Comparing the Impact of Problem Solving vs Problem Posing Approaches on Mathematics Achievement in Junior High School

Wirnayanti[1], Jeffrey Craig[2], Jeffrey Fourrie Malatjie[3]
[1]Muhammadiyah University of Makassar, Makassar, Indonesia
[2]University of Arizona, United States
[3]University of South Africa, South Africa

Article Info	ABSTRACT
	Purpose of the study: The purpose of this research is to describe students' mathematics learning outcomes using a problem solving approach, describe students' mathematics learning outcomes using a problem posing approach, and to find out differences in mathematics learning outcomes between those using the problem solving and problem posing approaches. **Methodology:** This research is a type of quasi-experimental research with the Nonequivalent Posttest-Only Control Group Design. The population in this research is all students of class VIII junior high school Muhammadiyah 1 Makassar in the 2018/2019 academic year and the sample from this research consists of 2 classes, where the two classes will receive different treatment, namely the first class uses the Problem Solving approach and the second class uses the Problem Posing approach, with a total of 25 students for the Problem Solving approach and also 25 students for the Problem Posing approach. **Main Findings:** The results of this research are that there are differences in the average results of learning mathematics through the Problem Solving approach and the Problem Posing approach. Where in the Problem Solving approach the average learning outcome value is 82.96 with a standard deviation of 4.78, and the average learning outcome in the Problem Posing approach is 87.88 with a standard deviation of 7.36. **Novelty/Originality of this study:** This study provides new insights into how problem solving and problem posing approaches affect the mathematics learning outcomes of grade VIII students. *This is an open access article under the CC BY license*

Corresponding Author:
Wirnayanti,
Muhammadiyah University of Makassar
Jl. Sultan Alauddin No.259, Gn. Sari, Kec. Rappocini, Kota Makassar, Sulawesi Selatan 90221, Indonesia
Email: wrnynttiwirna@gmail.com

1. INTRODUCTION

Education is one of the most important things in life, this means that every human being has the right to receive and hopes to always develop in education. Education in general means a life process in developing each individual to be able to live and survive [1],[2]. Therefore, education is very important because without education humans will find it difficult to develop and will even be left behind, thus education must really be directed at producing people who are qualified and able to compete [3],[4]. The learning process is composed of a number of interrelated components. The interaction of teachers and students in the teaching and learning process plays an important role in achieving the desired goals.

The possibility of teacher failure in delivering learning material is caused when the teacher's teaching and learning process does not arouse student attention and activity or the teacher has difficulty making students understand the material presented so that learning outcomes are low. In reality, Indonesia is still experiencing various problems, this is in the field of education, especially mathematics [5]. In the mathematics learning process, students often find it difficult to understand the lessons taught by the teacher, lack enthusiasm for participating in learning, and even consider mathematics as a scary subject [6],[7]. Mathematics is a scientific discipline that aims to train humans to think logically, critically, responsibly and be able to solve problems using axioms and logic [8] ,[9] explains that this is due to the characteristics of mathematics, namely having an abstract object of study, relying on agreement, having a deductive mindset, having symbols that are empty of meaning, showing a universe of discussion, and being consistent in its system.

Learning mathematics has an important role as one of the activities to obtain knowledge that supports the progress and welfare of an individual in particular and a nation in general. Considering the importance of mathematics subjects, mathematics learning must be designed to attract students' interest and foster the urge to learn [10],[11]. So, they are engaged in the mathematics learning process and have a positive attitude towards mathematics and the results of mathematics learning are no longer a concern. This requires educational practitioners, especially teachers, to create a fun and communicative mathematics learning process by innovating interesting learning models and involving all students to actively participate in the ongoing learning process so that students learn without being forced [12].

Based on the results of observations made on class VIII students of junior high school Muhammadiyah 1 Makassar, in learning mathematics, students still experience various kinds of difficulties. Among them are difficulty solving problems, difficulty determining the formula to be used, difficulty using different methods or strategies that will be used to solve problems and difficulty carrying out calculations. These obstacles are focused on students' ability to understand problems, reformulate problems, and plan a solution. Understanding a problem is demonstrated by knowing what is known and what is asked.

Formulating a problem means that students can recreate a problem that is similar to the existing problem, making it easier to solve it. Meanwhile, planning a solution is demonstrated by organizing existing information or data using certain strategies to find possible solutions. Difficulty in understanding this can affect student learning outcomes.

