

Effect of Models Problem Based Learning with Approach Problem Posing on The Mathematical Analytical Abilities of Junior High School Students

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Abstract

In learning mathematics, it always contains numeracy skills as well as analytical skills related to solving problems in everyday life. Application of learning models Problem Based Learning with approach Problem Posing aims to improve students' analytical skills so that they gain new knowledge to solve problems. This research uses quantitative methods quasi experiment with type pretest posttest control group design. To find out the effect of implementing this model, namely through a test instrument in the form of a written test or essay which is used to measure analytical abilities according to analytical ability indicators. The research results state that the implementation Problem Based Learning with approach Problem Posing has a significant influence on students' analytical abilities in mathematical numeracy. It is hoped that future researchers will be able to apply research regarding the model Problem Based Learning with approach Problem Posing over a longer research period.

Keywords: Problem Based Learning, Problem Posing, Analytical Ability

1. Introduction

The quality of education in Indonesia is measured through the level of understanding of literacy and numeracy based on PISA results (Programme for International Students Assessment) organized by the OECD (Organization for Economic Cooperation and Development). The 2018 PISA results show that Indonesia's mathematics numeracy is relatively low with a score of 379, far from the international average score of 489 (OECD, 2019). Meanwhile, the PISA 2022 results show that Indonesia's numeracy score is 366, far from the international average score of 480 (OECD, 2023). The assessment carried out by PISA every 4 years aims to measure the quality of a country's learning, related to the achievement of student learning outcomes at secondary school level. Based on the PISA results, mathematical literacy and numeracy skills have an important role in the lives of Indonesian people. In mathematical numeration, problem solving or problem solving is the main heart (Irawati & Mahmudah, 2018).

Mathematical numeracy is the ability to use numbers, symbols, data, and mathematical skills to draw conclusions and make decisions related to problems in everyday life (Anderha & Maskar, 2021). Mathematical numeracy is assessed as the ability to formulate, apply and interpret mathematical problems in various concepts, so that mathematical numeracy ability is closely related to problem solving in everyday life (Napsiyah et al., 2022). Mathematical numeracy is not just a quantitative ability, but a learning process that prioritizes high-level thinking skills such as analyzing to solve a problem (Syahara & Astutik, 2021).

Analytical ability as a high-level thinking ability needs to be instilled to improve the quality of Indonesian education in the development of the 21st century. Analytical ability at a high level is not just memorizing, but rather a way of exploring, reflecting which is done consciously to obtain goals or solutions to problem solving (Ware & Rohaeti, 2018). Analytical capabilities are included in HOTS capabilities (High Order Thinking Skill) in Bloom's Taxonomy is used to separate important information and look for relationships or connections before observing (Marini, 2014). Analytical skills are used to draw conclusions based on previous information and knowledge. Analytical ability has three important indicators, namely differentiating, organizing, and attributing or drawing conclusions (Eka et al., 2021). To improve analytical skills, problem-based learning is needed which provides learning experiences and acquires new knowledge (Sabaruddin, 2019).

In line with the problems above, a student-centered learning model is needed. Problem Based Learning is considered an innovative learning model because the teacher only acts as a facilitator, and is more student-centered to improve problem-solving abilities (Narayana, 2020). Learning Problem Based Learning has stages that make students directly involved in it, so that they can develop thinking skills to obtain new knowledge (Ware & Rohaeti, 2018). Application of learning Problem Based Learning presented a problem related to everyday life. In the process of solving this problem, students will discover new information and knowledge. There are stages of the learning model Problem Based Learning as follows: 1. Orientation to the problem, 2. Organizing students to study in groups, 3. Investigating the problem, 4. Presenting the results of problem solving, 5. Evaluating the problem solving process (Min Liu & Barrow, 2005)

