



Analysis of the effect of project-based learning on mathematical creativity skills in cube and block materials

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Abstract

This study aims to investigate the influence of Project-Based Learning (PjBL) on students' mathematical creativity skills in the topic of cubes and rectangular prisms VII of SMP Swasta TD Pardede Foundation in the academic year 2025/2026. This study is expected to provide a clear description of the extent to which the project-based learning model can enhance students' creativity in solving mathematical problems, particularly those related to cube and rectangular prism topics. The type of research used is a quantitative method with a descriptive quantitative approach, which aims to analyze the effect of project-based learning on mathematical creativity skills. The research population consists of eighth-grade students, with a research sample of 60 students selected using purposive sampling. The instruments used were essay-type test items and an observation sheet. The results of simple regression analysis revealed the regression equation $\hat{Y} = 40.126 + 0.508X$, with $t_{\text{count}} = 2.076 > t_{\text{table}} = 2.002$, indicating a positive and significant relationship between the independent variable (Project-Based Learning) and the dependent variable (mathematical creativity skills). Furthermore, the significance test of regression showed that $F_{\text{count}} = 4.309 > F_{\text{table}} = 4.01$ at a 0.05 significance level, suggesting that Project-Based Learning can be used to predict students' mathematical creativity skills. The coefficient of determination (R^2) was 0.539, which means that 53.9% of the variation in mathematical creativity skills is explained by Project-Based Learning, while the remaining 46.1% is influenced by other factors. In conclusion, Project-Based Learning has a considerable and significant effect on enhancing students' mathematical creativity skills in learning the topic of cubes and rectangular prisms..

Keywords : Project-Based Learning, Mathematical Creativity Skills, Cubes and Rectangular Prisms

INTRODUCTION

Mathematics is a basic science that has an important role in everyday life so that mathematics is one of the subjects taught at every level of education in Indonesia from elementary school to college (Ma'ruf Al Ashari & Qohar, 2024). Mathematics as a science that expects students to have the ability to think logically, systematically, critically, objectively, disciplined, and honestly to solve problems in mathematics, scientific

knowledge, and even in everyday life (Kartika & Rakhmawati, 2022). According to the Ministry of National Education (2020) , mathematics must be taught to all students because it aims to develop logical, critical, and creative thinking skills as well as the ability to work together that are relevant to the needs of the 21st century.

However, in reality, Indonesian students' mathematics learning outcomes remain low and problematic, based on rankings. The 2022 *Programme for International Student Assessment* (PISA) results show that Indonesia ranks 66th out of 81 countries, with an average score of 366, far below the OECD average (OECD, 2023). The 2019 national mathematics exam also showed that students still lack understanding of mathematics (Kemendikbud, 2019). These PISA results indicate that students' mathematical abilities remain low. Students are still lacking in solving non-routine problems and tend to only be able to solve routine or simple problems. This shows that students' thinking abilities are still low, one of which is creativity. Factors that can influence student learning outcomes include students' perceptions that mathematics is a difficult subject (Firdaus, 2019; Tambunan, 2018) , boring, less interesting, and even tends to be considered boring for most students (Ratumanan & Tetelepta, 2019). In addition, students' interest in learning mathematics is also relatively low (Friantini & Winata, 2019). The learning process that is still centered on the teacher is also another cause (Litna & Seli, 2019).

According to Guilford (Masitoh, 2020), creativity is an individual's ability to create new and unique concepts. This ability is related to personality and cognitive abilities, such as aesthetic orientation, interest in complexity, independent judgment, persistence, curiosity, intellectual honesty, and the ability to use divergent and flexible thinking, stating that creativity is an individual's capacity to generate ideas based on divergent thinking rather than convergent thinking. Creativity is a person's ability to create new products or combinations of existing things that are useful and can be easily understood. However, in reality, students' creativity is currently developing slowly.

Creativity can be used to predict learning success. In fact, everyone has creative abilities. However, developing these abilities requires practice and guidance from parents and teachers. Suherman et al. (2023) stated that creativity is not only possessed by those who work in fields that require creative thinking as part of their work, but can also be possessed by ordinary people when completing various tasks and solving problems. In the context of mathematics learning, creativity is an important competency because mathematics is not only about memorizing formulas, but also about critical thinking, finding patterns, and solving problems flexibly. Therefore, mathematics learning must be able to provide space for students to develop their creative thinking.

