



# The Effectiveness of Problem-Based Learning with Model Eliciting Activities Approach towards Problem Solving Competency

Candra Kusuma Nurjanah<sup>1\*</sup>, Supandi<sup>2</sup>, Agnita Siska Pramasdyahsari<sup>3</sup>

<sup>1-3</sup> *Mathematics Education Study Program, Faculty of Mathematics and Natural Sciences, PGRI University Semarang*

\*Corresponding author's email: [candrakusumanurjanah@gmail.com](mailto:candrakusumanurjanah@gmail.com)

---

## ARTICLE INFO

**Received:** November 10<sup>th</sup>, 2022

**Revised:** December 7<sup>th</sup>, 2022

**Accepted:**

This is an open access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



---

## Keywords:

*Problem Based Learning, Mathematics Eliciting Activities Model, Problem Solving Ability*

---

## ABSTRACT

This study was conducted to examine if there was a difference between the average score and the effectiveness of problem-based learning against the mathematics model eliciting activities approach to problem-solving abilities. The type of study is quantitative research with a quasi-experimental design using a pretest-posttest only control group design. The population in this study was class VIII SMPN 5 Jepara in the academic year 2022/2023 which consist of two classes. The sampling technique was carried out by purposive sampling technique, class VIII A was the control class and class VIII B was the experimental class. The data obtained through the pretest and posttest values were then processed by normality test, homogeneity test, T-Test, and N-Gain. The results obtained from the T-Test is a problem based learning model with an approach model of bringing up mathematical activities with a number of respondents 32 students and a mean of 81.22. While the control class taught by conventional learning has 31 students as respondents and the mean is 71.65. The value of t-count = 6.011 and a significance level of 5% obtained t-table = 1.999. Based on the t value, it can be written  $t_{count} (6.011) < t_{table} (5\% = 1.999)$ , then the results of the data analysis can be said that  $H_0$  is rejected and  $H_1$  is accepted so that "there is a difference in the average problem-solving ability of students in class that uses the learning problem learning model raises students' mathematical activities. The next test is the N-Gain test. It is found that the experimental class mathematical problem solving is better than the control class, namely the increase in the experimental class has a medium category that is 0.47 and the increase in the control class has a low category that is 0.21 so that it can be said to be increasing and effective.

---

## Introduction

Mathematics is an inseparable part of everyday life. One of the goals of mathematics at the education level is to prepare students to face problems, especially those that involve mathematics and have mathematical problem solving abilities. However, junior and senior high school Indonesian students have low problem-solving abilities. Problem-solving is a planned process or as an attempt to find a way out of a problem (Cahyani & Setyawati, 2016). Therefore, many students often experience errors in solving given mathematical problems.

---

Mathematics problem-solving schools can be viewed as a goal, process, or basic skill, with a different interpretation for teaching and learning problem-solving (Arumanita et al., 2018). Thus, problem-solving can be used in the learning and teaching process in mathematics in accordance with the curriculum. Mathematical problem-solving skills must be bolstered through the use of appropriate learning methods and methodologies. One of the classes aimed to improve problem-solving skills is problem-based learning, which helps students build their intellectual, thinking, and problem-solving skills (Sumartini, 2016). As stated by the previous study, it revealed that the implementation of problem-based learning also improves the students' learning outcomes in mathematics (Inayah, Buchori, and Pramadyahsari, 2021).

According to Polya (1973), there are several steps taken to solve the problem, namely understanding the problem, planning problem-solving, implementing problem-solving plans and seeing the completeness of problem-solving. Therefore, a mathematical model-eliciting activity is applied as an approach to the problem-based learning model. The Eliciting Activities Model Mathematics can be said to be one of the learning activities that allow students to be actively involved in the mathematics learning process in the classroom which provides opportunities for students to take control of their own learning with minimal direction from the teacher (Amalia et al., 2015).

Based on previous research that the Eliciting Activities and Problem Based Learning models are expected to improve students' problem solving abilities. Learning with the Problem Based Learning model in this case is applied to the control class. With the condition that the average problem solving ability of students in both classes has reached the minimum completeness limit that has been set both individually and classically (Dzulfikar et al., 2012). For that reason, the researchers are interested in examining the effectiveness of the problem based learning model using the Eliciting Activities Mathematics model approach. The purpose of this research was to evaluate the impact of the problem-based learning model using the mathematics eliciting activities model in the Number Pattern material in class VIII SMP Negeri 5 Jepara in terms of: increasing mathematical problem-solving skills using a problem-based learning model with an eliciting activities model approach. mathematics in the experimental class.

