Table 8. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.872 ^a	.760	.751	3.85548

a. Predictors: (Constant), Motivasi_Belajar

In Table 8 above, it shows that the correlation coefficient (R) is 0.872 and the coefficient of determination (R square) is 0.760, indicating that the influence of learning motivation on grades is 76%.

Table 9. ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1317.954	1	1317.954	88.663	.000 ^b
	Residual	416.212	28	14.865		
	Total	1734.167	29			

a. Dependent Variable: Nilai_Akhir_DGMATH

b. Predictors: (Constant), Motivasi_Belajar

From the calculation in Table 9, ANOVA results in F count = 88.663 with a significance level of $0.000 < 0.05$, which means that the regression model can be used to predict the final grade variable, or in other words, there is an influence of learning motivation on the final grade of PBL-based DGMATH learning.

Table 10. Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	15.516	7.184		2.160	.040
	Motivasi_Belajar	1.209	.128	.872	9.416	.000

a. Dependent Variable: Nilai_Akhir_DGMATH

In Table 10. Coefficients, it is known that the value of the constant (a) is 15.516, while the value of the regression coefficient (b) or motivation to learn is 1.209, so a regression equation is obtained: $Y = a + bX$

$$Y = 15,516 + 1,209X$$

Where the equation can be translated as: The constant value of 15.516 indicates that the consistent value of the final DGMATH learning outcome is 15.516. The regression coefficient X of 1.209 indicates that for every 1% increase in motivation to learn, the final DGMATH value increases by 1.209. The regression coefficient is positive, so it can be said that the direction of the X variable's influence on Y is positive. Thus, the decision taken in the Simple Regression Test is that the significance value is obtained from Table 10. Coefficients, which is $0.000 < 0.05$, so it can be concluded that the motivation to learn variables have an effect on the final DGMATH learning outcome.

DISCUSSION

The results of this study are the calculation of the effectiveness and the extent of the influence of students' learning motivation on learning outcomes in PBL-based DGMATH. This study is a development of previous studies related to the application of PBL in learning, such as those conducted by Simbolon & Koeswanti (2020), Nurcahyoko (2014), and Sukmana & Amalia (2021). The novelty of this study is the use of digital media in mathematics subjects, specifically DGMATH, in PBL-based learning. The DGMATH application used in this PBL model has been proven effective, and learning motivation has a 76% influence on the learning outcomes of PBL-based DGMATH. This study is also a continuation of previous research

conducted by Ariani Finda Yuniarti et al. (2022), where practical and usability tests have been carried out before.

The results of the descriptive statistical analysis of PBL-based DGMATH learning in grade one (1) students at the Insan Cendekia Islamic Elementary School show that the overall average score of students in PBL-based DGMATH learning is 82.83, where students can achieve maximum results. With the learning applied in the PBL-based DGMATH model, students are given a fun learning experience that motivates them to capture what is taught by the teacher to the fullest.

Furthermore, the study supported the mean difference test between two (2) sample groups, namely the experimental class and the control class. The results showed that the average learning outcomes of the PBL-based DGMATH class were 82.83, while the control class, which used conventional learning methods applied by the teacher, had an average score of 78.00, which is similar to Nurhadiyati et al.'s (2020) study, which found that the Project-Based Learning Model also has a positive effect on learning outcomes.

From the results of the simple linear regression analysis of the influence of students' learning motivation on learning outcomes in PBL-based DGMATH, it was found that motivation has a significant 76% positive effect on the learning outcomes of PBL-based DGMATH. The simple linear regression equation obtained was $Y = 15,516 + 1,209X$. Based on these results, it can be interpreted that the value of 15,516 is the constant value of the final DGMATH learning outcome. The regression coefficient X of 1,209 indicates that for every 1% increase in learning motivation, the final DGMATH score increases by 1.209.

CONCLUSION

Based on the research conducted, it can be concluded that PBL-based learning using DGMATH is effective and meets several effectiveness criteria such as (1) achieving the minimum passing grade and (2) showing a significant difference in learning outcomes compared to conventional teaching methods used by the teacher. Additionally, a positive correlation was found between students' learning motivation and their learning outcomes, as demonstrated in the experimental group which received PBL-based learning using DGMATH. Therefore, this study supports the use of DGMATH as a learning media to support effective learning outcomes when combined with appropriate teaching models.

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