Multidisciplinary Output Research For Actual and International
Issue(MORFAI Journal) ISSN (e): 2808-6635
Volumes 5 No. 1 (2025)

THE INFLUENCE OF DIFFERENTIATED LEARNING WITH THE APPLICATION OF PROBLEM BASED LEARNING MODELS ON MATHEMATICS LEARNING OUTCOMES

[1]Cantika Meiysalika Harahap, [2*]Nurlina Ariani Hrp, [3]Laili Habibah Pasaribu
[1]Student of Mathematics Education, Faculty of Teacher Training and Education, Universitas Labuhan Batu
[2,3]Lecturer of Mathematics Education, Faculty of Teacher Training and Education, Universitas Labuhan Batu,
Coresponden Email: nurlinaariani561@gmail.com

Received	: 15 January 2025	Published	: 20 March 2025
Revised	: 31 January 2025	DOI	: https://doi.org/10.54443/morfai.v5i1.2636
Accepted	: 17 February 2025	Link Publish	: https://radjapublika.com/index.php/MORFAI/article/view/2636

Abstract

The learning model used is Problem Based Learning Education is an investment in the future of a nation. Therefore, special attention is needed to educators and the quality of education provided.The purpose of this study is to see the learning outcomes of students using the Problem Based Learning learning model,To find out whether there is an influence of differentiated learning with the application of the Problem Based Learning Model on the Mathematics Learning Outcomes of Junior High School Students at Panglima Polem Rantauprapat.This research method uses data in the form of numbers as a measuring tool because the research used uses a quantitative approach. The validity or otherwise of a study depends on the type of data collection used to select the right method according to the type of research.The results of this study arefound that the teaching and learning process using Problem Based Learning can improve students' understanding of mathematical concepts. In this study, students who participated in project-based learning had a deeper understanding of mathematical concepts compared to students who participated in traditional learning and could significantly improve student learning outcomes.This approach creates a more interactive and immersive learning environment, which has a positive impact on their academic achievement.

Keywords: ***Problem Based Learning, learning outcomes and school.***

I. INTRODUCTION

Education is an investment in the future of a nation. Therefore, there needs to be special attention to educators and the quality of education provided.(Tatik Pudjiani, 2023). Tripusat Pendidikan emphasizes that the education received by students takes place in three environments: the family environment, the school environment, and the community environment. These three environments have an educational influence in shaping the child's personality.(Ita Puspitasari et al., 2024). The limitation of this research is that the differentiated learning used is limited to process and product differentiation.

This is due to the lack of teaching methods that provide students with the freedom to develop their best potential according to their learning readiness so that learning becomes less meaningful. According to Rompis (2023), in reality students have various characteristics, with different strengths and learning needs. Of course, this needs to be addressed properly.

The learning model used is Problem Based Learning (PBL). Research by (Muslimin et al., 2022) concluded that the application of differentiated learning through the Problem Based Learning model in Mathematics learning in class IX of SMP Panglima Polem Rantauprapat can improve student learning outcomes and student learning activities. From research by Sitorus et al., (2023) it was concluded that the pretest score of students in the experimental class had an average score of 47.16. The posttest score of students in the experimental class had an average score of 78.67. So based on the overall data analysis, it can be concluded that there is an influence of differentiated learning strategies through the PBL model on the learning outcomes of class VIII students of SMP Negeri 13 Medan. Learning management in the independent curriculum refers to the Operational Curriculum of the Education Unit (KOSP) developed by the education unit according to the characteristics of the school (Gusteti & Neviyarni, 2022). Diagnostic assessments are carried out to determine the diversity of initial abilities, learning

styles, or interests of students (Purnawanto, 2023). Teachers also need to pay attention, guide and direct students during classroom learning so that students can follow their learning according to the learning steps that have been prepared (Sitorus et al., 2023). The application of differentiated learning will be a flexible and non-rigid curriculum that only believes in one way to achieve educational goals in schools (Wahyuningsari et al., 2022). The importance of emphasizing active learning, providing a good influence and being able to improve student learning outcomes is highlighted, by exploring students' individual needs (Magdalena et al., 2024).

