The Effectiveness of Problem Based Learning Aided by Gamification Teaching Materials on Students' Mathematical Problem Solving Ability

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Abstract: The low mathematical problem solving ability of junior high school students in Pringsewu, Lampung, Indonesia is because students understand the explanations given by the teacher and are less active during the learning process. The study was conducted to determine the differences in problem solving of students who follow the learning process using the PBL model using gamification teaching materials. The research uses quantitative methods with a quasi-experimental design type of research. The population used is junior high school students in Pringsewu, Lampung, Indonesia. The research sample used cluster random sampling technique. The data analysis used was one-way ANOVA analysis of variance with a significance level of 5% using SPSS which obtained a value of sig. <0.05 so H_0 is rejected, this indicates that there is an effect. After conducting a further test in the form of a Scheffe test, it can be concluded that there is an effect of the PBL learning model using gamification teaching materials on students' mathematical problem solving abilities.

Keywords: problem based learning, gamification, mathematical problem solving ability.

Abstrak: Rendahnya kemampuan pemecahan masalah matematis siswa SMP di Pringsewu, Lampung, Indonesia dikarenakan siswa kurang memahami penjelasan yang guru berikan serta siswa kurang aktif saat proses pembelajaran. Penelitian dilakukan untuk mengetahui adanya perbedaan kemampuan pemecahan masalah matematis siswa yang mengikuti proses pembelajaran dengan menggunakan model PBL menggunakan bahan ajar gamifikasi. Penelitian menggunakan metode kuantitatif dengan jenis penelitian quasy eksperimen design. Populasi yang digunakan yaitu siswa SMP di Pringsewu, Lampung, Indonesia. Sampel penelitian menggunakan teknik cluster random sampling. Analisis data yang digunakan adalah analisis variansi anova satu jalan dengan taraf signifikansi sebesar 5% dengan menggunakan SPSS yang memperoleh nilai sebesar sig. <0.05 sehingga H_0 ditolak, hal ini menunjukkan bahwa terdapat pengaruh. Setelah melakukan uji lanjut berupa uji scheffe dapat diambil kesimpulan bahwa adanya pengaruh model pembelajaran PBL menggunakan bahan ajar gamifikasi terhadap kemampuan pemecahan masalah matematis siswa.

Kata kunci: pembelajaran berbasis masalah, gamifikasi, kemampuan pemecahan masalah matematis.

▪ **INTRODUCTION**

Education has a meaning, namely the process of change or self-maturation, starting from not knowing to knowing, from not being able to be able, and from not understanding to understanding. Education is a means that plays a very important role in creating human beings with high potential and quality (Farisi, Hamid, and Physics 2017). Through education, it can be used for the formation of good character and attitude values for students (Kurniyawati, Mahmudi, and Wahyuningrum 2019). In ensuring the survival of a country, education has a very important role because education is a tool to improve and develop the quality of human resources (Anwar 2014). So, with education, the quality of human resources will be even better.

Mathematics is one of the subjects taught in schools and is an important part of efforts to improve education. In life, mathematics has an important role in improving human thinking (Palguna et al., 2020).

Science is based on a scientific attitude from nature to the symptoms of science (Bambang Sri, 2019). Students who can find ways to solve problems are the result of the knowledge and experience that students have when they want to find a solution to a problem at hand. Therefore, educators must be able to help students grow mathematical problem solving skills to deepen students' understanding in learning mathematics (Mathematics 2015). In learning mathematics, problem solving skills are very important to develop. Mastery of problem solving skills allows students to solve everyday problems, learn about rational science, and be skilled in applying mathematics (Mufida, Suyitno, and Marwoto 2018). However, there are still students who have difficulty in solving mathematical problems due to students' low interest in learning mathematics. As for those who have difficulty solving problems because students only memorize formulas but do not understand how to solve problems correctly and students' interest in learning is low (Access 2020). Problem solving ability is an ability that is needed by every human being in his life, especially in the era of globalization and information as it is today.

Mathematics is a universal science that makes humans think critically, logically, and train self-confidence. Mathematics subjects have been given since elementary school to high school level. However, not a few people make mathematics a scourge because it is difficult to understand (Rianto 2017). Therefore, educators try to increase students' interest in learning and train to improve mathematical problem solving skills by using an interesting learning model for students (La'ia and Harefa 2021)

Interview results from junior high school mathematics teachers in Pringsewu, Lampung Province, mathematics educators use a conventional learning approach, like expository approach during the learning process. Learning activities are centered on educators who explain the material, question and answer after that the teacher gives assignments. However, this makes only some students active, while others just pay attention without understanding because they feel they have no interest in mathematics. This potentially decreased students problem solving ability. During the learning process in classroom, students did not understand the formulas and explanations that the teacher gave. So that students will experience confusion when the teacher gives slightly different questions. This is because students do not have confidence in the ability to solve the questions given by the teacher and not a few students prefer to see the answers from friends.