Problem Posing be an approach that is in line with the model Problem Based Learning which both present problems and the process of solving them in learning. Through models Problem Based Learning Problems will be presented according to everyday life, then supported by the Problem Posing approach where students are required to solve and propose new problems (Min Liu & Barrow, 2005). Approach Problem Posing will make it easier to apply the model Problem Based Learning, because in solving a problem students will be more focused on formulating the problem to be simpler so that it is easy to understand (Wawat, 2022). Approach Problem Posing requires students to be active in implementing the learning process by asking students to ask simpler questions again based on the problem topic that has been given until they find information to solve the problem (Amri et al., 2019). Approach Problem Posing provides opportunities for students to think freely in analyzing problems with stages 1. The teacher explains the material and gives problems to students, 2. The teacher organizes students into groups, 3. Students are asked to ask questions from the problems given, 4. Students analyze the solutions to the questions made, 5. Students present the results in front of the class, 6. Teachers and students carry out evaluations regarding the solutions presented (Min Liu & Barrow, 2005).

One of the previous studies that became the basis for conducting this research was to determine the increase in analytical thinking abilities and science process skills of class XI students at SMA Negeri 1 Sleman through the application of the model. Problem Based Learning. The results of his research showed that analytical abilities and science skills were significantly improved using models Problem Based Learning (Ware & Rohaeti, 2018).

In other research, the aim is to increase student achievement and learning motivation through learning models Problem Based Learning with approach problem posing. The results of this research reveal that learning Problem Based Learning with approach problem posing has a positive influence on student learning achievement compared to conventional approaches in mathematics lessons (Amiluddin & Sugiman, 2016).

Facts obtained through primary data in the field show that mathematics learning still uses conventional methods, so students still have difficulty working on story problems related to analytical skills in problem solving. This difficulty is due to the lack of variety in the learning models used. Apart from that, students are also more interested if learning is carried out directly or through frequently encountered daily problems. Therefore, this research aims to determine whether there is an effect of implementing the learning model Problem Based Learning with approach Problem Posing on students' analytical abilities on numeracy material.

2. Method

This research includes quantitative research using *quasi experiment* (quasi-experiment). This quasi-experimental research is like a real experiment, because there is an action to see the cause and effect relationship in a study by comparing one or more comparison groups that did not receive treatment (Sugiyono, 2016). The use of quasi-experiments is because this method allows more control over the variables used and minimizes the influence of undesirable variables. Apart from that, this quasi-experimental method allows researchers to have access to the population and situation being studied, so that real experiments that are difficult to achieve can be carried out using this method. This quasi-experimental research uses a form *pretest-posttest control group design*. Briefly, this research can be seen from table 1 below:

Table 1. Research Design

Group	Initial Test	Treatment	Final Test
Experimental Class	AND ₁	X	AND ₂
Control Class	AND ₁	-	AND ₂

With Y terms₁ as *pretest* experimental group and control group. Y₂ as *posttest* (final test) experimental and control groups. While X is the treatment given (*treatment*) namely the learning model *Problem Based Learning* with approach *Problem Posing*.

This research was carried out at SMPN 4 Malang in the 2023/2024 academic year. This research subject was chosen because SMPN 4 Malang is an upper middle class school with a fairly high level of cognitive understanding. This will make it possible to test analytical skills in more depth and allow students to easily accept the treatment given. The population in this study was class VIII students, with research samples taken using simple techniques *random sampling* which was carried out randomly, namely class VIII-B students with a total of 32 students, and class VIII-C with a total of 32 students. Class VIII-B is used as a control class with a learning process using a model *Problem Based Learning*. Meanwhile, class VIII-C as an experimental class received learning treatment using models *Problem Based learning* with

approach *Problem Posing*. The data collection technique in this research uses a test instrument for students' analytical abilities which has been tested first to be validated and its level of reliability measured. The test instrument used to measure analytical abilities is in the form of a written test or *essay* which is arranged based on the following analytical ability indicators:

Table 2. Indicators of Analytical Ability (Polya, 2004).