## **Research Methods**

This type of research is quantitative research with a Quasi Experimental experimental (Sugiyono, 2011) design using a pretest-posttest only control group design. The population in this study was class VIII of SMPN 5 Jepara in the academic year 2022/2023, which consisted of 2 randomly selected classes. The sampling technique was carried out by purposive sampling technique, class VIII A as the control class and class VIII B as the experimental class. In this study, the independent variable is the Problem Based Learning (PBL) learning model with the effectiveness of the Mathematics Eliciting Activities (MEA) model on mathematical problem solving abilities and conventional learning, while the dependent variable is problem solving abilities. Data collection techniques with tests, questionnaires and documentation. The validity, reliability, level of difficulty, and discriminatory test instruments were processed with the help of the Rasch model

---

(Sumintono & Widhiarso, 2015) with Winsteps software. There are two prerequisite tests, namely normality test and homogeneity test, Hypothesis Test using T-Test and N-Gain Improvement Test.

## Findings

The data obtained from the pretest values were then processed by normality, homogeneity, T-Test, and N-Gain Improvement Test. Before carrying out the test, an analysis of the instrument trial was carried out in class IX D which had 32 students. The following are the results of the analysis of the test questions using Winsteps:

validitas dan daya pembeda - Notepad

File Edit Format View Help

TABLE 13.1 Book1.xlsx ZOU090WS.TXT Oct 31 9:30 2022

INPUT: 32 PERSON 4 ITEM REPORTED: 32 PERSON 4 ITEM 26 CATS WINSTEPS 3.73

-----

PERSON: REAL SEP.: 1.46 REL.: .68 ... ITEM: REAL SEP.: 6.61 REL.: .98

-----

ITEM STATISTICS: MEASURE ORDER

| ENTRY NUMBER | TOTAL SCORE | TOTAL COUNT | MEASURE | MODEL S.E. | INFIT MNSQ | ZSTD | OUTFIT MNSQ | ZSTD | PT-MEASURE CORR. | EXP. | EXACT MATCH OBS% | EXP% | ITEM |
|--------------|-------------|-------------|---------|------------|------------|------|-------------|------|------------------|------|------------------|------|------|
| 1            | 457         | 32          | .56     | .08        | .55        | -1.5 | .69         | -.9  | .82              | .77  | 25.0             | 26.1 | 1    |
| 3            | 466         | 32          | .50     | .08        | 1.04       | .2   | 1.02        | .2   | .68              | .76  | 34.4             | 20.9 | 3    |
| 4            | 689         | 32          | -.50    | .07        | .70        | -1.2 | .78         | -.7  | .90              | .78  | 28.1             | 19.2 | 4    |
| 2            | 702         | 32          | -.56    | .07        | 1.54       | 1.9  | 2.04        | 2.9  | .77              | .79  | 28.1             | 18.6 | 2    |
| MEAN         | 578.5       | 32.0        | .00     | .07        | .96        | -.2  | 1.13        | .4   |                  |      | 28.9             | 21.2 |      |
| S.D.         | 117.1       | .0          | .53     | .01        | .38        | 1.3  | .54         | 1.5  |                  |      | 3.4              | 2.9  |      |

**Figure 1** Calculation of Validity Test, Distinguishing Power, and Difficulty Level of Instrument Items using Winsteps

### a. Validity

The purpose of calculating the validity is to find out whether the questions being tested are valid or not. The validity value provisions are taken from the INFIT MNSQ, OUTFIT ZSTD, and PT MEASURE CORR columns. The MNSQ value is declared valid if it is in the range of 0.5-1.5 and the correlation value is in the range of 0.4-0.85. According to (Widhiarso, 2015) if there are only two criteria or one criterion that is met then the items can still be maintained and do not need to be changed so that they can be categorized as "appropriate" and can be used. So items/questions 1, 2, 3, and 4 are declared valid.

### b. Reliability

Reliability is a reliable instrument used as a data collection tool. Cronbach's Alpha value (KR-20) is the reliability coefficient obtained based on the classical test theory approach. This value is the interaction between the person and the item as a whole.