Overcoming this problem requires a more varied learning approach. One alternative that teachers can use to create more active learning is to apply the Problem Solving and Problem Posing approaches to solve problems or issues [13],[14]. This approach is very suitable to be applied, because in the Problem Solving approach students are encouraged [15]. Meanwhile in the Problem Posing approach, it prioritizes students' activeness, creative and critical thinking abilities through a problem solving activity by reformulating a problem.

Analisis kesenjangan antara penelitian yang dilakukan oleh Akben [16] with the research currently being conducted, namely previous studies have focused on the effects of the problem posing approach on students' problem-solving skills and metacognitive awareness in science education. However, the current study broadens its context to mathematics by directly comparing two approaches, namely problem solving and problem posing, on the mathematics learning outcomes of eighth-grade students. The existing gap shows that, although the problem posing approach has been shown to improve problem-solving skills in science, there has been no study comparing its effectiveness with the problem solving approach in the context of mathematics learning. This study is expected to answer this need by providing a more comprehensive understanding of the impact of the two approaches in improving mathematics learning outcomes.

This study has the novelty of directly comparing two learning approaches, namely problem solving and problem posing, each of which has different potential in developing students' critical and creative thinking skills. This uniqueness is important because there have not been many studies that have reviewed the two approaches comparatively in the context of mathematics at the middle school level. The urgency of this study lies in the need to find the most effective learning method to improve students' mathematics learning outcomes, especially amidst learning challenges that demand deep understanding and problem-solving skills. The findings of this study can be a reference for teachers and policy makers in designing more effective learning strategies that are in accordance with the needs of grade VIII students.

Based on the explanation above the purpose of this research is to describe students' mathematics learning outcomes using a problem solving approach, describe students' mathematics learning outcomes using a problem posing approach, and to find out differences in mathematics learning outcomes between those using the problem solving and problem posing approaches

2. RESEARCH METHOD
2.1. Research Design

This research is a quasi-experimental research involving two groups, namely experimental group I and experimental group II. Experimental group I was taught using the Problem Solving approach while experimental

group II was taught using the Problem Posing approach. The research design is The Nonequivalent posttest-Only Control Group Design [16],[17] . Which is a type of pseudo-experiment (quasi-experimental design). The research design model used is presented in the following table.

Table 1. Research design model

Group	Variables	Posttest
E_1	X_1	O_1
E_2	X_2	O_2

Source: [12]

Information:
E_1 = Experimental class I (problem solving approach)
E_2 = Experimental class II (problem posing approach)
X_1 = Experiment I (problem solving approach)
X_2 = Experiment II (problem posing approach)
O_1 = Test results after using the problem solving approach
O_2 = test results after using problem posing

2.2. Population and Sample

Population is a generalization area consisting of objects/subjects that have certain characteristics determined by researchers to be studied and then draw conclusions. So population is not only people, but also objects and other natural objects. Population is also not just the number of objects/subjects being studied, but includes all the characteristics/attributes possessed by that subject or object [18] . The population in this research is all students of class VIII Junior High School Muhammadiyah 1 Makassar, presented in the following table.

Table 2 . Population of class VIII students at Junior High School Muhammadiyah 1 Makassar

Class	Posttest
VIII A	25
VIII B	33
VIII C	32
VIII D	26

The sample from this research consists of 2 classes, where the two classes will receive different treatment, namely the first class uses the Problem Solving approach and the second class uses the Problem Posing approach. These two classes will be selected through two stages, because in class VIII Junior High School Muhammadiyah 1 Makassar there are 2 criteria, namely superior class (class VIII A), while classes VIII B, VIII C, and VIII D have almost the same abilities. So in the first stage it will be selected using a purposive sampling technique to select classes that have almost the same abilities. Then in the second stage, it will continue using the cluster random sampling technique.

2.3. Data Collection Technique

The instruments in this research are tools used to measure student learning outcomes. The learning outcomes referred to in this research are aspects of cognitive assessment, namely understanding and application. With this, the instrument used is a sheet. Tests are a way of measuring knowledge, skills, feelings, intelligence or attitudes, individuals or groups [19], [20] .

