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The Effect of Problem-Based Learning and Project Based Learning Method on Mathematics Learning Outcomes in Pati Elementary School

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Abstract: The learning model is the presentation of the entire series of teaching materials, including all aspects of the teacher before and after learning and all relevant facilities that are used directly or indirectly in the teaching process. The selection of the right learning model affects the implementation of the learning process. This study aims to determine the difference between the average problem-based learning model and the direct learning model, the difference between the project-based learning model and the direct learning model, and the difference between the problem-based learning model and the project-based learning model. This type of research uses an experimental research model. This study uses a research design "pre-test and post-test control group design". Data collection techniques in this study are tests, observations, and interviews. The data analysis technique in this study used a multiple regression test. The results of this study indicate that 1) students' mathematics learning outcomes in the problem-based learning model are more than students' mathematics learning outcomes in the direct learning model, 2) students' mathematics learning outcomes in the project-based learning model are more than students' mathematics learning outcomes in the direct learning model, 3) students' mathematics learning outcomes in the Problem-Based Learning method are more than students' mathematics learning outcomes in the Project-Based Learning method.

Keywords: Problem-based learning method, project-based learning method, mathematics learning outcomes

1. Introduction

Learning is a complex process and involves various interrelated aspects. Therefore, to create active, creative, effective, and fun learning, various skills are needed (Sequeira, 2012). Among them are teaching skills or teaching skills. Teaching skills are professional competencies that are quite complex as an integration of various teacher competencies as a whole and comprehensively (Loughland & Nguyen, 2016).

The reality on the ground, especially in the fourth-grade elementary school in the Teuku Umar Gugus, shows that when the learning process is ongoing, some or most of the students have not learned before the teacher teaches. During the learning process, a teacher has not utilized the full potential of his skills in teaching, so most students have not been able to reach the level of the intended criteria. Some of the students did not understand the subject matter taught by their teacher (Agus Budi Yuwono, one of the fourth-grade teachers at Gugus Teuku Umar).

Moreover, in mathematics, the material identifies various forms of flat shapes based on their properties. In this material, there are still many students who have difficulty mentioning the properties of various types of flat shapes (Harun et al., 2021). In addition, the majority of students are confused in determining the right flat shape based on its properties which are almost the same as other flat shapes. The complexity of the material that must be mastered by students and its wide scope makes students less enthusiastic about learning. Especially if the method used by the teacher to teach is only lectured (conventional) and working on student worksheets. This cannot fail to improve student learning outcomes.

Learning outcomes for mathematics subjects, especially the results of daily test scores on the material identifying the properties of flat shapes in the first semester of the 2020/2021 school year are still in the category below the Minimum Completeness Criteria value, namely the average daily test score is 67, even though the Minimum Completeness Criteria in elementary schools in the Teuku Umar cluster for mathematics subjects is 68. Meanwhile, only 40% of students who have fulfilled learning mastery have met and 60% of other students have not fulfilled mastery.

The main problem that triggers the main cause of the decline in mathematics learning outcomes is that the development of science and technology coupled with the development of educational progress in the current reform era

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is not balanced with the completeness of facilities and infrastructure in elementary schools such as the use of LCDs and computers (Munir, Murtono, & Darmanto, 2022). In addition, teachers are also not given training on innovative and meaningful learning system renewal innovations. The impact is that students' mathematics learning outcomes are less satisfactory and learning objectives are not maximally achieved.

Many alternatives can be done by teachers to improve student learning outcomes, especially in learning mathematics. Several things must be considered in providing innovation in the learning process, namely characters including students, materials, methods, and media that will be used (Sandefur et al., 2022). Based on the results of the initial analysis where the character of students toward mathematics learning material is still difficult to understand the material or questions related to everyday problems (Istikomah, Utaminingsih, & Sumaji, 2022). Therefore, one method that is deemed appropriate is the Problem Based Learning method and the Project Based Learning method. The PBL and PjBL learning methods are interesting because the design of the learning system focuses on open-ended and student-centered questions or tasks. So that it is expected to be able to provide a significant influence on improving student learning outcomes.