However, in reality, students' mathematical creativity is still relatively low. Based on initial observations conducted in class VIII of TD Pardede Foundation Private Junior High School in the odd semester of the 2025/2026 academic year, it was found that most students experienced difficulty in solving math problems that require original ideas, non-routine problem solving, and divergent thinking skills. This is evident from the low variety of

answers given by students and the minimal use of alternative strategies in solving problems. Most students tend to fixate on one solution and are not accustomed to exploring other ideas.

Based on the results of the initial test (Appendix 20) given to 32 students on the material of flat-sided solid shapes (especially cubes and cuboids), only 7 students (21.9%) achieved the high creativity category, while 25 students (78.1%) were in the medium to low category. The weakest aspects of creativity were in the indicators of *originality* (uniqueness of ideas) and *fluency* (fluency in expressing ideas). This indicates that most students do not yet have the habit and ability to think creatively in solving mathematical problems.

In fostering creativity in elementary school students, there are various ways, including through the implementation of P5, in classroom learning using *the Inquiry Based Learning model, Game Based Learning, Collaborative Learning & Discussion, Problem Based Learning (PBL), Project Based Learning (PjBL)*. In addition, student creativity can be developed through extracurricular activities. There are many ways that teachers can do to stimulate student creativity. Teacher creativity in packaging learning models, and applying the 8P framework on creative thinking is the key to success in fostering creativity in elementary school students.

To address the various problems associated with students' low mathematical creativity, a learning model is needed that not only emphasizes the final result but also values the students' thinking process. A learning model that can accommodate this is project-based learning. Hidayat & Marlina (2023) showed that project-based learning can increase students' creativity in solving mathematical problems because it directly involves students in the process of thinking, designing, and creating solutions. This model places students at the center of learning (*student-centered learning*), where they do not only receive information passively, but actively construct knowledge through collaborative and reflective activities. According to Tambunan et al. (2021), project-based learning is a learning approach that focuses on meaningful questions and problems, the process of searching, problem-solving, and drawing conclusions (Tambunan et al., 2024). Damayanti (2022) stated that "Project-based learning facilitates the development of higher-order thinking skills, including creativity, because students are challenged to create products and present their work with an innovative and solution-oriented approach." Thus, project-based learning has great potential in encouraging the development of students' mathematical creativity, especially in the material of spatial structures such as cubes and cuboids.

Based on research results, the project-based learning model is able to encourage active participation of each student in mathematics learning activities (Kristiyanto, 2020). Furthermore, this learning model has also been proven effective in developing students' creativity (Musa'ad et al., 2023). Through the implementation of project-based learning, it is hoped that students can be more actively involved in the learning process, feel responsible

for their learning outcomes, and ultimately be able to develop creative thinking skills in understanding mathematical concepts more meaningfully.

Based on the description above, the researcher will conduct a study with the title, "Analysis of the Influence of Project-Based Learning on Mathematical Creativity Abilities in Cube and Rectangular Block Material in Class VIII of TD Pardede Foundation Private Middle School in the 2025/2026 Academic Year."

METHOD

This research uses a quantitative descriptive method. According to Sugiyono (2020) , "This research uses a quantitative descriptive approach. According to Sugiyono (2020) , a quantitative research method is a method that uses research instruments to collect data which is then analyzed statistically with the aim of testing predetermined hypotheses. This method was chosen because the research aims to analyze the influence of project-based learning models on mathematical creativity abilities objectively and measurably.

Quantitative descriptive research is a type of non-experimental research. According to Creswell, a quantitative approach is used to test specific theories by measuring the relationships between variables using research instruments, with quantitative and descriptive data analysis, and aims to test predetermined hypotheses (Lestari & Yudhanegara, 2019) . Meanwhile, the purpose of this research is to describe a variable as it is without comparing or linking the independent and dependent variables. (Sugiyono, 2021)

The design used in this study is *the Posttest-Only Non-Equivalent Group Design* (Sugiyono, 2021) . *Posttest-Only Non-Equivalent Group Design* is one of the designs in quasi-experimental research (*quasi-experimental design*) which is used without a *pre-test* and without a control group. randomization group. *Posttest-only* just done post-treatment measurement (*post-test*) . There was no initial measurement (*pre-test*).

This research will be conducted at TD PARDEDE FOUNDATION Middle School in the academic year 2025/2026. The research was conducted in the odd semester of the academic year 2025/2026. According to Sugiyono (2020) "Population is a generalization area consisting of objects, or subjects that have certain qualities and characteristics that are applied by researchers to be studied and then conclusions are drawn". So the population in the study is all students of class VIII of TD Pardede Foundation Private Middle School.