In this case, the test sheet given is in the form of a description that is used to determine student learning outcomes after being given treatment. Before carrying out the test, the two experimental classes were given treatment, namely the experimental class I was taught by applying the Problem Solving approach, and the experimental class II was taught by applying the Problem Posing approach. The final test was carried out by giving test sheets containing 5 numbered problem descriptions to both classes, both those taught using the Problem Solving approach and those taught using the Problem Posing approach. After the final test is carried out, scoring is carried out as a result of the students' mathematics learning. By obtaining these students' mathematics learning results, the data is processed to test the truth of the hypothesis.

2.4. Data Analysis Technique

Data analysis techniques are used to analyze data obtained using descriptive statistical analysis and inferential statistical analysis. Descriptive statistics are used to describe students' mathematics learning achievement scores which will then be categorized based on the standards applied in the Department of Education and Culture and junior high school Muhammadiyah 1 Makassar.

Table 3 . Standard category of the Department of Education and Culture

Mark	Category
$0 \leq X < 55$	Very low
$55 \leq X < 70$	Low
$71 \leq X < 80$	Currently
$80 \leq X < 90$	Tall
$90 \leq X < 100$	Very high

Table 4 . Standard category for Junior High School Muhammadiyah 1 Makassar

Mark	Category
$70 \leq X < 100$	Not finished
$90 \leq X < 100$	Complete

Next, inferential statistics are used to analyze sample data and the results are applied to the population. The independent sample t test is used with the criteria for testing the hypothesis that H_0 is rejected or H_1 is accepted if $p < \alpha$, meaning there is a difference between the two treatments given. On the other hand, H_0 is accepted or H_1 is rejected if $p > \alpha$, meaning there is no difference between the treatments given.

2.5. Research Procedure

The research procedure in this study follows a quasi-experimental design with two experimental groups, each receiving different instructional approaches. Experimental group I, taught using the Problem Solving approach, and experimental group II, taught using the Problem Posing approach, were assessed using the Nonequivalent Posttest-Only Control Group Design to measure outcomes post-treatment. The study population included all students in grade VIII at Junior High School Muhammadiyah 1 Makassar, from which two classes were selected through purposive and cluster random sampling. Data collection involved a cognitive test focusing on understanding and application, administered post-intervention, with results analyzed using descriptive and inferential statistics. Descriptive analysis categorized scores based on institutional standards, while inferential analysis, using an independent t-test, assessed statistical differences between the two groups.

3.   RESULTS AND DISCUSSION
3.1. Results of Descriptive Statistical Analysis

The following is a table that presents the results of descriptive statistical analysis of learning outcomes for problem solving classes and problem posing classes which were calculated using the SPSS program.

Table 5 . Descriptive Statistics of Learning Results for Class VIII Students who were taught through the Problem Solving Approach

Statistics	Statistical Value
Maximum value	91.00
Minimum value	76.00
Mean	82.96
Median	83.00
Standard deviation	4.78
Variance	22.87
Range	15.00

Based on the table above, it can be seen that the average learning outcome of class VIII C students at junior high school Muhammadiyah 1 Makassar after carrying out the learning process by applying the Problem Solving approach is 82.96, with the scores achieved by students spread from the lowest score of 76 to the highest score of highest 91. If students' mathematics learning outcomes are grouped into 5 categories, the frequency and percentage distributions are obtained as in the following table:

Table 6 . Descriptive Statistics of Learning Results for Class VIII Students who were taught through the Problem Solving Approach

No	Score	Category	Frequency	Percentage (%)
1	$0 \leq x < 55$	Very low	0	0
2	$55 \leq x < 70$	Low	0	0
3	$70 \leq x < 80$	Currently	7	28
4	$80 \leq x < 90$	Tall	15	60
5	$90 \leq x \leq 100$	Very high	3	12
Amount			25	100

In table 6 above, it is shown that of the 25 students in the Problem Solving class there were no students who were in the very low category, 7 students (28%) got scores in the medium category, 15 students (60%) got scores in the high category, and 3 students (12%) got scores in the very high category. The mathematics of students in the Problem Solving class is generally in the high category.

Table 7 . Descriptive Statistics of Learning Results for Class VIII Students who were taught through the Problem Posing Approach

Statistics	Statistical Value
Maximum value	100
Minimum value	74.00
Mean	87.88
Median	89.00
Standard deviation	7.36
Variance	54.19
Range	26.00

Based on the table above, it can be seen that the average learning outcome for class VIII D students of junior high school Muhammadiyah 1 Makassar after carrying out the learning process by applying the Problem Posing approach is 87.88, with the scores achieved by students spread from the lowest score of 74 to the highest score. 100. If students' mathematics learning outcomes are grouped into 5 categories, the frequency and percentage distributions are obtained as in the following table.