This Problem-Based Learning method was chosen as a solution to overcome problems in learning mathematics because in this method teachers are expected to develop programs and teaching materials according to student needs (Yew & Goh, 2016). Applying this method in learning mathematics, will strengthen the problem-solving ability and independent character of students so that students can formulate, solve, and interpret mathematics, especially the properties of flat shapes in various contexts.

In addition to Problem Based Learning (PBL), there is one method that has the same character, namely Project Based Learning (PjBL) learning which can also be a solution for teachers to support problem-solving abilities. Project Based Learning (PjBL) is student-centered learning that involves students in constructing their knowledge by exploring real-world problems that are raised in scenarios and learning activities (Handrianto & Rahman, 2019). Problem-Based Learning and Project Based Learning, of them, are related to solving mathematical problems, namely Problem Based Learning (PBL) focuses on solving real-world (solving real-world problems) while Project-Based Learning (PjBL) focuses on involving the real world by creating a product or concept from an authentic problem (Campbell, 2014). In the Project-Based Learning method students are required to learn and produce work as a medium. Given that each student has a different learning style, the Project Based Learning method is interesting because each student has the opportunity to explore material using various means that are meaningful to them and to conduct collaborative experiments (Männistö et al., 2019). Therefore, the Project Based Learning method can increase students' motivation to learn as well as improve students' problem-solving skills and increase student collaboration in group work.

With the existence of innovative activities that are used to anticipate problems in learning mathematics, it is hoped that students will gain a broader and deeper understanding of the related field of science (Mainalii, 2021). The existence of learning methods that have the same character, so researchers are interested in testing the effect of the two methods. The expected goal is to find out how much influence the method has on student learning outcomes.

1.1 Conceptual Framework

The framework of thinking in this research is described as follows:

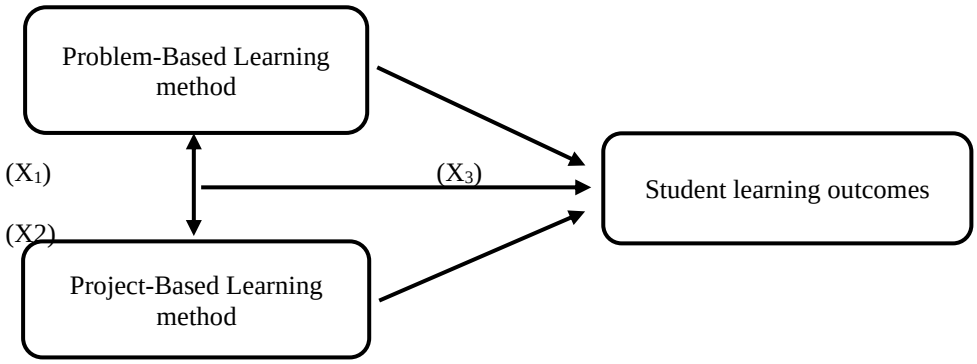

Fig. 1 - Conceptual framework.

Description:
X_1 : there is a difference between the problem-based learning model and the direct learning model
X_2 : there is a difference between the project-based learning model and the direct learning model
X_3 : there is a difference between the problem-based learning model and the project-based learning model

2. Literature Review

2.1 Problem-Based Learning Method

Problem-based learning (PBL) is a method that presents students with a case that is connected to the learning material. Students are invited to solve and think of solutions to an issue that is raised in learning to form critical thinking. Problem-Based Learning (PBL) is a learning concept that helps teachers create an interesting learning environment that starts with problems that are important and relevant to students and allows students to get a more realistic learning experience (real). Steps of the Problem-Based Learning method: 1) orient the students to the problem, 2) organizing students to study, 3) guiding investigating individually and in groups, 4) develop and present the work, 5) analyzing and evaluating the problem-solving process.