Reliabilitas - Notepad  
File Edit Format View Help

TABLE 3.1 Book1.xlsx ZOU090WS.TXT Oct 31 9:30 2022  
INPUT: 32 PERSON 4 ITEM REPORTED: 32 PERSON 4 ITEM 26 CATS WINSTEPS 3.73

---

SUMMARY OF 32 MEASURED PERSON

|                           | TOTAL<br>SCORE | COUNT   | MEASURE | MODEL<br>ERROR | INFIT |                    | OUTFIT |      |
|---------------------------|----------------|---------|---------|----------------|-------|--------------------|--------|------|
|                           |                |         |         |                | MNSQ  | ZSTD               | MNSQ   | ZSTD |
| MEAN                      | 72.3           | 4.0     | .11     | .21            | 1.14  | -.6                | 1.13   | -.5  |
| S.D.                      | 12.2           | .0      | .51     | .02            | 2.23  | 1.7                | 2.20   | 1.6  |
| MAX.                      | 90.0           | 4.0     | .85     | .25            | 8.75  | 3.9                | 8.94   | 4.0  |
| MIN.                      | 38.0           | 4.0     | -1.34   | .18            | .01   | -3.6               | .01    | -3.6 |
| REAL RMSE                 | .29            | TRUE SD | .42     | SEPARATION     | 1.46  | PERSON RELIABILITY | .68    |      |
| MODEL RMSE                | .21            | TRUE SD | .47     | SEPARATION     | 2.20  | PERSON RELIABILITY | .83    |      |
| S.E. OF PERSON MEAN = .09 |                |         |         |                |       |                    |        |      |

PERSON RAW SCORE-TO-MEASURE CORRELATION = 1.00  
CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .78

**Figure 2** Calculation of Instrument Item Reliability Test using Winsteps

Based on the table above, it can be concluded that the question has a reliability value of 0.78, which means that the reliability value of the test item is good or reliable.

#### c. Difficulty Level

The level of difficulty of a question is to test whether the questions being tested are how easy or difficult. Items of difficulty/measurement can be categorized as easy items (-4.00 to -2.00), medium items (-1.99 to 1.99), and difficult items (2.00 to 4.00) (Widhiarso, 2015). Based on the table above, it can be concluded that the value of the Measure item/question has a moderate level of difficulty.

#### d. Distinguishing Power

Distinguishing power is the ability of questions to distinguish between students who master the material and students who do not master the material. The discriminatory power index can be declared feasible if it is more than 0.20.

Based on the table above, determine the distinguishing power using the PT-Measure Corr if the value is more than 0.20 it is said to be feasible or good. In item/question 1 has a measure corr value of 0.82, item/question 2 has a measure corr value of 0.68, item/question 3 has a measure corr value of 0.90, and item/question 4 has a measure corr value of 0.77 so it can be concluded that the value of PT-Measure Corr is decent or good.

Initial data analysis was conducted to determine whether the experimental class and control class came from the same conditions or starting point.

#### a. Initial data normality test

For the initial normality test for the two classes with  $\alpha = 5\% = 0.05$  with the acceptance test criteria  $H_0$  if the value is  $\text{sig.} > 0.05$  so it can be concluded that the sample is normally distributed. Then the results obtained  $\text{Asymp. sig.} = 0.945 > 0.05$  in the experimental class then

$H_0$  is accepted and Asymp sig.  $0.270 > 0.05$  in the control class then  $H_0$  is accepted. Then both classes come from samples that are normally distributed.

b. Initial data homogeneity test

For the initial homogeneity test, the sig value is known. The average variable of early math problem solving ability in class A and class B students is 0.980. because tilapia sig.  $0.980 > 0.05$ , it can be concluded that the two classes have the same variance (homogeneous).

c. Final Data Normality Test

It is reasonable to infer that the sample follows a normal distribution if the value of the final normality test for the two classes meets the acceptance test condition  $H_0$  and the value of sig.  $> 0.05$ . Consequently, if the obtained Asymp sig.  $0.168 > 0.05$  in the experimental class, and if the obtained Asymp sig.  $0.105 > 0.05$  in the control class, then  $H_0$  is accepted. This means that both groups have a normal distribution.

d. Final data homogeneity test

For the final homogeneity test, the sig value is known. the average variable of mathematical problem solving ability completeness in class A and class B students is 0.891. because tilapia sig.  $0.891 > 0.05$ , it can be concluded that the two classes have the same variance (homogeneous).

e. Test T-Test

To find out the difference in the average value of problem solving abilities.

