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## The Effect of Project-Based Management Learning Implementation on Mathematical Problem-Solving Using Standard Indonesian in Fifth Grade Elementary School

### Abstract

This study is a quasi-experimental research aimed at describing the effect of implementing Project-Based Management Learning on mathematical problem-solving using Standard Indonesian in Grade V at SDN Neg. 1 Tigaraksa. The sample consisted of 28 fifth-grade students from SDN Neg. 1 Tigaraksa, Tangerang Regency, in the even semester of the 2021/2022 academic year, divided into two classes: VA and VB. The study was conducted over six sessions in both the experimental and control classes. Data collection techniques included student learning outcome tests through pretests and posttests, as well as observation results. Data analysis techniques consisted of descriptive analysis and inferential analysis, which included normality tests, homogeneity tests, and hypothesis testing. The collected data were analyzed using both descriptive and inferential statistical methods. The results showed that: (1) the average learning outcome score of students in the experimental class was 83.4 with a standard deviation of 7.1, and (2) the average learning outcome score of students in the control class was 70.1 with a standard deviation of 8.4. The results of inferential statistical analysis indicated that the obtained t-test (sig 2-tailed = 0.000 < 0.05) led to the rejection of H<sub>0</sub> and acceptance of H<sub>a</sub>, meaning that the experimental learning method was proven to be more effective than conventional learning.

**Keywords:** Project-Based Learning, Mathematical Problem-Solving, Standard Indonesian

### 1. Introduction

Mathematics is one of the subjects that plays a strategic role in developing students' logical, critical, and systematic thinking skills. At the elementary school level, mathematics not only aims to enhance counting abilities but also trains students to solve real-life problems. However, in practice, mathematical problem-solving remains a major challenge for many students, particularly in fifth grade. Many students struggle to understand problems, formulate strategies, and present solutions correctly.

One contributing factor to the low level of mathematical problem-solving skills is the teacher-centered learning approach, which fails to actively engage students in the learning process. This approach tends to make students passive, merely receiving information without being trained to think independently and critically. Therefore, it is essential to adopt a learning model that actively engages students both cognitively and affectively, while providing opportunities to develop their ability to communicate ideas in a scientific and structured manner.

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One alternative solution is Project-Based Learning (PjBL). This learning model is designed to actively involve students through the completion of projects relevant to the subject matter. In this approach, students are faced with real-life situations that require them to plan, collaborate, seek information, and produce specific outputs. These activities indirectly stimulate higher-order thinking skills (HOTS), which generally involve the ability to analyze (C4), evaluate (C5), and create (C6)-skills that are inherently related to problem-solving.

In addition to cognitive skills, mathematics learning also requires strong language skills so that students can communicate their ideas and solutions effectively. The Indonesian language used in learning should follow the rules of Standard Indonesian, as outlined in the *Pedoman Umum Ejaan Bahasa Indonesia* (PUEBI). The use of Standard Indonesian not only helps students express their ideas clearly but also trains them to think in a coherent and systematic manner. Therefore, proper and correct use of Indonesian should be an integral part of the learning process, including in project activities and reporting of project outcomes.

Based on the background above, the objective of this study is to determine the effect of implementing Project-Based Management Learning on the ability to solve mathematical problems using Standard Indonesian among fifth-grade elementary school students. The results of this research are expected to contribute to the development of knowledge, particularly in the fields of mathematics education and Indonesian language literacy, through the application of Project-Based Learning models.

## 2. Literature Review

The Project-Based Learning (PjBL) model is an innovative learning approach that emphasizes student-centered learning and positions the teacher as a motivator and facilitator (Alhayat et al., 2023). Project-based learning is considered potentially more engaging for both students and teachers, and more effective than traditional approaches in developing higher-order thinking skills (HOTS) (Sasson, Yehuda, & Malkinson, 2018). The PjBL model can enhance students' reasoning abilities, enabling them to think creatively and independently in producing tangible outcomes (Ghaira & Febrian, 2024).

PjBL is a learning model that organizes instruction around complex and authentic projects or tasks. Students are required to design, plan, and complete projects within a specific time frame, resulting in real products. PjBL is regarded as an experiential and student-centered approach that promotes active learning through direct engagement in projects, along with the contextual integration of relevant technologies (Dogantan, 2025).