II. THEORETICAL STUDY

Theoretical basis

Differentiated Instruction is a teaching approach designed to meet the diverse learning needs of the classroom. This concept recognizes that each student has different strengths, interests, and learning styles. Therefore, learning must be tailored so that all students, with varying abilities and needs, can achieve the same learning goals.

Problem Based Learning(PBL)

Problem-Based Learning (PBL) is a learning approach that focuses on solving real problems as the primary means of acquiring and developing knowledge. In PBL, students are given a challenging and relevant problem, which they then solve by conducting investigations, working collaboratively, and integrating existing and newly acquired knowledge.

Problem Based Learning(PBL) is an effective approach to foster deep learning, enhance problem-solving skills, and develop students' collaborative skills. Despite challenges in its implementation, PBL provides significant long-term benefits for the development of 21st-century skills that students need to succeed in an increasingly complex and changing world.

Advantages of Problem-Based Learning (PBL)

Critical and Creative Skills Development**:**PBL teaches students to think critically, analytically, and creatively in finding solutions to problems. This helps them develop problem-solving skills that are useful in everyday life and in the workplace.

III. RESEARCH METHOD

This research was conductedat Panglima Polem Rantauprapat Middle School, Labuhanbatu Regency, North Sumatra.

Research Design

The approach that will be used in this research is a quantitative research approach. The research design used in this study is a quantitative experimental research design using an experimental questionnaire design. By using the Quasi-experimental research type, the researcher applies treatment to only one class, namely the experimental class which will later be given a learning model (Program Based Learning).

Data collection technique

This study uses data in the form of numbers as a measuring tool because the research used uses a quantitative approach. The validity or otherwise of a study depends on the type of data collection used to select the right method according to the type of research.

Research Procedures

This research was conducted in the following stages:

Preparation Stages

In this research, the preparation stages carried out were:

a. Conducting school observations to see the conditions at school such as the school curriculum, number of classes, characteristics and number of students, and how teachers teach.
b. Preparing learning tools (giving assignments to students) and test instruments used in research.
c. Determining the Research Sample, where the selected samples were 2 classes, namely class Ix-a with 26 students and Ix-b with 26 students.
d. Test the validation of the test instrument and then conduct a trial of the test instrument.

e. Analyze the results of the test instrument trials and improve the instrument.

Implementation Stages

a. Distributing tests to students.
b. Implementing conventional learning or lecture methods in the control class.
c. Carrying out learning using the Project Based Learning (PBL) model.

Final Stage

a. Processing data and analyzing data on student understanding results.

Compiling conclusions and research reports.

IV. RESULTS AND DISCUSSION

Instrument Trial

This research instrument is used as a content validity test and then tested first to find out whether the instrument meets the requirements of rehabilitation, discrimination power, and level of difficulty. The content validity of an instrument is the accuracy of the instrument in terms of the material to be studied. According to Arikunto (2010:211) validity is a measure that shows the levels of validity or authenticity of an instrument.

Reliability Test

This reliability test will use the SPSS 22 (Statistical Program for Social Science) application carried out after the validity test to determine the level of trustworthiness of the instrument. Reliability indicates an understanding that the instrument is reliable enough to be used as a data collection tool.