According to Dirgatama & Ninghardjanti (2016) the Problem-Based Learning method has characteristics that distinguish it from other learning methods, namely 1) learning is student-centered, 2) learning is divided into small groups, 3) the teacher acts as a facilitator and moderator, 4) problems become the focus of study and become a means to develop problem-solving skills, 5) new information is obtained from own business or self-directed learning.

The problem-based learning model is a learning model with a student learning approach to authentic problems so that students can construct their knowledge, develop higher skills and inquiry, make students independent and increase self-confidence (Saputra, 2021). The problem-based learning model is a learning model with a student learning approach to authentic problems so that students can construct their knowledge, develop higher skills and inquiry, make students independent, and increase confidence.

Problem-based learning models include asking questions or problems, focusing on interdisciplinary linkages, authentic inquiry, collaboration, and producing works and demonstrations. Problem-based learning is not designed to help teachers provide as much information as possible to students. Problem-based learning, among others, aims to help students develop thinking skills and problem-solving skills. In problem-based learning, the attention of learning is not only on the acquisition of procedural knowledge. Therefore, the assessment is not only enough for the test. Assessment and evaluation following the problem-based learning model are to assess the work produced by students as a result of their work and discuss the results of the work together. Process assessment can be used to assess the student's work.

2.2 Project-Based Learning Method

Project-Based Learning (PjBL) is a strategy in teaching and learning activities that involves students working on a project that is useful for solving community problems or their environment. Project-Based Learning method steps is 1) define basic questions, 2) develop project planning, 3) arrange schedule, 4) monitor students and their project progress, 5) testing/assessing results, 6) evaluating experience.

PjBL is a learning method that provides opportunities for teachers to manage learning in the classroom by involving project work. Project-based learning has enormous potential to make learning experiences more interesting and useful for students (Rati, Kusmaryatni, & Rediani, 2017). Project-based learning has great potential to provide a more interesting and meaningful learning experience for students. Project work in project-based learning is seen in the process, creativity, and student activities in the learning process so that it will have an impact on increasing student learning outcomes.

In practice, PjBL teaches students to master process skills and their application in their daily lives. This method involves students in problem-solving activities and assigned tasks that are following what applies in everyday life to provide opportunities for students to work independently to solve problems or produce products that can facilitate life in society (Sastrika, Sadia, & Muderawan, 2013).

2.3 Mathematics Learning Outcomes

Learning outcomes are generally related to aspects of knowledge while learning outcomes include aspects of the formation of students' character. Learning outcomes are more centered on the ability of the knowledge aspect to achieve a work result, while learning outcomes refer more to the affective aspect as the formation of student character (Lestari, 2017). The focus of this research refers to the cognitive aspects of students who focus on math test results.

The success of students in learning mathematics can be influenced by several factors such as internal factors which include initial abilities, intelligence levels, student motivation, and so on. In addition, external factors also play an important role in mastery and mathematical skills (Bungsu et al., 2019). External factors include the family environment, community environment, socio-economic conditions, and others.

3. Methodology

This type of research is quantitative research, using experimental research methods. To find out how much influence the independent variables (X1) and (X2) have on the dependent variable (Y), this study used a pre-test and post-test control group design research design. Data collection techniques in this study are tests, observations, and interviews. The data analysis technique in this study used a multiple regression test. The population in this study is class IV in the Teuku Umar Cluster, Jaken District, Pati Regency in 2020/2021.

4. Result and Discussions

A prerequisite test is used to find out if the data to be used meets the requirements. The following prerequisite test results are presented in Table 1. Table 1 shows that the data meet the requirements to be carried out to the next hypothesis testing stage.

Table 1 - Prerequisite test results.

Prerequisite	Sig.	5%	Conclusion
Normality test	0.200	0.05	Normal Distribution
Homogeneity Test	0.851	0.05	Data Homogen
Average Similarity Test	0.000	0.05	There is a difference in the average of the three classes

4.1 Hypothesis Test 1: Test the Effect of Problem-Based Learning Method on Mathematics Learning Outcomes

The average difference test in this study was to test that the mathematics learning outcomes in the experimental class were better than the mathematics learning outcomes of students in the control class. The difference test of the two averages in this study was carried out using the right-hand one test with the t-test formula. The hypothesis used is as follows.