Based on previous studies, researchers agree that PjBL is not merely a technical method but a pedagogical approach that:

- a. Emphasizes real-world experience and student-driven inquiry.
- b. Has been proven to enhance 21st-century skills such as critical thinking, creativity, collaboration, and communication.
- c. Achieves optimal effectiveness when designed with careful consideration of implementation duration, group size, and subject context.

The application of the PjBL model follows the steps outlined by the George Lucas Educational Foundation in Kemendikbud (2017):

- a. Determine the essential question.
- b. Design the project plan.
- c. Develop a schedule.
- d. Monitor students and project progress.
- e. Assess outcomes.
- f. Evaluate the learning experience.

The application of the 4C framework, based on the findings of Putri et al. (2023), provides evidence that critical thinking, collaboration, communication, and creativity can be effectively enhanced through the implementation of the PjBL model. Similarly, Yusri et al. (2023) concluded that the main elements PjBL can develop in students include creativity, collaboration, critical thinking, communication, conceptual understanding, innovative thinking, motivation, problem-solving skills, and self-confidence. In their study, five frameworks were analyzed, and from this critical review, a new framework was proposed. Project-Based Learning and Simulation (PjBLS).

Table 1 Comparison of Strengths and Weaknesses

Table 1. Advantages and Disadvantages Strengths:	Weaknesses:
1. Enhances motivation, creativity, and conceptual understanding	1. Requires more time and detailed planning
2. Develops collaboration and communication skills	2. Evaluation is more complex and subjective
3. Relevant to real-life contexts	3. Risk of role imbalance within groups
4. Supports active learning and the use of formal language	4. Teachers need strong facilitation skills

Source: Processed by the researcher

The purpose of mathematical problem-solving is to develop students' ability to think critically, logically, analytically, and creatively in order to find solutions to various problems, both in mathematics and in everyday life. According to Polya (Shadiq & Fajar, 2014, pp. 105–108), there are four stages in solving problems: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) reviewing the results.

Problem-solving is an important indicator in achieving basic mathematical competencies at the elementary school level. This ability trains students to think logically, systematically, and creatively. According to NCTM (2022), problem-solving should be an integral part of mathematics learning. Jahanggiri et al. (2022) state that applying rigorous mathematics with multiple solutions for a single problem enables students to be constructive and productive without negatively affecting performance, while also reducing stress levels for both students and teachers.

Standard Indonesian (Bahasa Indonesia baku) is the form of the language used according to official grammar rules established by the Language Center. It is used in formal situations such as teaching, academic writing, and official communication. Kosasih and Hermawan (2012) define standard language as the spoken or written form that follows established guidelines such as PUEBI, standard grammar, and dictionaries. Marsusiadi (2023) found that mastery of correct and proper Indonesian still needs improvement, and the use of standard language among railway infrastructure personnel remains limited in the proper application of standard and non-standard word forms, both functionally and grammatically. Effective communication using standard language can be achieved through adherence to a Standard Operating Procedure (SOP). Therefore, students must have knowledge and understanding of standard words to ensure smooth communication (Ningrum, 2019).

Standard words in Indonesian serve four functions: three symbolic and one objective. These functions are (1) a unifying function, (2) a function of giving distinctiveness, (3) a function of conveying authority, and (4) a reference framework (Sugihastuti & Siti Saudah, 2018, p. 18). According to Azmil et al. (2024), research shows that a good understanding of the Indonesian language can influence the effectiveness of communication between teachers

and students in mathematics learning. Teachers who can effectively integrate Indonesian with mathematical language are able to enhance students' understanding of mathematical concepts. Mastery of Indonesian by mathematics teachers is key to creating an effective and inclusive learning environment in mathematics.