**Table 1** Test T-Test Average Completeness

| <b>Class</b> | <b>N</b> | <b>Mean</b> |
|--------------|----------|-------------|
| Experiment   | 32       | 81,22       |
| Control      | 31       | 71,65       |

From the output of the T-test in table 1 above, it is known that in class 2 as an experimental class taught with a problem based learning model with a mathematical eliciting activities model approach, the number of respondents was 32 students and the mean (average) was 81.22. While in class 1 as the control class which is taught with conventional learning has 31 students as respondents and the mean (average) is 71.65.

## f. N-Gain Enhancement Test

**Table 2** Improved Problem-Solving Ability

| No. | Class      | Category  | N-Gain |
|-----|------------|-----------|--------|
| 1.  | Experiment | Currently | 0,47   |
| 2.  | Control    | Low       | 0,21   |

Table 2 shows that the N-gain results for the experimental class are superior to those for the control class, with the experimental class achieving 0.47 and the control class achieving only 0.21. If the N-Gain test score rises with an interpretation of 0.3 g 0.07, which includes the medium category but not the control group, we can conclude that the problem-based learning learning model with eliciting activities mathematics model approach is successful in improving problem-solving skills. In the experimental group, where g is between 0.3 and 0.7, it is considered to be increasing, but in the control group, where g is between 0.3 and 0.7, it is not considered to be increasing.

**Discussion**

This research was conducted to determine the effectiveness of the problem-based learning model with the eliciting activities mathematical model approach to problem solving abilities. At the initial stage, the researcher took two classes that were selected purposively so that class VIII B was chosen with a problem-based learning model with a mathematical eliciting activities model approach, with a total of 32 students, class VIII A with conventional learning with a total of 31 students. The test class is class IX D with 32 students.

Based on the analysis of the data that has been described in the research results, it can be seen that before carrying out the research, the researchers conducted a preliminary analysis first, by conducting an initial evaluation test (pretest) in the experimental class and conventional class and then conducting an initial normality test using the Kolmogorov-Smirnov test, the initial homogeneity test. with the F test. The results of the normality test of the two groups obtained the value of Sig. > 0.05 which indicates that the sample comes from a normally distributed population. The result of homogeneity is obtained by  $F_{hitung} \leq F_{table}$  which means that each class has the same variance (homogeneous). From the results of the analysis, the two classes have met the requirements of normality and homogeneity so that the class can be used as a sample.

The Mathematics Eliciting Activities Model is a teaching strategy designed to improve students' capacity to solve mathematical problems. With the proviso that both classes as a whole have an average problem-solving capacity above the threshold of completeness that has been established both individually and classically (Dzulfikar et al., 2012). To answer the hypothesis in this study, the data analysis that has been described in the hypothesis research results section.



There is a difference in the average value of students' problem solving abilities. In the first hypothesis using the T-Test test to determine the average value of problem solving abilities. Furthermore, each class was given different treatment for class VIII B using a problem based learning model with a model approach of eliciting mathematical activities and class VIII A using conventional learning. After the two classes were given different treatment, then an evaluation test (posttest) and student response questionnaires for the experimental or treatment classes were carried out using a problem based learning learning model with a mathematical eliciting activities model approach as the final data. The test questions given have met the trial stage in class IXD using Winsteps calculations so that the questions meet the requirements as posttest evaluation questions, which are valid, reliable, discriminatory and have the appropriate level of difficulty (Widhiarso, 2015).

The final data in the form of evaluation scores (posttest) of problem solving abilities on the number pattern material were then analyzed using the normality test, homogeneity test, T-Test test and student response questionnaires. The results of the normality test using the Kolmogorov-Smirnov test from both classes obtained the Sig value.  $> 0.05$  which indicates that the sample comes from a normally distributed population. The results of the homogeneity test were obtained which means that the experimental class and the control class have the same variance (homogeneous). Based on the results of the analysis that has been carried out on the evaluation data of problem-solving abilities for class VIII A and VIII B, it is known that the distribution is normal and the same (homogeneous), so that both classes meet the requirements for further calculations.

The results of the T-Test in the experimental class have a number of respondents 32 students and the mean (average) 81.22. Meanwhile, the control class taught by conventional learning has 31 students as respondents and the mean (average) is 71.65. It can be concluded that the problem based learning learning model with eliciting activities model approach to problem solving ability has a higher average value of completeness than the average value of the control class or the so-called conventional class. This research is in line with what was done by (Dzulfikar et al., 2012). Then a student response questionnaire was given in the experimental class which had a percentage result of 63.40% with a good category of student response percentage results (Sugiyono, 2011).