Table 2 - Research hypothesis test 1.

$H_0: \mu_1 \leq \mu_2$	(students' mathematics learning outcomes in the problem-based learning model are less than or equal to students' mathematics learning outcomes in the direct learning model)
$H_0: \mu_1 > \mu_2$	(students' mathematics learning outcomes in the problem-based learning model are more than students' mathematics learning outcomes in the direct learning model)

The problem-based learning method is learning uses real-world problems as a context for students to learn about critical thinking and problem-solving skills and to acquire essential knowledge and concepts from the subject matter. According to Dolmans et al. (2016), the Problem-Based Learning method helps students either individually or in groups to recognize and understand the math problems that are used as problems. With this method, students can find their way or how solve the problem given. It is different from Veli's (2014) Problem-Based Learning method and is designed and developed to develop students' ability to solve problems. In addition, this problem-based learning method can foster student motivation in learning.

4.2 Hypothesis Test 2: Test the Effect of Project-Based Learning Method on Mathematics Learning Outcomes

The average difference test in this study was to test that the mathematics learning outcomes in the experimental class were better than the mathematics learning outcomes of students in the control class. The difference test of the two averages in this study was carried out using the right-hand one test with the t-test formula. The hypothesis used is as follows.

Table 3 - Research hypothesis test 2.

$H_0: \mu_1 \leq \mu_2$	(students' mathematics learning outcomes in the Project-Based Learning model are less than or equal to students' mathematics learning outcomes in the direct learning model)
$H_0: \mu_1 > \mu_{2_1}$	(students' mathematics learning outcomes in the Project-Based Learning model are more than students' mathematics learning outcomes in direct learning models)

Based on the data obtained from the calculation process using SPSS. 20, the average test results of the experimental class and control class were 73.33 and 71.22. Respectively, the number of students in the experimental class (n_1) and control class (n_2) was the same, namely 40 students and 36 students. The variance of the experimental class mathematics learning achievement test score (s_1^2) is 79.57 while the variance of the control class mathematics learning achievement test score variance (s_2^2) is 90.25. The test criteria used are accepted H_0 if $t\text{-}_{count} < t_{(1-\alpha)}.(dk)$ with dk=74. Average difference test results obtained the price $t\text{-}_{count} = 2.047$ and $t\text{-}_{table} = 1.1992$. Because $t\text{-}_{count} > t_{(1-\alpha)}.(dk)$ then H_0 is rejected. This means students' mathematics learning outcomes in the project-based learning model are more than students' mathematics learning outcomes in the direct learning model.

The results of the average difference above indicate that the Project-Based Learning model is better than the direct learning model. The application of the Project-Based Learning model shows the teaching and learning using projects can build mathematical concepts. According to Kokotsaki, Menzies, & Wiggins (2016) in implementing the project, students have the opportunity to explore, assess, interpret, synthesize, and provide information to produce various forms of

findings related to concepts that have been previously agreed upon with the teacher. In line with Wardani, Suyitno, & Wijayanti (2019) the Project-Based Learning model produces a project, each student or group is responsible for finding various sources so that they can contribute to the problem-solving process. The Project-Based Learning model adds to the motivation of students to be actively involved in learning and students will compete to get the value as expected.

4.3 Hypothesis Test 3: Test the Effect of Problem-Based Learning Methods and Project-Based Learning Methods on Mathematics Learning Outcomes

The average difference test in this study was to test the mathematics learning outcomes in the experimental class were better than the mathematics learning outcomes of students in the control class. The test for the difference between the two averages in this study was carried out using the right-hand one test with the t-test formula. The hypothesis used is as follows.

Table 4 - Research hypothesis test 3.