The characteristics of elementary school mathematics include basic materials such as numbers, measurement, geometry, and data. According to the Ministry of National Education (Depdiknas, 2006), the goal of teaching mathematics in elementary school is to develop numeracy skills, logical thinking, and problem-solving abilities. Karso (2007, p. 26) outlines the functions of mathematics as: (a) a tool, (b) a means of shaping thought patterns, and (c) a body of knowledge. Asri et al. (2024) identify factors contributing to the challenges of mathematics education, such as traditional teaching methods that are less relevant to real-life applications. Their study highlights the need for innovative pedagogical approaches, including the integration of technology and collaborative learning strategies, to improve student engagement and understanding.

The objectives of mathematics learning in elementary school, drawn from various sources, are to:

- a. Develop thinking skills
- b. Train problem-solving abilities
- c. Apply mathematical concepts in daily life
- d. Foster a positive attitude toward mathematics
- e. Understand the role of mathematics in life

Table 2 Class and Material Categories

Class	Materials
1	<b>Introduction to Numbers (1–10)</b> Counting numbers, addition and subtraction, and understanding the concept of time (hours and days).
2	<b>Basic Number Skills.</b> Counting numbers, comparing groups of objects and numbers, ordering numbers, place value, addition, and subtraction.
3	<b>Expanding Arithmetic Skills.</b> Deepening the concepts of addition, subtraction, multiplication, and division, as well as an introduction to fractions
4	<b>Intermediate Mathematics.</b> Operations with whole numbers and fractions, measurement, two-dimensional shapes (parallelograms, triangles), and three-dimensional shapes
5	<b>Advanced Mathematics Concepts.</b> Fractions, decimals, measurement, two-dimensional and three-dimensional shapes, as well as data processing
6	<b>Comprehensive Mathematical Operations.</b> Operations with whole numbers, fractions, decimals, two-dimensional and three-dimensional shapes, scale, and data processing

Source: Processed by Researchers

Here are some characteristics of mathematics learning in elementary schools according to experts: 1) Concrete and Gradual Approach, 2) Inductive Approach, 3) Enjoyable Learning, 4) Active and Creative Teacher Role, 5) Problem-Based Learning, 6) Emphasis on Conceptual Understanding, 7) Attention to Student Uniqueness and Needs. According to Pardosi et al. (2025), "Some of the main challenges include a lack of understanding of mathematical concepts among students and teachers, ineffective teaching methods, lack of student interest and motivation, and a lack of support and positive feedback."

The Project-Based Learning (PjBL) model is highly suitable for mathematics learning in elementary schools because it encourages students to learn actively and creatively and understand mathematical concepts through real-life projects. Experts believe that PjBL can improve students' learning outcomes, conceptual understanding, and problem-solving abilities in mathematics. (Fadillah et al. (2021).

The Project-Based Learning (PjBL) model allows students to connect mathematics to the real world, practice teamwork, critical thinking, and convey their ideas using good and correct language. Several relevant studies: 1) Sari (2021) showed that the implementation of the PjBL model can improve elementary school students' problem-solving skills in mathematics; 2) Andini and Utami (2022) found that the use of standard Indonesian in the teaching and learning process helps students understand mathematics problems better; 3) Rafik (2022) found that the project-based learning model has a significant impact on creative thinking skills and student learning outcomes.

**Theoretical Framework:** The project-based learning model provides a methodological foundation for developing problem-solving skills. Standard Indonesian is used as a thinking and communication tool in the process of solving mathematical problems. The interaction between the learning model, language, and thinking processes forms a comprehensive and contextual learning system.

**Framework:** The implementation of project-based learning is expected to improve students' ability to solve mathematical problems through real-life and collaborative activities. By using standard Indonesian, students can understand problems accurately and convey solutions clearly. This intervention is expected to have a positive impact on improving the problem solving abilities of fifth grade elementary school students.