Table 8 . Descriptive Statistics of Learning Results for Class VIII Students who were taught through the Problem Posing Approach

No	Score	Category	Frequency	Percentage (%)
1	$0 \leq x < 55$	Very low	0	0
2	$55 \leq x < 70$	Low	0	0
3	$70 \leq x < 80$	Currently	4	16
4	$80 \leq x < 90$	Tall	11	44
5	$90 \leq x \leq 100$	Very high	10	40
Amount			25	100

In table 8 above, it is shown that of the 25 students in the Problem Posing class there were no students in the very low category, 4 students (16%) got scores in the medium category, 11 students (44%) got scores in the high category, and 10 students (40%) got scores in the very high category. After the average score of students' learning outcomes of 87.88 is converted into the 5 categories above, it can be concluded that the mathematics learning outcomes scores of students in the Problem Posing class are generally in the high category. From the description of the data above, it can be seen that the average score of the learning outcomes for the Problem Solving class is different from the average score for the Problem Posing class. To see whether the differences between the two classes are significant or not, further statistical tests will be carried out.

3.2. Results of Inferential Statistical Analysis
In accordance with the research hypothesis, the technique used to test the hypothesis is the statistical technique (t-test). However, before discussing statistics, the analysis requirements are first carried out, namely the normality test and homogeneity test.

3.2.1. Normality Test

Table 9. Test of Normality
Tests of Normality

Problem solving	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
TestLearning Results	,172	25	,055	,914	25	,037

Table 10. Test of Normality
Tests of Normality

Problem posing	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
TestLearning Results	,160	25	,096	,949	25	,233

After carrying out a descriptive statistical test of the learning result test score data for experimental class I and experimental class II, the next step is a normality test between the learning result test scores of the two experimental classes. Normality testing aims to find out whether the average student learning outcomes come from a normally distributed population.

From inferential data analysis, a value of p = 0.055 was obtained for experimental class I and a value of p = 0.096 for experimental class II, which was greater than the value of α = 0.05, which means that both groups of data were normally distributed.

3.2.2. Homogeneity Test

Table 11. Test of Homogeneity
Test of Homogeneity of Variances
Learning Results Test

Levene Statistics	df1	df2	Sig.
2,819	1	48	,100

After testing the normality of the test data on the learning outcomes of experimental class I and experimental class II, it can be seen that the results of the distribution of the data are normally distributed so that for further testing the Levene's Test is used. Based on the results of homogeneity testing using the Levene's Test, a value of p = 0.1 was obtained which was greater than α = 0.05, which means the data in this study had homogeneous variance.

3.2.3. Hypothesis Testing

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Tes Hasil Belajar	Equal variances assumed	2.819	.100	2.802	48	.007	4.92000	1.75575	1.38982	9.45018
	Equal variances not assumed			2.802	41.196	.008	4.92000	1.75575	1.37470	8.46530

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Figure 1. T-test results of learning outcomes

Based on the results of the research that has been described, descriptively, class VIII students of junior high school Muhammadiyah 1 Makassar who studied through the Problem Solving approach obtained an average score of 82.96, and the Problem Posing Approach obtained an average score of 87.88, which is higher than the test average. Learning outcomes of the Problem Solving approach class. The scores obtained in both classes show that the learning outcomes test scores in class C (Problem Solving approach) have a higher score compared to class D

(Problem Posing approach). So, in this study there are differences Mathematics learning outcomes among students who learn through the Problem Solving approach with the Problem Posing approach in learning number patterns.

Learning using a problem solving approach, students are trained in solving problems given by the teacher [21],[22]. So that it can improve students' ability to analyze problems. Meanwhile, in the Problem Posing approach, students solve problems [24]. Apart from that, students were challenged to create new questions and one of the group representatives explained their findings in front of the class. So this can improve students' creative thinking abilities.