A sample is a portion of the population's size and characteristics (Sugiyono, 2020) . This study used a *purposive sampling technique for sampling*. The sample used by the researcher was two eighth-grade students from TD Pardede Foundation Private Middle School. A research variable is anything that has a specific variation in any form created by the researcher for study, thus generating information about the object being studied. Conclusions are then drawn (Sugiyono, 2019).

RESULTS AND DISCUSSION

Time and Place of Research

This research was conducted at TD Pardede Foundation Private Junior High School located in Lalang Village, Telaga Sari, Sunggal District, Deli Serdang Regency, North Sumatra Province. This research was conducted in the 2025/2026 Academic Year.

Research Instrument Trial Results

Before the test instrument was used on the research sample, a test was conducted first, which included validity, reliability, difficulty level, and item discrimination. This test aimed to ensure that the material being tested was in accordance with the indicators and learning objectives that had been set. The validity test of the mathematical creativity ability test was carried out using the *Product Moment Correlation formula*. In data processing, the researcher used *SPSS 27.0 for Windows* with the provision that $r_{count} > r_{table}$, then the test item was valid at the level of $\alpha = 5\%$.

Descriptive Statistics

Descriptive statistical analysis was used to describe the mathematical creativity ability after the project-based learning model was applied to the cube and block material in grade VIII. Based on the results of data processing from 60 valid samples, the average mathematical creativity ability of students was 50.82, which indicates that students have quite good mathematical creativity abilities for the cube and block material. The standard deviation of 20.2 indicates that the distribution of data is quite varied and there are also quite large deviations. The results of the study show that students gave a fairly positive response to the application of project-based learning. The mathematical creativity abilities possessed by students also appear to be in a relatively stable condition, thus indicating that this learning model can be well accepted by students and is able to maintain the consistency of student creativity levels.

Simple Linear Regression Equation

Based on calculations using *SPSS 27.0 for windows* in the *coefficients table*, a regression equation was obtained for project-based learning (X) on mathematical creativity ability (Y) with a constant value (a) of 40.126 and a regression coefficient (b) of 0.508. So the regression equation for the influence of X on Y is $\hat{Y} = 40,126 + 0,508 X$.

Table 1. Simple Linear Regression

Model	Coefficients ^a		Unstandardized Coefficients	Standardized Coefficients	T	Sig.
	B	Std. Error				
1	(Constant)	40,126	5,743		6,987	.000
	X	.508	.245	.263	2,076	.042

a. Dependent Variable: Y

The constant value of 40.126 is a constant which means that if there is no application of the project-based learning model ($X = 0$), then the students' interest in learning is still at 40.126. The regression coefficient value (b) of 0.508 is the regression direction coefficient which shows that every one unit increase in the application of the project-based learning model will have an impact on increasing students' creativity abilities by 0.508 units.

Regression Linearity Test

The regression linearity test is conducted to determine whether the relationship between variables X and Y is linear or not. The regression linearity test is conducted by looking at the results of ANOVA Table 4.10. In accordance with the decision making, namely, $F_{count} > F_{table}$ then H_0 is rejected and H_a is accepted, if $F_{count} < F_{table}$ then H_0 is accepted and H_a is rejected.

Table 2. Regression Linearity

		ANOVA Table				
		Sum of Squares	Df	Mean Square	F	Sig.
X * Y	Between Groups	1742.217	30	58,074	.357	.997
	Linearity	446,997	1	446,997	2,745	.108
	Deviation from Linearity	1295,219	29	44,663	.274	1,000
	Within Groups	4721.717	29	162,818		
Total		6463.933	59			

of SPSS 27.0 for windows assistance, it shows that the F count value = 0.274 and then compared with the F_{table} (Appendix 19, page 121) which is 4.01. Thus, for decision making, $F_{count} < F_{table}$ ($0.274 < 4.01$), then H_0 is rejected, H_a is accepted. This shows that there is a linear relationship between project-based learning and mathematical creativity abilities in the material of cubes and cuboids in class VIII of TD Pardede Foundation Private Middle School in the 2025/2026 academic year.