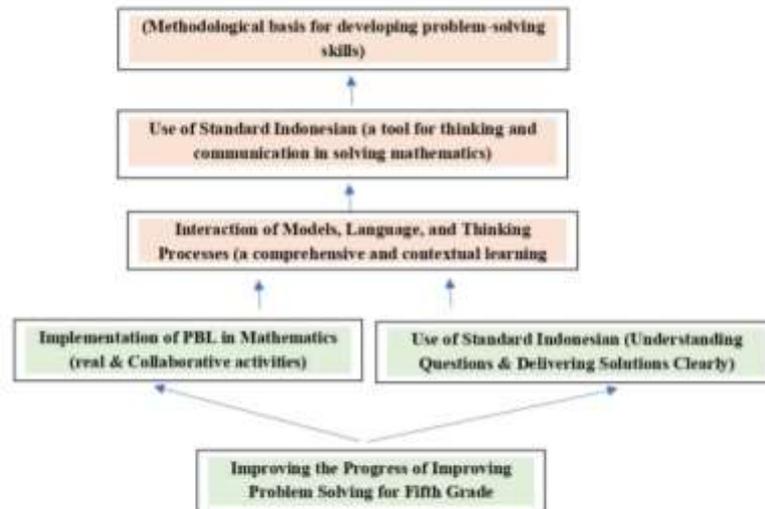


Figure 1 Theoretical Framework

### 3. Method

This research uses a quantitative approach with a quasi-experimental approach. This approach was chosen because it aimed to test the effect of implementing a project-based learning model (Project-Based Learning) on students' mathematical problem-solving abilities, while considering the use of standard Indonesian, using control and experimental groups, as well as pre- and post-tests.

The population in this study was all fifth-grade elementary school students at a public elementary school in the Regency/City (please specify the exact location, e.g., Karawaci District, Tangerang City) in the odd semester of the 2025/2026 academic year. The sampling

technique used purposive sampling, taking into account the readiness of teachers and schools to implement the project-based learning model. The sample size was: Class VA as the experimental group receiving project-based learning, and Class VB as the control group receiving conventional learning.

The research variables included: 1) the independent variable (X) Implementation of Project Management Learning, 2) the variable (Y) Mathematical problem-solving ability, and 3) the moderator variable (Z) Use of standard Indonesian in the learning and problem-solving process.

Table 3. Operational Definition of Variables

Variables	Operational Definition	Indicator
Project-Based Learning (X)	A learning process that emphasizes investigative activities through planning, implementing, and completing projects in mathematics learning.	- Problem identification
Mathematical Problem Solving (Y)	Students' ability to solve non-routine mathematics problems logically and systematically.	- Project planning
Standard Indonesian	Use of language in accordance with EYD (Indonesian Standard of Education), clear and logical sentence structure in the thinking process and delivery of mathematical answers.	- Project implementation

To obtain relevant data, the researcher used testing techniques (pre-test and post-test), observation, and documentation, as follows:

The research instruments used were: 1) the Poyla model of mathematical problem-solving using descriptive questions and an assessment rubric; 2) observations containing indicators of student activity in project-based learning; 3) a rubric assessing standard language, vocabulary accuracy, and logic of achievement in mathematical problem-solving. Data analysis included: 1) analysis prerequisite tests: normality and homogeneity tests; 2) hypothesis tests: independent sample t-tests and paired sample tests; 3) tests of the influence of standard language: correlation or regression between the level of standard language use and mathematical problem-solving scores.

Research Procedure: 1) Preparation Stage: Developing learning tools and research instruments; Instrument validation by experts; Determining research subjects; 2) Implementation Stage: Pretest on both groups; Implementation of learning models: a) Experimental group using PjBL; b) Control group using conventional learning; Observation and documentation; Posttest after learning is complete; 3) Analysis and Reporting Stage: Analysis of pretest and posttest results, Data interpretation and hypothesis testing, Preparation of research report.

## 4. Results And Discussion

### 4.1. Results

This research was conducted in fifth-grade elementary school students with two groups: an experimental group treated using Project Management-Based Learning (PjBL) and a control group taught using conventional learning. Before treatment, both groups were given a pretest to determine their initial mathematical problem-solving abilities. After treatment, a posttest

was administered to determine the effect of the learning implementation. Number of students: 1) Experimental group: 28 students, and 2) Control group: 27 students.

Pretest scores indicate that the initial abilities of both groups were relatively balanced.

Table 4. Pretest Scores for Experimental and Control Classes.

Group	Average	Highest Score	Lowest Score	SD
Experiment	58,6	75	40	9,8
Control	57,3	73	38	10,2

After implementing PjBL in the experimental group and conventional learning in the control group, posttest scores increased.