To overcome the problems above, an effective learning model during the learning process is crucial. In a good problem solving process, students need to be trained to synthesize knowledge and skills before they apply it to the problems to be faced (Mufida et al. 2018). Problem Based Learning is expected to help to improve students' problem solving skills. Due to the ability of educators in designing the learning process will affect learning outcomes (Putrawangsa, 2018). Problem Based Learning is suitable for use in learning mathematics because by using this learning model students can be more active and think critically when learning mathematics (Yulianti and Gunawan 2019). Due to the mathematical problem-solving abilities used in solving real-life-oriented problems, one of the appropriate learning models is the problem-based learning

model (Imam, Ayubi, and Bernard 2018). With this learning model, students will be trained to think critically to solve the problems they face and students can develop their own knowledge, while the teacher is only a facilitator (Assegaff and Sontani 2016). In addition to applying the learning model, educators must have teaching materials as an effort to achieve learning goals with effective learning process activities (Diyanto et al. 2018). In this study using gamification teaching materials in the hope of increasing student motivation and reducing obstacles during the process of understanding a mathematical material (Sitorus 2016). Because the learning process using gamification teaching materials becomes interesting and fun so it is easy to understand (Rembulan, Wahyu, & Putra 2018).

▪ **METHOD**

This research uses a quantitative research approach which is carried out by collecting and analyzing data in the form of numbers (Abdullah 2015). This study uses a Quasi Experimental Design, which is to find the effect or find out whether or not there is a result of the treatment on the subject under study. The way to find out is by comparing the experimental group with the control group (Mai Sri Lena, Netriwati 2019). The population in the school where the research will be conducted consists of 8 classes with a total of 244 students. The sampling technique used is cluster random sampling. And get the results that the samples used are 2 classes consisting of 1 experimental class and 1 control class. The experimental class uses problem based learning using gamification teaching materials, then the control class uses a direct learning approach.

This research instrument uses a test instrument in the form of a description of 5 questions, with 4 questions indicators, namely understanding the problem, preparing a settlement plan, carrying out a calculation plan, and checking again (Di Perri et al. 1996). This test was developed by the researcher himself. Before the test is used, it must go through the validation stage, namely with two mathematics education lecturers and one junior high school mathematics teacher in Pringsewu. Then the instrument was corrected according to the opinions and inputs given by the validators. After that, the instrument was tested to obtain information on the instrument. The reliability is 0.40, where $r_{count} > r_{table}$, the instrument can be said to be good and feasible to be used in research data collection.

Table 1. Interpretation of effectiveness of n-gain (Hake, 1999)

| Percentage (%)	Interpretation
<40	Ineffective
40-55	Less Effective
56-75	Effective Enough
>78	Effective

To understand the effectivity of a treatment, each class was given a pretest and posttest. Then after the scores from the two classes were obtained, the N-Gain was calculated from the pretest and posttest the experimental class using problem based learning with gamification teaching materials, while the control class used direct learning with printed books from schools. After calculating the N-Gain, then the researcher continued with the further normality test which was carried out to assess

whether the distribution of the data was normally distributed or not.

▪ **RESULT AND DISSCUSSION**

The learning process at the time of the study using statistical material in each class was carried out for 4 meetings. At the first to the third meeting the researchers gave material about statistics, then at the fourth meeting the researchers gave a posttest about the students' mathematical problem solving ability test. Problem based learning using gamification teaching materials was carried out in 4 meetings with a learning time of 2x45 minutes. During the learning process in class, it is done by making small groups in groups consisting of 5-6 people. Then, each group discusses the statistical material that has been presented in the gamification module. During the learning process, students looked very enthusiastic because the gamification module attracted students' attention. And students are more comfortable because they can discuss with their peers. The class becomes the control class, the researcher provides learning as usual which is done by the teacher at the school. Then from the four classes a posttest to test students' mathematical problem solving abilities.

After doing pretest and posttest, students' mathematical problem solving abilities with statistical material. Then obtained data that can be determined the highest value of Xmax, the lowest value of Xmin, mean score X, modus (Mo), median (Me), and the value of group variance with range (R) and standard deviation (SD). The description of the data can be seen as follows.
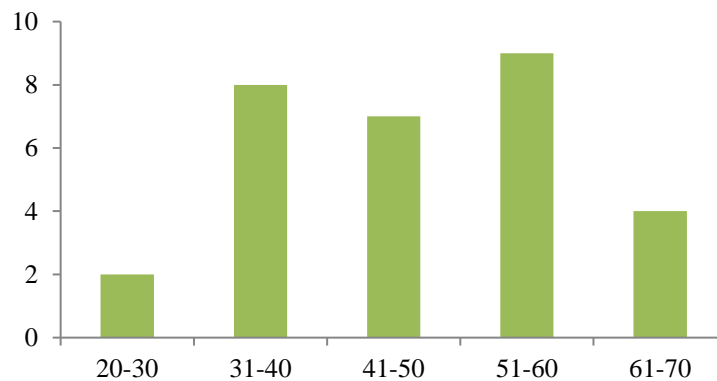
Figure 1. Pretest score