Reliability testing uses the Cronbach Alpha formula with the following reliability index criteria:

Table 1. Instrument Reliability Correlation Coefficient Criteria

Correlation coefficient	Reliability Interpretation
$0.90 \leq r < 1.00$	Very high
$0.70 \leq r < 0.90$	Tall
$0.40 \leq r < 0.70$	Currently
$0.20 \leq r < 0.40$	Low
$r < 0.20$	Very low

Distinguishing Power of Questions

The test of the discriminating power of questions aims to differentiate the individual abilities of students. The discriminating power of questions is the ability of a question to differentiate between students with high abilities and students with low abilities. To find out the calculation of the discriminating power of questions in this study, the following formula is used:

The criteria used to determine the differentiating power are as follows:

Table 2. Interpretation Criteria for Differential Power

Mark	Information
$D \leq 0.00$	Not good
$0.00 \leq D < 0.20$	Not good
$0.20 \leq D < 0.40$	Pretty good
$0.40 \leq D < 0.70$	Good
$0.70 \leq D < 1.00$	Very good

Test the level of difficulty of questions

Difficulty Level Test Questions can be known to be classified as difficult by conducting a difficulty level test. The difficulty level of the test is the ability of the test that will be given. Good questions are questions that are not too easy or too difficult. Questions that are too easy do not stimulate students to increase their efforts to solve them. The level of difficulty is obtained by calculating the percentage of students who answered the question correctly. The more students answer a question correctly, the easier the question is and vice versa.

The criteria used to determine the level of difficulty are as follows:

Table 3. Test instrument difficulty index criteria

Correlation coefficient	Interpretation of difficulty index
P = 0.00	Very difficult

$0.00 \leq P < 0.30$	Difficult
$0.30 \leq P < 0.70$	Currently
$0.70 \leq P < 1.00$	Easy
$P = 1.00$	Very easy

Hypothesis Testing

To find out the effect of the problem solving learning model on conceptual understanding, it is done using the F-regression test. Multiple Linear Regression Test is used to find the effect of a treatment between the dependent variable and the independent variable that has provided quite interesting color in finding how much influence learning resources have on student learning outcomes.(Dr. Deni Darmawan S.Pd., 2013).According to(Gultom et al., 2024)This Multiple Linear Regression Analysis method is used to test the hypothesis, as well as to see the strength of the relationship/influence of Analytical Ability, Evaluative Ability, and Creative Ability together on Students' Cognitive Aspect Learning Outcomes.This hypothesis testing uses the F-test in the SPSS program. The F-test is used to determine whether there is an influence of independent variables together on the dependent variable used to determine whether or not there is an increase in the Use of the TTW (Think-Talk-Write) learning model to improve students' critical thinking skills in the material of two-variable linear equation systems.

According to(Rahmatullah et al., 2023)Linear regression technique is a statistical approach that makes predictions using mathematically related improvements between variables, especially the steady variable (Y) with the unbiased variable (X). Predictions on values are made if the dependent and independent variables are known.

Multiple linear regression is a multiple linear regression model is an equation that describes the relationship between two or more independent variables/predictors (X1, X2,... Xn) and one dependent variable/response (Y). The purpose of multiple linear regression analysis is to predict the value of the dependent variable/response (Y) if the values of the independent variables/predictors (X1, X2, ..., Xn) are known. In addition, it is also to determine the direction of the relationship between the dependent variable and the independent variables. The multiple linear regression equation is mathematically expressed by:

Y = a + b1X1+ b2X2+... + bn Xn

Which one:

Y = dependent variable (value to be predicted)

a = constant

b 1 b2 bn= regression coefficient

X1, X2 .... Xn

If there are 2 independent variables, namely X1 and X2 = independent variables and Y, then the form of the regression equation is:

Y = a + b1X1+ b2X2

The conditions when the values of the regression coefficients b1 are:

- If the value is 0, then there is no influence of X1 on Y
- If the value is negative, then there is a reverse relationship between the independent variable X and the dependent variable Y.
- If the value is positive, then there is a unidirectional relationship between the independent variable X and the dependent variable Y.
- The constant a and the regression coefficients b1 and b2 can be calculated using the formula:

$$a = \frac{(\sum y)(b_1 x \sum x_1) - (b_2 x \sum x_2)}{n}$$

$$b_1 = \frac{\left[(\sum {x_2}^2 x \sum x_1 y) - (\sum x_2 y x \sum x_1 x_2)\right]}{[\sum {x_1}^2 x \sum {x_2}^2 - (\sum x_1 \, x x_2)^2]}$$

$$b_2 = \frac{\left[(\sum {x_1}^2 x \sum x_2 y) - (\sum x_1 y x \sum x_1 x_2)\right]}{[\sum {x_1}^2 x \sum {x_2}^2 - (\sum x_1 \, x x_2)^2]}$$