Indicator	Description
<i>Differentiating</i> (Differentiate)	<ul style="list-style-type: none"> - Select the important parts of the problem - Select the related problem section
<i>Organizing</i> (Organize)	<ul style="list-style-type: none"> - Identify important and related parts of the problem presented to obtain complete information - Form strategies and ways of solving problems
<i>Attributing</i> (give attributes)	<ul style="list-style-type: none"> - Identify conclusions from the results solution problem

The first data analysis technique carried out was the prerequisite test using the normality test in the experimental class and the control class *shapiro wilk* di IBM SPSS *Statistics* 24. Apart from that, there is also a homogeneity test as a prerequisite test to fulfill parametric assumptions. Meanwhile, the second data analysis technique is hypothesis testing using a test *Independent Samples T-Test*.

3. Results and Discussion

3.1 Result

Obtained scores from students' analytical ability tests in the control group using the model *Problem Based Learning* and an experimental group that uses the model *Problem based learning* with approach *Problem Posing* From the research that has been carried out, it can be seen in the following data:

Table 3. Descriptive Statistics

	Learning model	N	Mean	Std. Deviation	Std. Error Mean
Pretest	Control Class	32	64.97	8.548	1.511
	Experimental Class	32	62.97	11.209	1.982
Posttest	Control Class	32	72.09	8.956	1.583
	Experimental Class	32	80.72	10.795	1.908

Through the average (*mean*) in table 3 it can be seen that the average value *pre-test* in the control class it was 64.97 and the average value *post-test* amounting to 72.09. Meanwhile, the average value *pre-test* in the experimental class is 62.97 and the average value *post test* amounting to 80.72. So it can be seen that the increase in the average value was higher in the experimental class. Learning model *Problem Based Learning* with approach *Problem Posing* considered more effective in improving students' analytical skills compared to the control class which uses the learning model *Problem Based Learning*.

Normality test

The normality test is carried out to determine whether the data obtained is normally distributed or not. The normality test is also used as a prerequisite before carrying out the t-test. Apart from being a prerequisite, the normality test is also carried out to determine a more reliable data confidence interval if the data has been proven to be normally distributed. This normality test has levels significance $\alpha=0.05$ If Sig. > α then the data is said to be normally distributed, and if Sig. < α then the data is said to be not normally distributed. In testing data normality, examiners used IBM SPSS *Statistics* 24, until the following data is obtained

Table 4. Normality Test

	Learning model	Shapiro-Wilk		
		Statistic	df	Sig.
Pretest	Control Class	.946	32	.111
	Experimental Class	.949	32	.139
Posttest	Control Class	.956	32	.207
	Experimental Class	.951	32	.158

Based on table 4, the probability (Sig.) value can be seen *pre-test* control class on the column *shapiro-wilk* namely 0.111. So this value is greater than 0.05 ($0.111 > 0.05$). So it can be seen that the value data *pre-test* in the control class it was stated to be normally distributed. Meanwhile, the probability value (Sig.), value *pre-test* experimental class in column *ssapiro-wilk* namely 0.139. So this value is greater than 0.05 ($0.139 > 0.05$). So it can be seen that the value data *pre-test* in the experimental class it was stated to be normally distributed.

Probability value (Sig.) value *post-test* class control on the column *shapiro-wilk* namely 0.207. So this value is greater than 0.05 ($0.207 > 0.05$). So it can be seen that the value data *post-test* in the control class declared to be normally distributed. Meanwhile, the probability value (Sig.) value *post-test* class experiments on columns *shapiro-wilk* namely 0.158. So this value is greater than 0.05 ($0.158 > 0.05$). So it can be seen that the value data *post-test* in the experimental class it was stated to be normally distributed.

Homogeneity Test

The homogeneity test is carried out to determine whether the data group comes from a population that has the same variation. The homogeneity test is also used as a prerequisite before carrying out the t-test. Apart from that, by carrying out a homogeneity test, you can compare the averages between observed groups and ensure that the data is uniform. This homogeneity test has levels significance $\alpha=0.05$ If Sig. $> \alpha$ then the data is said to be homogeneous, and if Sig. $< \alpha$ then the data is said to be not homogeneous. In testing data homogeneity, examiners used IBM SPSS *Statistics* 24, until the following data is obtained:

Table 5. Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	3.211	1	62	.078
	Based on Median	2.082	1	62	.154
	Based on Median and with adjusted df	2.082	1	54.711	.155
	Based on trimmed mean	3.150	1	62	.081
Posttest	Based on Mean	.619	1	62	.434
	Based on Median	.511	1	62	.477
	Based on Median and with adjusted df	.511	1	57.532	.478
	Based on trimmed mean	.631	1	62	.430

Based on table 5 it can be seen that the level significance mark *pretest* on *based on mean* (based on average) namely 0.78. This value is greater than 0.05 ($0.078 > 0.05$). From this value it can be said that the value data *pre-test* declared homogeneous. While level significance mark *post-test* on *based on mean* (based on average) namely 0.434. This value is greater than 0.05 ($0.434 > 0.05$). From this value it can be said that value *post test* declared homogeneous. So it can be concluded that the value data *pre-test* and *post test* in control and experimental classes declared homogeneous.

Hypothesis testing

The independent samples t-test was used to prove the research hypothesis from two different groups, namely the control group and also the experimental group that received treatment. The independent samples t-test has a significance level of $\alpha=0.05$ if Sig. $> \alpha$ then H_0 is accepted, whereas if Sig. $< \alpha$ then H_0 is rejected. In carrying out the independent samples t-test, the examiner used IBM SPSS *Statistics* 24, until the following data is obtained:

Table 6 Independent Samples T-Test

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2-tailed)
Pretest	Equal variances assumed	3.211	.078	.803	62	.425
	Equal variances not assumed			.803	57.943	.425
Posttest	Equal variances assumed	.619	.434	-3.478	62	.001
	Equal variances not assumed			-3.478	59.957	.001

Based on table 6, it can be seen that the significance value (Sig (2-tailed)) in the initial analytical ability at *pre-test* namely 0.425. This value is greater than 0.05 ($0.425 > 0.05$), so it can be concluded that the analytical skills possessed by students before receiving treatment between the control group and the experimental group are not significantly different. Significance value (Sig. (2-tailed)) final analytical capability at *post test* namely 0.001. This value is smaller than 0.05 ($0.001 < 0.05$), so H_0 is rejected and it can be concluded that the analytical skills possessed by students before receiving treatment between the control group and the experimental group are significantly different. Based on some of the data presented above, it can be concluded that H_0 is rejected and H_a is accepted, so there is an influence on the application of the learning model *Problem Based Learning* with approach *Problem Posing* on students' analytical abilities in numeracy material.

3.2 Discussion

The results of data analysis carried out in the Independent Samples T-Test show the value *sig (2-tailed)* of 0.001. This value is smaller than 0.05 ($0.01 < 0.05$) so it can be concluded that the learning model *Problem Based Learning* with approach *Problem Posing* has an influence on students' analytical abilities in numeracy material. Judging from the average value *post test* in the control class was 72.09, and the average value *post test* in the experimental class it was 80.72. From this value it can be seen that there is an increase in the value at *post test*. This experimental class can show that the learning model *Problem Based Learning* with approach *Problem Posing* can help students to improve their analytical skills in solving numeracy problems.

The increase in analytical skills in solving the mathematical numeration questions given can be seen based on the way students answer the questions. Students will begin to differentiate by selecting important parts of the problem that are related to problem solving through approaches *Problem Posing*. After that, students will begin to analyze by identifying the important parts of the problem. Then obtain information which will later be used to form a strategy or way of solving problems and then conclude.

This increase in students' analytical skills can be seen from the way they define existing problems, then look for alternatives until they choose the right alternative, then provide conclusions from the results of the problem solving that has been carried out. This is in accordance with the analytical ability indicator, namely distinguishing (*Differentiating*), organizing (*Organizing*), and provide attributes/conclusions (*Attributing*) (Polya, 2004). All students, whether they have high or low mathematical abilities, will use analytical skills first when solving the problems presented.

Implementation of the learning process in the learning model *Problem Based Learning* with approach *Problem Posing* This is done to test students' analytical skills in mathematical numeracy material. Learning model *Problem Based Learning* with approach *Problem Posing* This requires each student to solve problems related to real contexts and students are asked to create their own questions from the problem topics that have been given. This means that students must have analytical skills to solve the mathematical numeracy problems that have been given.