Diagram above shows the results of the pretest scores that have been carried out. Based on the diagram above shows that there are two students who scored between 20-30, then there were 8 students who scored between 31-40, there were 7 students who scored between 41-50, there were 9 students who scored between 51-60, and there are 4 students who score between 61-70.
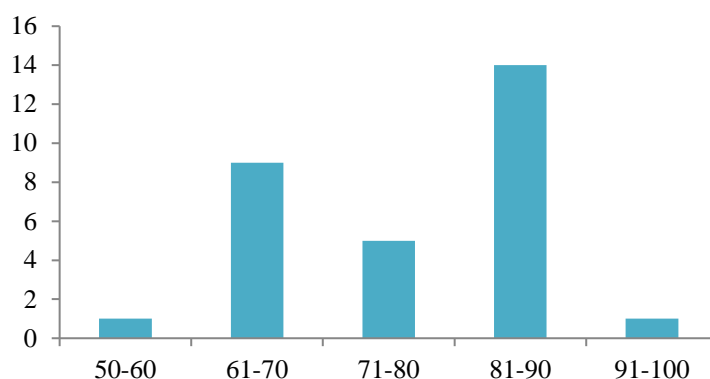
Figure 2. Posttest score

Diagram above shows the posttest scores of students' mathematical problem solving abilities. There is one student who scores between 50-60, then there are nine students who score between 61-70, there are five students who score between 71-80, then there are fourteen students who get 81-90, and there is one student who score between 91-100. Based on the value data from the control class and the experimental class, the minimum value for the experimental class is 58, the minimum value is 94, the mean value is 77.2, the median value is 79 and the mode value is 82. Then for the control class the minimum value is 27, the maximum value is 67. , the mean value is 47.1, the median value is 44.7 and the mode value is 43. The results that have been obtained from the pretest and posttest in the control and experimental classes, then carried out the N-gain test. The questions used in the pretest and posttest are used to measure the effectiveness or not of learning with a problem based learning with gamification. The questions given have gone through trials in the form of validity, reliability, level of difficulty and differentiating power.

Furthermore, normality test was conducted using data on students' mathematical problem solving abilities and performed calculations using SPSS to determine whether the data in the study were normally distributed or not. The calculation of the normality test uses pretest and posttest for students' mathematical problem solving abilities. Based on the calculation using SPSS obtained the value of sig. of 0.246 for the pretest and 0.052 for the posttest. The two significant values of the pretest and posttest values are more than 0.05. Furthermore it can be interpreted that the data that has been obtained is normally distributed. The next step will be to calculate the homogeneity test on the results of students' mathematical problem solving abilities. Used to be able to find out whether or not the variance of the data population is the same. Based on the calculations carried out with SPSS that the results of the homogeneity test of mathematical problem solving ability obtained sig > 0.05 so that H_0 accepted. That way, the mathematical problem solving ability has a homogeneous variance.

After knowing that the data is normally distributed and homogeneous, it can be decided to do the N-Gain test in order to see an increase in the pretest and posttest. There is an N-Gain score assessment criteria, namely the limit score of $g>0.7$ is the high category, the limit score of $0.3 \leq g \leq 0.7$ is in the medium category, then the limit score of $g<0.3$ included in the low category (Melzer in Syahfitri, 2008:33).

Based on the N-Gain calculation, the researcher obtained a value of 0.5 which means that it is included in the medium category. After getting the N-Gain value, then look for the N-Gain value in the form of a percentage and obtained a value of 57 which is included in the "fairly effective" category according to the category of N-Gain effectiveness interpretation. Learning with a problem based learning will be more effective if it is added with gamification teaching materials in the process of solving students' mathematical problems in learning.

After doing many calculation stages, with normal and homogeneous data, as well as N-Gain calculations, it shows that the value is included in the quite effective category. And the results of the study show that mathematical problem solving abilities are better if learning is carried out with the help of problem based learning with gamification teaching materials. Compared with learning that only applies learning with a direct approach. This is also in line with research by Susanti (2021), namely the application of problem based learning using gamification teaching materials can improve mathematical concepts (Susanti, 2021). Moreover, research conducted by Yanti (2017) concludes that the problem based learning has an influence on the mathematical problem solving ability of junior high school students. This is evident from the results of the analysis which shows that students who use the problem-based learning get a better average score and experience an increase of 11% compared to students who receive conventional learning. Based on the description above, it can be concluded that learning with problem based learning models using gamification teaching materials is more effective than conventional learning.

▪ **CONCLUSION**

Based on the results of data analysis that has been carried out, it can be concluded that there are differences in the improvement of mathematical problem solving abilities of students who receive learning with problem based learning models using gamification teaching materials. Mathematical problem solving ability gets the best results in the class that is applied to the problem based learning using gamification teaching materials. After doing several stages of N-Gain in order to obtain a value in the form of a percent of 57 and included in the category of quite effective. So it can be concluded that problem-based learning assisted by gamification teaching materials on problem-solving abilities is effective. Based on the results of this study, the problem based learning can be used as an alternative for teachers to improve students' mathematical problem solving skills, especially in learning mathematics. However, before that, the implementation must be adjusted, especially the time allocation, and the learning model and characteristics of students in schools that will be used in research.

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