V. CONCLUSION

The conclusion of this study isfound that the teaching and learning process using Problem Based Learning can improve students' understanding of mathematical concepts. In this study, students who participated in project-based learning had a deeper understanding of mathematical concepts compared to students who participated in traditional learning and could significantly improve student learning outcomes.This approach creates a more interactive and immersive learning environment, which has a positive impact on their academic achievement.

REFERENCES

[1]. Fathurrahman, F., Irawan, A. ., & Fridayanti, sri . (2023). Effectiveness Of Regional Regulation Number 20 Of 2001 Regarding Regulation Of Street Traders And Seasonal Street Traders In Tarakan City. International Journal of Educational Research &Amp; Social Sciences, 4(3), 429–434. https://doi.org/10.51601/ijersc.v4i3.652.
[2]. Tatik Pudjiani. (2023). Tatik Pudjiani. 3, 2023. Https://Intisari.Grid.Id/Read/0392335/Ajaran-
[3]. Beni Triansyah. (2022). Implementation Of Problem Based Learning.
[4]. Ita Puspitasari, Putri Hasanah Kusumaningrum, Septiana Ardiningsih, Sulisetias Dinarti, & Teni Wahyuningsih. (2024). Implementation Of Differentiated Learning In Addressing The Diversity Of Students' Learning Styles In Elementary Schools. Khatulistiwa: Journal Of Education And Social Humanities, 4(1), 82–93. Https://Doi.Org/10.55606/Khatulistiwa.V4i1.2720
[5]. Pgri Semarang, U., Handayani, I., Zuhri, M., Profesi Guru, P., Sidodadi Timur, J., Matematika, G., & Raya Tugu, J. (2023). National Seminar On Teacher Professional Education Implementation Of Differentiated Learning With The Discovery Learning Model To Improve Students' Learning Activeness.
[6]. Sastri1, Im, Ariesty2, Y., Adiputra3, J., & Nisa4, M. (2024). Difficulties Faced By Teachers In Implementing The Independent Curriculum In Pekanbaru Elementary Schools. Journal Of Educational Science And Local Wisdom (Jipkl), 4, 683–693.
[7]. Marni, & Pasaribu, Lh (2021). Improving Creative Thinking Skills And Student Independence Through Realistic Mathematics Learning. Jurnal Cendekia: Jurnal Pendidikan Matematika, 05(02), 1902. Https://J-Cup.Org/Index.Php/Cendekia/Article/View/621
[8]. Merrante Tulen, C., Relmasira C., S., & Hardini A. Tyas, A. (2019). Application Of The Ttw (Think, Talk, Write) Model To Improve Learning Outcomes And Critical Thinking Of Grade Iv Elementary School Students. Education, 3, 8. Https://Www.Jptam.Org/Index.Php/Jptam/Article/View/298/276
[9]. Pasaribu, Lh, & He, H. (2022). Then Ho Was Accepted, Which Means That There Was A Significant Increase Among Students' Creative Thinking Abilities And Self-Efficacy With Realistic Mathematics Learning. Based On Research Findings That. Journal Of Eduscience (Jes), 9(3), 698–706.
[10]. Rahma, If, Hasibuan, Lr, Julyanti, E., Irawan, B., & Hasanah, D. (2020). Efforts To Improve The Ability To Understand Mathematics Learning Concepts With The Example Non Example Model. Journal Of Learning And Mathematics Sigma (Jpms), 6(2), 123–127.
[11]. Rahmatullah, S., Juningsih, Eh, & Rachmawati, S. (2023). Prediction Of Students' Academic Grades During The Covid-19 Pandemic Using Multiple Linear Regression. Jisamar (Journal Of Information System, Applied, Management, Accounting And Research), 7(1), 112–123. Https://Doi.Org/10.52362/Jisamar.V7i1.1012
[12]. Retnowati, P., & Ekayanti, A. (2020). Think Talk Write As An Effort To Improve Students' Mathematical Communication. Sigma, 6(1), 17. Https://Doi.Org/10.36513/Sigma.V6i2.863
[13]. Roisah, R., Kusrina, T., & Porwanto, Be (2023). The Think Talk Write (Ttw) Type Cooperative Learning Model Can Improve Critical Thinking Skills And Learning Achievement In Social Studies Subjects. Journal Of Education Research, 4(3), 1481–1487. Https://Jer.Or.Id/Index.Php/Jer/Article/View/355
[14]. Saputra, H. (2020). Mathematical Critical Thinking Skills. Iai Agus Salim Metro Lampung Library, 2(April), 1–7.
[15]. Mutiara Cipta, D. ., & Alvin, S. (2023). Safeguarding Personal Information: Communication Privacy Management By Gen-Z Influencers. International Journal of Educational Research &Amp; Social Sciences, 4(3), 465–471. https://doi.org/10.51601/ijersc.v4i3.653.
[16]. Mohammad Solekhan, Kunarto, & Mahmuda Pancawisma Febriharini. (2022). Forest And Land Fire