This is reinforced by the results of inferential statistical analysis which show that there is a significant difference in mathematics learning outcomes between students whose learning uses a problem solving approach, and a problem posing approach. This is shown by the p value = 0.008, where the p value < 0.05 means H_0 is rejected and H_1 is accepted. Based on research conducted by [24] in his research entitled "Comparison of the Effectiveness of Problem Solving and Problem Posing Approaches in mathematics learning among students Junior High School" states that; (1) The problem solving approach is effective in terms of mathematical understanding and reasoning abilities; (2) The Problem Posing approach is effective in terms of mathematical understanding and reasoning abilities; (3) The Problem Solving approach is more effective than Problem Posing in terms of mathematical understanding abilities but the Problem Solving approach is not more effective than Problem Posing in terms of the mathematical reasoning abilities of junior high school students in building learning. flat side space.

Based on research conducted by Falach [25] in his research entitled "Application of the Problem Posing Approach to Improve Problem Solving Abilities" stated that the indicator of student success in solving problems is that at least students are able to solve problems at a good level. The results of problem solving abilities in mathematics in cycle I were categorized as not good, at 12.9%, while at a good level it was 87.1%. In cycle II, mathematical problem solving ability was 100% at a very good level. Based on previous research conducted by Shanti and Abadi [26] states that the Problem Solving learning approach with cooperative settings and Problem Posing with cooperative settings are effective, and the Problem Posing approach with Cooperative settings are more effective than the Problem Solving approach with cooperative settings in mathematics learning in terms of the achievement of competency standards, critical thinking abilities and students' emotional intelligence.

Based on the description above, in this research it can be seen that there are differences in the learning outcomes of students who use the Problem Solving approach and the Problem Posing approach. This can be seen from the p value = 0.008, where the p value < 0.05 means H_0 is rejected and H_1 is accepted. So, from the results of research on descriptive statistics and inferential statistics, the learning outcomes of students taught via the Problem Posing approach are better than the learning outcomes of students taught via the problem solving approach.

The problem solving approach in learning mathematics is very effective because it helps students develop critical, analytical and creative thinking skills. As explained by Putri et al [9], the following are some of the positive results that can be achieved by using this approach: deeper understanding of concepts, critical thinking skills, creativity, increased self-confidence, ability to adapt, increased memory and long-term understanding, development of collaboration skills. It is important to note that teaching with a problem solving approach requires time, patience, and support from the teacher. Students need to be given the opportunity to experiment, make mistakes, and learn from their own experiences [27]. If implemented well, this approach can create a deep and meaningful mathematics learning environment.

The problem posing approach in learning mathematics focuses on students' ability to formulate questions, solve problems, and create new questions. The following opinions from [28],[29] are some of the positive results that can be achieved by using this approach: deeper understanding of mathematical concepts, development of creativity and courage to think, ability to think critically, increased motivation and involvement, development of mathematical communication skills, more contextual problem solving, development of critical skills in assessing questions and solutions, and increased social involvement. It is important to note that the problem posing approach may require a paradigm shift in mathematics learning and may require time to adapt [30]. However, if implemented well, it can help create a dynamic learning environment, build critical skills, and improve understanding of mathematics.

This study has a significant impact in providing insight into which approach is more effective in improving the mathematics learning outcomes of eighth grade students. By knowing the differences in the effects of these two approaches, teachers can choose the most appropriate method to improve students' conceptual understanding and problem-solving skills. Another positive impact is helping students develop critical and creative thinking skills according to the approach used. However, this study has limitations, such as variations in students' initial abilities that can affect the results, as well as limited time and resources to implement the problem posing approach, which often requires more guidance and time to train students to formulate their own problems. In addition, differences in student responses to the two approaches are also a challenge, because each student may be more comfortable or effective with a different approach.

4.   CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the mathematics learning outcomes of class VIII C students of junior high school Muhammadiyah 1 Makassar who learn through the Problem Solving approach have an average score of 82.96 with a standard deviation of 4.78. Meanwhile, the mathematics learning outcomes of class VIII D students who learn through the Problem Posing approach have an average score of 87.88 with a standard deviation of 7.36. There are differences in mathematics learning outcomes between students who learn through the Problem Solving and Problem Posing approaches, where the average learning outcomes of students taught through the Problem Posing approach are higher than those of students taught through the Problem Solving approach. For further research, it is recommended to explore the effect of a combination of problem solving and problem posing approaches in improving mathematics learning outcomes, as well as considering individual factors such as students' learning styles and their initial skill levels.

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