$H_0: \mu_1 \leq \mu_2$	(students' mathematics learning outcomes in the Problem-Based learning model are less than or equal to students' mathematics learning outcomes in the Project-Based Learning model)
$H_0: \mu_1 > \mu_{2_1}$	(students' mathematics learning outcomes in the Problem-Based Learning model are more than students' mathematics learning outcomes in the Project-Based Learning model)

Based on the data obtained from the calculation process using SPSS version 20, the average test results of the experimental class and control class were 75.18 and 73.33, respectively, the number of students in the experimental class 1 (n_1) and experimental class 2 (n_2) were the same, namely 33 students and 40 students, and the variance of the test scores for the experimental class mathematics learning outcomes (s_1^2) was 76.91 while the variance of the test scores for the control class mathematics learning outcomes (s_2^2) was 90.25. The test criteria used are accepted H_0 if $t\text{-}_{count} < t_{(1-\alpha)}.(dk)$, with dk=74. The results of the average difference test obtained the value of $t\text{-}_{count}$ = 2.104 and $t\text{-}_{table}$=1.1992. Because $t\text{-}_{count} > t_{(1-\alpha)}.(dk)$then H_0 is rejected. This means that students' mathematics learning outcomes in the problem-based learning model are more than students' mathematics learning outcomes in the Project-Based Learning model.

The results of the average difference test above show that the Problem-Based Learning model is better than the Project-Based Learning model. This is because the two models have almost the same characteristics as the characteristics of students. This model refers to a problem taken from everyday life. Therefore, students more easily understand the problem and can solve it well. The elementary school students more easily understand the problems in the environment, because they will think concretely about the problem.

In essence, Problem-Based Learning and Project-Based Learning methods emphasize solving a problem. The two learning methods aim to create active and meaningful learning activities so that the enthusiasm of students can increase (Putri, Koeswanti, & Giarti., 2021). If students' interest in learning has increased, then student learning outcomes will also increase. In addition, students are also invited to build new knowledge that is analyzed in the real world. This is reinforced by the results of previous studies by Fiana, Relmasira, & Hardini (2019), the differences in the application of Problem-Based Learning and Project-Based Learning methods to mathematics learning outcomes for 4-grade elementary schools.

5. Conclusion

The results of this study indicate that 1) students' mathematics learning outcomes in the Problem-Based Learning model are more than students' mathematics learning outcomes in the direct learning model, 2) students' mathematics learning outcomes in the Project-Based Learning model are more than students' mathematics learning outcomes in the direct learning model, 3) students' mathematics learning outcomes in the Problem-Based Learning model are more than students' mathematics learning outcomes in the Project-Based Learning model. Both of these models have the same characteristics that affect students' mathematics learning outcomes.

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Conflict of Interest

The authors declare no conflicts of interest.

References

Bungsu, T. K., Vilardi, M., Akbar, P., & Bernard, M. (2019). Pengaruh kemandirian belajar terhadap hasil belajar matematika di SMKN 1 Cihampelas. *Journal on Education*, *1*(2), 382-389.

Campbell, C. (2014). Problem-based learning and project-based learning. *Australian Council for Educational Research–ACER*.

Dirgatama, C. H. A., Th, D. S., & Ninghardjanti, P. (2016). Penerapan model pembelajaran problem based learning dengan mengimplementasi program microsoft excel untuk meningkatkan keaktifan dan hasil belajar mata pelajaran administrasi kepegawaian di SMK Negeri 1 Surakarta. *Jurnal Informasi Dan Komunikasi Administrasi Perkantoran*, *1*(1).

Dolmans, D. H., Loyens, S. M., Marcq, H., & Gijbels, D. (2016). Deep and surface learning in problem-based learning: a review of the literature. *Advances in health sciences education*, *21*(5), 1087-1112.

Fiana, R. O., Relmasira, S. C., & Hardini, A. T. A. (2019). Perbedaan Penerapan Model Project Based Learning Dan Problem Based Learning Terhadap Hasil Belajar Matematika Kelas 4 Sd. *Jurnal Basicedu*, *3*(1), 157-162.