Management Strategies : Prevention And Law Enforcement. International Journal of Educational Research &Amp; Social Sciences, 3(2), 567–580. https://doi.org/10.51601/ijersc.v3i2.306.

[17]. D. Yuliana Sinaga. (2022). The Effect Of Ralistic Mathematics Learning Model And Project-Based Learning Model On Problem Solving Ability And Motivation Of Students In Class V Private Sd Markus Medan Helvetia. International Journal of Educational Research &Amp; Social Sciences, 3(2), 590–600. https://doi.org/10.51601/ijersc.v3i2.268.

[18]. Nugroho, A. . (2022). Principle of Balance of Relationship Between Banks and Customers in Mudharabah Agreements. International Journal of Educational Research &Amp; Social Sciences, 3(2), 645–652. https://doi.org/10.51601/ijersc.v3i2.325.

[19]. Siregar, Md, & Partha, Idp (2020). Overcoming Reading Learning Problems Through Tutors At Sd Negeri 2 Selong. Jkp (Journal Of Educational Counseling), 4(1), 20–26. Https://Doi.Org/10.29408/Jkp.V4i1.2598

[20]. Sormin, Er, & Pasaribu, Lh (2023). Improving Students' Critical Thinking Skills In Mathematics Learning With The Problem Solving Method. Prisma, 12(1), 295. Https://Doi.Org/10.35194/Jp.V12i1.3126

[21]. Sulistiyowati, W. (2017). Textbook Of Basic Statistics. Textbook Of Basic Statistics, 14(1), 15–31. Https://Doi.Org/10.21070/2017/978-979-3401-73-7

[22]. Suryatul Aini Asyhara, Mm (2023). Junior High School Mathematics Module. In M. Deni Efendi, Junior High School Mathematics Module (Pp. 6-20). Bandar Lampung: Uml Press Muhammadiyah University Of Lampung Jl.

[23]. Sulaiman, S., Halim Soebahar, A. ., & Mundir, M. (2023). Madrassa Diniyah Curriculum Transformation In Pesantren: A Study Of Wali Songo Mimbaan And Salafiyah Syafi'iyah Sukorejo Pesantren In Situbondo. International Journal of Educational Research &Amp; Social Sciences, 4(3), 444–453. https://doi.org/10.51601/ijersc.v4i3.659.