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Problem based learning model with metacognitive approach to problem solving ability : is it effective?

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Abstract

This research aims to determine the effect of the problem based learning (PBL) model with metacognitive approach to problem solving ability on quadrilateral at seventh grade of junior high school students. The research method used is quantitative method with an experimental design, namely a posttest control design only. This research consisted of an experimental class with treatment using PBL model with metacognitive approach and control class with treatment using PBL model without metacognitive approach. The instrument in this research uses a mathematical problem solving ability test in the form of a description test. The results of research and information processing show that learning using PBL model with metacognitive approach has an influence on students' mathematical problem solving abilities. From the results of the inferential analysis of hypothesis testing using the two-sample t test, it can be seen that Ho is rejected and H1 is accepted because it meets the test criteria for $t_{count} > t_{table}$, 1.882 > 1.68195. So, it can be concluded that the mathematical problem solving ability of students who are taught using PBL model with metacognitive approach are higher compared to classes without metacognitive approach.

Keywords*: Problem Based Learning Model, Metacognitive Approach, Problem Solving Ability*

Abstrak

Penelitian ini bertujuan untuk mengetahui dampak model pembelajaran problem based learning (PBL) dengan pendekatan metakognitif terhadap kemampuan pemecahan masalah pada materi bangun datar segiempat di kelas VII SMP. Teknik ujian yang digunakan adalah strategi kuantitatif dengan desain eksperimen yaitu posttest-only control design. Eksplorasi terdiri dari kelas uji coba dengan perlakuan menggunakan model PBL dengan pendekatan metakognitif dan kelas kontrol dengan perlakuan menggunakan model PBL tanpa pendekatan metakognitif. Instrumen dalam penelitian ini menggunakan tes kemampuan pemecahan masalah matematika berbasis tes uraian. Hasil pengujian dan penanganan informasi menunjukkan bahwa penerapan model PBL dengan pendekatan metakognitif berdampak terhadap kemampuan pemecahan masalah siswa. Dari hasil penyelidikan inferensial pengujian hipotesis dengan menggunakan uji t dua sampel, dapat diketahui bahwa H0 ditolak dan H1 diterima karena memenuhi standar pengujian $t_{hitung} > t_{tabel}$ atau 1,882 > 1.68195. Jadi dapat disimpulkan bahwa kemampuan pemecahan masalah siswa di SMP yang diperlihatkan menggunakan model problem based learning pendekatan metakognitif lebih tinggi dibandingkan dengan kelas yang ditampilkan menggunakan model PBL tanpa pendekatan .

Kata Kunci *: Model Problem Based Learning, Pendidikan Metakognitif, Kemampuan Pemecahan Masalah*

INTRODUCTION

Advances in science and innovation have led to rapid changes in some parts of human life. The teaching area is one of the areas affected by this. Due to the continuous advancement of contemporary technology, the general knowledge of mathematics is increasing (Cristia & Cueto, 2020; Maritsa et al., 2021). Mathematics is also very important and supports various logical disciplines. Mathematics is a premise that can help students in making it easier to learn various sciences such as science, physical science, and others.

One of the learning models that can empower students to work based on their point of view is Problem Based Learning (PBL) (Hendriana et al., 2018; Simanjuntak et al., 2021). PBL model is a model whose purpose is to direct students in learning exercises through various real problems that can be experienced in everyday life (Dwi & Anitah, 2018) and then connect them with the information learned and In addition, PBL can enhance students' motivation and learning outcomes (Almulla, 2020; Phungsuk et al., 2017; Safitri et al., 2023).

During the learning process, describing students' thought processes and abilities is not always appropriate. Some students may underestimate their mathematical skills and avoid taking risks on more difficult problems. Therefore, problem solving should be a direct object that students should learn. However, to be able to solve problems, students must master at least five aspects of ability, namely: the ability to think mathematical concepts, the ability to master mathematical skills, the ability to process understanding, and the ability to do something positive and metacognitive (Jedaus et al., 2019). Cognitive style is an ability in a person whose development is in line with the development of intelligence For students, cognitive style is given and can affect the learning outcomes of students (Margunayasa et al., 2019; Setiawan et al., 2023; Sutama et al., 2021). Therefore, learners with certain cognitive styles need certain learning strategies as well in order to get good learning outcomes (Shi, 2011).

From the results of interviews with mathematics teachers and observations of seventh grade students at SMP Muhammadiyah Tilango on Tuesday, 23 November 2023, it is known that the school uses the 2013 Curriculum with the *Problem Based Learning* (PBL) learning model. He said that by minimising group members in a group, it can make students more responsible in understanding the material. However, he said that from the results of the daily test results of class VII students, there are still many who have not reached the KKM, which is 70 so they have to do remedial, especially the quadrilateral.

Table 1. Student achievement of KKM in 2019-2022

Teaching Year	Number of Students	Remedial Students
2019-2020	29 students	12 or 41%
2020-2021	31 students	16 or 51%
2021-2022	24 students	14 or 58%

Many students struggle with learning mathematics, especially at quadrilateral (Aprilia et al., 2021; Asdar et al., 2021; Sumiati & Agustini, 2020) . This is because students find it difficult to recognise the properties of quadrilateral have not mastered the steps of solving problems. Lack of student awareness in restudying the material that has been taught so that they cannot know which material has not been mastered for further review. This shows that students' self-thinking in making materials at school is less precise due to a lack of information about themselves which includes beliefs, actual views and judgements, individual qualities, inspiration, shortcomings or abilities, disappointments, and others.