Handrianto, C., & Rahman, M. A. (2019). Project based learning: a review of literature on its outcomes and implementation issues. *LET: Linguistics, Literature and English Teaching Journal*, *8*(2), 110-129.

Harun, F., Suparman., Hairun, Y., Machmud, T., & Alhaddad, I. (2021). Improving Students' Mathematical Communication Skills through Interactive Online Learning Media Design. *Journal of Technology and Humanities*, *2*(2), 17-23. https://doi.org/10.53797/jthkkss.v2i2.3.2021

Istikomah, Utaminingsih, S. ., & Sumaji. (2022). The Effectiveness of Guided Inquiry on Understanding Mathematical Concepts. *ANP Journal of Social Science and Humanities*, *3*, 70-76. https://doi.org/10.53797/anp.jssh.v3sp2.9.2022

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving schools*, *19*(3), 267-277.

Lestari, W. (2017). Pengaruh kemampuan awal matematika dan motivasi belajar terhadap hasil belajar matematika. *Jurnal Analisa*, *3*(1), 76-84.

Loughland, T., & Nguyen, H. T. M. (2016). Using the instructional core to implement a professional learning programme for primary science teachers in Australia: teacher learning and student skill outcomes. *Teacher Development*, *20*(4), 498-520.

Mainali, B. (2021). Representation in Teaching and Learning Mathematics. *International Journal of Education in Mathematics, Science and Technology*, *9*(1), 1-21.

Männistö, M., Mikkonen, K., Vuopala, E., Kuivila, H. M., Virtanen, M., Kyngäs, H., & Kääriäinen, M. (2019). Effects of a digital educational intervention on collaborative learning in nursing education: A quasi-experimental study. *Nordic Journal of Nursing Research*, *39*(4), 191-200.

Munir, A. M., Murtono, & Darmanto, E. (2022). The Influence of Quizizz-assisted Teams Games Tournament on Mathematics Learning Outcomes for Grade V Elementary School. *ANP Journal of Social Science and Humanities*, *3*, 85-89. https://doi.org/10.53797/anp.jssh.v3sp2.11.2022

Putri, F. P. W., Koeswanti, H. D., & Giarti, S. (2021). Perbedaan Model Problem Based Learning Dan Project Based Learning Terhadap Hasil Belajar Siswa Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, *3*(2), 496-504.

Rati, N. W., Kusmaryatni, N., & Rediani, N. (2017). Model pembelajaran berbasis proyek, kreativitas dan hasil belajar mahasiswa. *JPI (Jurnal Pendidikan Indonesia)*, *6*(1), 60-71.

Sandefur, J., Lockwood, E., Hart, E., & Greefrath, G. (2022). Teaching and learning discrete mathematics. *ZDM–Mathematics Education*, 1-23.

Saputra, H. (2021). Pembelajaran berbasis masalah (problem based learning). *Jurnal Pendidikan Inovatif*, *5*, 1-7.

Sastrika, I. A. K., Sadia, W., & Muderawan, I. W. (2013). Pengaruh model pembelajaran berbasis proyek terhadap pemahaman konsep kimia dan keterampilan berpikir kritis. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, *3*(2).

Sequeira, A. H. (2012). Introduction to concepts of teaching and learning. *Available at SSRN 2150166*.

Veli, B. (2014). The effects of a problem based learning approach on studentsâ€™ attitude levels: A meta-analysis. *Educational Research and Reviews*, *9*(9), 272-276.

Wardani, D. K., Suyitno, S., & Wijayanti, A. (2019). Pengaruh Model Pembelajaran Project Based Learning terhadap Hasil Belajar Matematika. *MIMBAR PGSD Undiksha*, *7*(3).

Yew, E. H., & Goh, K. (2016). Problem-based learning: An overview of its process and impact on learning. *Health professions education*, *2*(2), 75-