Effective learning model Problem Based Learning by using the approach of the Eliciting Activities Mathematical Model on problem solving abilities. The second hypothesis uses the Enhancement test with the Gain formula to determine whether it is effective or not, judging from the interpretation that the experimental class is better than the control class. Implementation of the evaluation test (Posttest) in the experimental class 32 students and the control class 31 students. The final data in the form of evaluation values (posttest) to increase the effectiveness of increasing the number pattern material then analyzed using the normality test, homogeneity test, and enhancement test (N-Gain).

The improvement test (N-Gain) was found that the mathematical problem solving ability of the experimental class was better than the control class, namely the increase in the experimental class had a medium category of 0.47 and an increase in the control class had a low category of 0.21. It can be said to be effective if the N-Gain increase test increases because it is at the interpretation of  $0,3 \leq g < 0,7$  including the medium category, while in the

---

control class it cannot be said to increase because  $0,3 \leq g < 0,7$  is in the medium category, while in the control class cannot be said to increase because  $g < 0,3$  and included in the low category (Meltzer, 2002). It can be concluded that the N-gain data on the problem-based learning model with the eliciting activities model approach to problem solving abilities increases and is said to be effective (Chamberlin & Sidney, 2008).

## Conclusion

After conducting research at SMPN 5 Jepara in August 2022 in class VIII A there were 31 students and VIII B there were 32 students regarding the "Problem Based Learning Model with Eliciting Activities Model approach to Problem Solving Ability" the following conclusions were obtained:

There is a difference in the average value of students' problem-solving abilities in classes that use the Problem Based Learning learning model with the Eliciting Activities Model approach and in classes with conventional learning models for Number Patterns for class VIII odd semester at SMPN 5 Jepara for the 2022/2023 academic year. There is an increase in the effectiveness of the Problem Based Learning learning model with the Eliciting Activities Model approach and in the classroom with the conventional learning model material on Number Patterns for class VIII in the odd semester of SMPN 5 Jepara for the 2022/2023 academic year.

## References

- Amalia, Yuli., M Duskri, and Anizar Ahmad. (2015). Application of Eliciting Activities Models to Improve Mathematical Creative Thinking Ability and Self Confidence of High School Students. *Journal of Mathematics Didactics*. Vol 2(2), 38–48.
- Arumanita, DM., Hery Susanto, and Rustanto Rahardi. (2018). Problem-Solving Skills of State 1 Junior High School Students Discusses Building Materials. *Journal of Math Educator Nusantara: A Vehicle for Publication of Scientific Writing in Mathematics Education*. Vol 4 (2), 104.
- Cahyani, H and Setyawati, RH. (2016). The Importance of Improving Problem Solving Ability Through PBL to Prepare a Superior Generation to Face MEA. *Prisma, Proceedings of the National Mathematics Seminar*. 151–60.
- Chamberlin, S.A & Sidney M. Moon. (2008). How Does the Problem Based Learning Approach Compare to The Model-Eliciting Activity In Mathematics. Tersedia di <http://cimt.plymouth.ac.uk>
- Dzulfikar, Ahmad., Muhammad Asikin, and Putriaji Hendikawati. (2012). The Effectiveness of Problem Based Learning and Eliciting Activities Models on Problem Solving Ability. *Unnes Journal of Mathematics Education*. Vol. 1(1):1-6.
- Inayah, Buchori, and Pramasdyahsari. (2021). The effectiveness of Problem Based Learning and Project Based Learning assisted Kahoot Learning Model on Students Learning Outcomes. *International Journal of research in Education*. Vol 1(2). 129-137.
- Meltzer, David E. (2002). The Relationship Between Mathematics Preparation and Conceptual Learning Gain in Physics: A Possible "Hidden Variable" in Diagnostic Pretest Scores. *AM. J. PHYS.*, Vol. 70, No. 12, December 2002.
-



- Polya, G. (1973). *How To Solve It*. Princeton: Princeton University Press.  
[https://notendur.hi.is/hei2/teaching/Polya HowToSolveIt.pdf](https://notendur.hi.is/hei2/teaching/Polya%20HowToSolveIt.pdf).
- Sugiyono. (2011). *Qualitative Quantitative Research Methods And R&D*. Alfabeta
- Sumartini, T.S. (2016). Improving Students' Mathematical Problem-Solving Ability Through Problem-Based Learning. *Journal of Mathematics Education STKIP Garut*. Vol. 8, No. 3.
- Sumintono, Bambang & Widhiarso, W. (2015). Rasch Modeling Applications for Educational Assessment
-