Application of the model *Problem Based Learning* with *Problem Posing* approach starting with problem orientation to students, then students will be guided to create simpler questions based on the problems presented in groups. Students will follow the stages *Problem Posing* to analyze the solutions that have been found to solve the problem. Then they will choose the best solution to solve the problem and present the solution through a presentation during learning.

At the first meeting, it was done *pre-test* To determine students' initial level of understanding, then students are given an explanation regarding the material on Systems of Linear Equations in Two Variables (SPLDV) starting from giving story problems related to everyday problems, concluding questions from the story problems to carrying out mathematical calculations. In this learning process, students will be invited to discuss in groups to exchange insights in solving problems in story problems that have been provided in the Student Worksheet (LKPD). Use of learning models *Problem Based Learning* with approach *Problem Posing* This can facilitate students to learn to find the core of a problem that needs to be resolved. In implementing this model there will be an interaction between students with high and low abilities so that an exchange of information occurs. Through good cooperation, students will be able to define an existing problem by looking for appropriate alternative solutions, so that it can become a solution to solving the problem. This will improve students' analytical skills in solving problems.

At the second meeting, review the discussion of the System of Linear Equations in Two Variables (SPLDV) then organize students to form groups again and solve the problems provided in the Student Worksheet (LKPD). After students have finished working on the LKPD, each group is asked to present the results of their work. This aims to find out alternative problem solving that has been chosen by the group and to find out students' analytical abilities. Apart from that, presenting the results of this group work is also used as reinforcement for SPLDV material to students before it is given *post test*.

In a learning design, *Problem Based Learning* This prioritizes student-centered learning, so that students can solve real problems in a structured manner using their thinking skills. This thinking ability is directly involved in the problem solving stage in learning using models *Problem Based Learning*, so that students can gain new knowledge that can be related to real life.

The advantage of carrying out this research is the application of model learning *Problem Based Learning* using approach *Problem Posing* in mathematical numeration material, namely Systems of Linear Equations in Two Variables (SPLDV). This SPDV material takes problems from everyday life that require problem solving through models *Problem Based Learning*. Focuses on mathematics subjects that other researchers rarely take into account when using the model *Problem Based Learning* with approach *Problem Posing*. Mathematical numeration is now always related to everyday life and of course a problem-based learning model is needed and requires students to solve the problem with the right solution.

Based on the data that has been obtained, it can be seen that H_0 is rejected and H_a is accepted, so there is a significant influence in the application of the learning model *Problem Based Learning* with approach *Problem Posing* on students' analytical abilities. This is in line with previous research which aims to increase students' analytical thinking abilities and science process skills through the application of models *Problem Based Learning* and it is known that analytical abilities and science process skills have increased quite a lot (Ware & Rohaeti, 2018). Apart from that, there is also previous research which aims to increase student achievement and learning motivation through learning models *Problem Based learning* with approach *Problem Posing* and it is known that there are significant differences in student motivation and achievement (Amiluddin & Sugiman, 2016). So a hypothesis can be obtained, namely "there is an influence on the application of the learning model *Problem Based Learning* with approach *Problem Posing* on students' analytical abilities in numeracy material" has been proven with quite different results.

4. Conclusion

Based on the results of research conducted, it can be concluded that the learning model Problem Based Learning with approach Problem Posing has an influence on students' analytical skills in the Mathematics System of Linear Equations in Two Variables (SPLDV) material at SMPN 4 Malang. This can be seen based on the results obtained from the test independent samples t-test with significance value (Sig. (2-tailed)) final analytical capability at post test namely 0.001. This value is smaller than 0.05 ($0.001 < 0.05$) then H_0 is rejected and H_a is accepted, so it can be concluded that the learning model Problem Based Learning with approach Problem Posing has a significant influence on students' analytical abilities.

Teachers are expected to apply learning models Problem Based Learning with approach Problem Posing in learning, because this model is considered effective for developing students' analytical skills in solving story problems and can be applied in everyday life. Future researchers are expected to develop research on models Problem Based Learning with approach Problem Posing over a longer research period.

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