Table 5. Posttest Scores for the Experimental and Control Classes

Group	Average	Highest Score	Highest Score	SD
Experiment	83,4	95	68	7,1
Control	70,1	85	55	8,4

In the Prerequisite Analysis Test: Normality tests were conducted using the Shapiro-Wilk test. Experimental Group: Significant Pretest Expiration Values of 0.091 and 0.107 for Posttest; and Control Group: Significant Pretest Expiration Values of 0.082 and 0.095 for Posttest. Since the significance value is  $>0.05$ , the data are normally distributed. A homogeneity test using Levene's test was conducted to determine the equality of variances. The significance value = 0.233 ( $>0.05$ ), indicating that the data variances are homogeneous.

Hypothesis Test for Paired Sample t-Test: To determine the difference between the pretest and posttest within one group. The significance value for both the experimental and control groups is 0.000, but further analysis is needed to determine which group is superior. Independent Sample t-Test: To determine the difference in posttest results between the experimental and control groups, where the Sig. Value is  $<0.05$ . (2-tailed) = 0.000  $< 0.05$ , indicating a significant difference between the two groups. The experimental group had a higher average than the control group.

## 4.2. Discussion

The Effect of Project-Based Learning on Problem-Solving The results of this study indicate that project-based learning has a positive effect on improving students' mathematical problem-solving abilities. The experimental group experienced a significant increase in posttest scores compared to the control group. This increase was due to: 1) Project activities that encourage students to be more active, creative, and collaborative; 2) Real-world context-based activities make it easier for students to connect mathematical concepts to everyday life; 3) The Project-Based Learning (PjBL) strategy requires students to formulate problems, search for data, develop solutions, and present them, which indirectly trains systematic thinking processes. These findings align with the research findings of Sari (2021) and Fitri (2020), which state that Project-Based Learning (PjBL) can improve problem-solving abilities through active involvement and group work.

The Role of Standard Indonesian: In project activities, students are encouraged to use standard Indonesian in discussions, reports, and project presentations. This helps students: 1) Understand math problems more accurately, 2) Develop logical arguments and explanations

for problem solving, 3) Improve their written and oral mathematical communication skills. Observations show that students in the experimental group used complete sentences, appropriate vocabulary, and logical structures more frequently in explaining their solutions, compared to students in the control group. This finding supports Moeliono's (2000) opinion that the use of standard language supports systematic and logical thinking in learning.

A project-based learning model that integrates the use of standard language creates a learning ecosystem that: 1) Fosters higher-order thinking skills, 2) Trains scientific communication skills, 3) Develops students' sense of responsibility, cooperation, and self-confidence. The implementation of this model is very much in line with the objectives of mathematics learning in elementary schools, which emphasize not only the final result but also the thought process and the ability to communicate ideas logically and accurately.

Some additional notes during the research: 1) Students in the experimental group appeared more motivated because they felt the learning activities were not monotonous, 2) Some students initially had difficulty in conveying ideas coherently, but this developed along with the learning process, 3) The role of the teacher as a facilitator was very important in determining the success of the implementation of PjBL.

## 5. Conclusion

Based on the research results and data analysis, the following conclusions can be drawn:

- a. The implementation of project-based learning (PjBL) has been shown to significantly improve fifth-grade elementary school students' mathematical problem-solving abilities. This is demonstrated by the higher post-test scores in the experimental group compared to the control group, and statistical test results show a significant difference between the two.
- b. The use of standard Indonesian in the learning process contributes to improving students' ability to understand math problems, develop problem-solving strategies, and communicate problem-solving results clearly and logically in writing and orally. Students involved in the PjBL model demonstrated more systematic language skills in explaining solutions.
- c. The integration of the project-based learning model with the use of standard Indonesian creates an active, contextual, and communicative learning environment. This encourages students to think critically, collaborate, and solve problems independently with logical and systematic argumentation.
- d. Overall, this study shows that the PjBL model accompanied by a good and correct linguistic approach can be an effective learning alternative in improving the quality of mathematics learning at the elementary school level, especially in the problem-solving aspect.

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