Based on the above problems, I hope that with the metacognitive approach in the problem-based learning model students can develop knowledge about themselves so that they can increase confidence in learning and maximise learning outcomes. The metacognitive approach involves understanding and managing one's own thinking processes. In the context of education, this means that students learn to be aware of how they learn, understand, and remember information, as well as develop strategies to enhance their learning (Marthaliakirana et al., 2022; Parwata et al., 2023). So the researcher is interested in conducting research with the title "Problem based learning model with metacognitive approach to problem solving ability : is it effective?".

RESEARCH METHODS

This research was conducted at seventh grade students of junior high school, in the even semester of the 2023/2024 school year. The method in this study is the experimental method, where this study consists of experimental classes and control classes that will be given different treatments, where certain treatments are given to each experimental unit with the aim of seeing the effects caused by each class. In the early stages of learning, the two classes were given different treatments. The experimental class was given treatment with a problem-based learning model with a metacognitive approach while the control class was

given treatment with a Problem Based Learning model without a metacognitive approach. After being given treatment to both classes, the two classes were given a final test, so the design used was Posttest Control Group Design. The population in this study was all grade VII consisting of three classes in the 2023/2024 school year.

The sampling technique in this study was carried out by simple random sampling. There are 2 stages completed in this examination system. The sampling technique is done randomly. In stage I, the class that will be given the treatment consisting of 2 classes is selected, namely class VII 1 and class VII 2. Stage II is done by drawing which one will be given the treatment of problem-based learning metacognitive approach and problem-based learning model without metacognition.

RESULTS AND DISCUSSION

Description of Research Results

Information on students' problem solving ability in mathematics on quadrilateral is described as *normal or mean ($\bar{x}$), median (Me), mode (Mo), variance, standard deviation (SD) and imagined as a distribution table and histogram. This information was obtained through an essay test which* was distributed into 7 questions. The information on the results of this study is presented in two groups, namely the information group of students' mathematics problem solving ability shown by using the problem-based learning model with metacognitive approach and the group of students' mathematics problem solving ability shown by problem-based learning without approach. In general, the description of students' problem solving ability information in the two groups can be presented in table 2 below.

Table 2. Description of Research Result Data

Source	N	Min Score	Max Score	Mean	Media (Me)	Mode (Mo)	St.Dev. (SD)	Variance
Experiment Class	21	60	89	76,79	77	76	8,052	64,829
Control Class	23	60	86	72,43	70	65,75	8,246	67,99

The following is information about mathematics problem solving ability with metacognitive problem-based learning approach: based on the experimental results obtained from 21 students, the highest score is 89 and the base score is 60. The average score is 76.79 with a standard deviation of 8.052. The following calculation gets the median and mode.

The distribution of information on the ability to solve mathematical problems using the *Problem Based Learning* Model metacognitive approach there are 5 students or 23.81% who score below the normal value. Then in the class range there were 6 students or 28.57% who had an average score of 76.79 and 10 students or 47.62% scored above normal.

While the data on mathematical problem solving using the *Problem Based Learning* Model without a metacognitive approach there were 11 students or 47.83% who scored below the normal value. Then the interval class that scored above normal was 3 people or 13.04% and scored above normal as many as 9 students or 39.13%. Normality test is conducted to determine whether the information obtained comes from research subjects with normal distribution or not. This test was carried out using the Lilliefors test assisted by Excel at the level of interest $\alpha = 0.05$. The normality test rule is H_0 is recognized if $L_{count} \leq L_{tabel}$ and H_0 is rejected if $L_{count} > L_{tabel}$. H_0 recognition means that the examination information comes from a regularly distributed community, and vice versa. The results of the normality test calculation in the experimental class and control class can be seen in the following table.

Table 3. Data Normality Test Results

Group	N	Counter	L_{tabel}	Conclusion
Experiment Class	21	0,0674	0,1933	Normal
Control Class	23	0,1301	0,1847	Normal

The results of the calculation of data homogeneity test using the F test students' mathematical problem solving ability in the study had a value of $F_{count} = 1.0488 < F_{tabel} = 2.071$ at the significance level $\alpha = 0.05$. This finding implies that the two data sets of students' mathematics problem solving ability come from a homogeneous pool.

Based on the calculation of the t test of two independent samples, at the confidence level $\alpha = 0.05$ and degrees of freedom (dk) = 42, t = 1.882 is much greater than the value of t table = 1.68195. This means that the null hypothesis stating that the average mathematical *problem* solving ability of students taught with the metacognitive approach is lower or equal to the mathematical *problem* solving ability of students taught with the *Problem Based Learning* model without the approach is rejected. Therefore, the alternative hypothesis is accepted, namely that the average mathematical problem solving ability of students taught using the *Problem-Based Learning* model with a metacognitive approach is higher than that of students taught using the *Problem-Based Learning* model without using this approach. From the calculation results, it can be seen that there is a difference in students' mathematical prob-

lem solving ability. The average score of mathematical problem solving ability of students taught using *Problem Based Learning* model with metacognitive approach = 76.85 is higher than the average score of students taught using *Problem Based Learning* model without approach = 72.22. This finding confirms the proposed hypothesis.

The results of this study are also reinforced by other research conducted, which shows that the mathematical problem solving ability taught using the *Problem Based Learning* (PBL) model with a metacognitive approach is higher than the mathematical problem solving ability taught using the direct learning model (Sihaloho et al., 2017; Sri Wahyu & Marlina Ginting, 2017).

CONCLUSIONS

The conclusion of this study is that there is a Metacognitive approach to the problem solving ability of seventh grade students of SMP Negeri Muhammadiyah Tilango. The effect can be seen from the students' learning outcomes after working on posttest questions that contain indicators of mathematical problem solving consisting of 7 questions in the form of tests (descriptions), with the average value of the experimental class 76.85 and the average value of the control class 72.22.

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