Discussion

The Effect of Project-Based Learning on Mathematical Creativity Ability

Based on the research results, it was found that the application of project-based learning had a significant effect on students' mathematical creativity abilities on cube and cuboid material at TD Pardede Foundation Private Middle School. This was indicated by the results of the regression significance test which produced a $calculated F$ value = 4.309, while $F_{table} = 4.01$ at a significance level of 0.05. Because the $calculated F > F_{table}$ ($4.309 > 4.01$), it can be concluded that H_0 is rejected and H_a is accepted, so there is a significant influence between project-based learning on students' mathematical creativity abilities.

Project-based learning provides opportunities for students to actively participate in the learning process by asking basic questions, developing project plans, scheduling, and assessing and evaluating results. This natural process can enhance students' mathematical creativity in learning mathematics. (Anggiehlia et al., 2019) .

The regression equation obtained is, $\hat{Y} = 40,126 + 0,508 X$. where the regression equation shows a positive relationship between the implementation of project-based learning and students' mathematical creativity abilities. The regression coefficient value is 0.508, which means that every one-unit increase in variable X will be followed by a 0.508 increase in variable Y (mathematical creativity abilities). In the educational realm, the existence of a sustainable positive influence has important meaning for increasing students' learning interest in the long term. (Iribaram & Huda, 2019) .

The linear relationship between project-based learning and mathematical creativity is demonstrated by the results of the linearity test. *The calculated F-value* = 0.274 and the *F-table* = 4.01 indicate that the implementation of project-based learning consistently improves mathematical creativity. This linearity indicates that the more intensive the implementation of project-based learning in learning, the higher the creativity abilities demonstrated by students. (Santoso & Wulandari, 2020) .

The correlation coefficient of 0.463 with a significance value of $0.042 < 0.05$ indicates that there is a strong relationship between project-based learning and students' mathematical creativity abilities. This moderate relationship category indicates that project-based learning provides a significant contribution in fostering and maintaining creativity abilities and encouraging students to be active, collaborative, and innovative. The significance of this influence is also proven through a correlation coefficient significance test which shows the results of $t_{count} > t_{table}$ ($0.2076 > 2.002$), with a sig value of $0.042 < 0.05$.

Based on the results of the data analysis, it can be concluded that project-based learning statistically has a significant influence on students' mathematical creativity abilities in the material of cubes and cuboids. Researchers reaffirm the views of experts that project-based learning is not only focused on achieving academic results alone, but also provides opportunities for students to develop essential social skills in everyday life. The results of the study showed that the application of the project-based learning model (*Project-Based Learning*) has a significant positive impact on increasing creativity abilities. This shows that the application of project-based learning is able to make a real contribution to increasing student interest and motivation in the learning process. (Budiono & Yahya, 2023) .

Description of the Influence of Project-Based Learning on Mathematical Creativity Ability

Based on the results of the determination coefficient analysis (R^2), a value of 0.539 or 53.9% was obtained. This result indicates that project-based learning is able to explain 53.9% of the variation in mathematical creativity abilities in the cube and cuboid material. The application of project-based learning allows students to be actively involved in the learning process through activities such as designing, developing, and completing projects related to

mathematical concepts, especially in the cube and cuboid material. (Simarmata et al., 2022) . This project-based learning was implemented, where students created a geometric model, calculated the volume and surface area based on the project design and presented the results in the form of a presentation and in class, students were able to discuss in groups to work on the project. This process makes students creative in finding solutions, developing strategies, and expressing their ideas in an original way. This learning is called innovative learning, this is because in the learning process students directly participate in producing a project. Thus, it can be said that project-based learning influences mathematical creativity abilities. The large influence of 53.9% is included in the category of moderate (sufficient) influence in the context of educational research (TRI REJEKI et al., 2024) .

From the discussion, it is concluded that the research hypothesis is accepted in accordance with the research results, it is concluded that the use of project-based learning has a positive impact on mathematical creativity abilities.

CONCLUSION

Based on the results of the research and discussion that has been carried out, it can be concluded that:

1. Project-based learning has a significant effect on mathematical creativity abilities in cube and cuboid material in class VIII of TD Pardede Foundation Private Middle School in the 2025/2026 academic year.
2. The magnitude of the effect of project-based learning on mathematical creativity was 53.9%, which is considered to be a sufficient influence. This indicates that the implementation of project-based learning contributes to improving mathematical creativity in mathematics lessons.

Suggestion

Based on the research conclusions, the researcher's suggestions are as follows:

1. Teachers are expected to be able to apply project-based learning consistently in the learning process to improve creativity in solving mathematical problems.
2. Students are expected to participate more actively in project-based learning activities, both in discussions, expressing opinions and working together in groups

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