



The Use of Problem-Based Learning Model Assisted by Quizizz to Improve The Mathematical Problem-Solving Ability of Junior High School Students

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ABSTRACT

This study aims to determine whether the mathematical problem-solving ability of students who receive the Problem-based Learning model assisted by Quizizz is better than students who receive the conventional learning model. This study uses a quantitative approach with a quasi-experimental design. The subjects of this study consisted of two classes, namely class VIII D as the experimental class that received the Problem-based Learning model assisted by Quizizz, and class VIII C as the control class that received the conventional model in one of the state junior high schools in West Bandung district. The instrument used in this study was a test of mathematical problem-solving ability. The data analysis technique for the mathematical problem-solving ability test used a two-sample test (t-test), which was processed using the IBM SPSS Statistics 23 for Windows software. The study's results showed that the mathematical problem-solving ability of students who received the Problem-based Learning model, assisted by Quizizz, was better than that of students who received the conventional learning model.

Keywords: Mathematical Problem-Solving Ability; Problem-Based Learning Model; Quizizz; Innovative Learning; Learning Technology

INTRODUCTION

Mathematics is a fundamental discipline that needs to be taught at every level of education because it supports logical thinking, scientific development, technological progress, and many everyday activities (Suryani et al., 2020; Jamal & Amalia, 2020). In school learning, mathematics is therefore positioned not only as content knowledge but also as a means of developing students' reasoning and problem-solving skills (Jamal & Amalia, 2020).

In mathematics education, problem solving is one of the core competencies that should be developed through classroom instruction. The objectives of mathematics learning include understanding concepts, reasoning, solving problems, communicating ideas, and appreciating the usefulness of mathematics in daily life (Jamal & Amalia, 2020; Kemendikbud, 2016). Likewise, the National Council of Teachers of Mathematics places problem solving among the main standards in school mathematics (NCTM, 2000; Sumartini, 2016).

Mathematical problem-solving ability refers to students' ability to understand a problem, represent it mathematically, select an appropriate strategy, and interpret the solution obtained in relation to the original situation (Ulva et al., 2020; Surya & Hasanah, 2017). This ability is essential because mathematics learning is expected to prepare students

to deal with both routine and non-routine problems in meaningful contexts (Surya & Hasanah, 2017).

Problem-solving ability is often regarded as the heart of mathematics learning because it integrates conceptual understanding, reasoning, and strategy use in a single performance (Kania et al., 2020; NCTM, 2000). For that reason, strengthening students' mathematical problem-solving ability remains an important target in mathematics instruction (Kania et al., 2020; Sumartini, 2016).

However, empirical evidence shows that students' mathematical problem-solving ability is still low. In PISA 2022, Indonesia obtained an average mathematics score of 366, which was still far below the OECD average of 472, indicating that Indonesian students continue to face difficulties in mathematical literacy and problem solving (OECD, 2023). This condition is also reflected in studies that report students' difficulty in solving PISA-type and non-routine mathematics problems (Febrianti & Nurjanah, 2022).

At the school level, previous studies also show a similar pattern. Fauziah et al. (2022) reported that most students were still in the low category of mathematical problem-solving ability, while Rustella and Chotimah (2023) found that students' completion of statistics problem-solving tasks was still unsatisfactory. These findings indicate a clear learning problem that needs to be addressed through appropriate instructional innovation (Fauziah et al., 2022; Rustella & Chotimah, 2023).

The importance of mathematical problem-solving ability and the persistence of low achievement suggest the need for learning innovation that actively involves students in constructing knowledge and selecting strategies for solving problems (Fisher et al., 2021). Learning should provide opportunities for students to explore ideas, build confidence, and engage meaningfully in the problem-solving process (Yunitasari & Zaenuri, 2020). In addition, Pasaribu et al. (2023) and Saputra and Rahman (2022) suggest that appropriately designed learning innovation and digital support can strengthen higher-order mathematical abilities, including critical thinking, reasoning, communication, and conceptual understanding.

One learning model that is relevant to this need is Problem-based Learning (PBL). PBL encourages students to learn through authentic problems, discuss solution strategies, and develop mathematical understanding through investigation, so it has strong potential to improve problem-solving ability (Gunantara et al., 2014; Saputri et al., 2019). Previous studies also reported that students who learned through PBL showed better mathematical problem-solving performance than those who learned through conventional instruction (Irfan et al., 2022; Farera et al., 2020). Related evidence from Saputra (2017), Suci et al. (2024), and Az Zahra et al. (2024) also indicates that problem-based or problem-oriented learning can contribute positively to students' self-regulated learning, mathematical resilience, and mathematical problem-solving ability.

Even so, the effectiveness of PBL can be strengthened by the use of instructional media that increase participation and make learning more interactive. Technology-assisted learning has been reported to support students' engagement and understanding during mathematics learning, including in problem-oriented instruction (Wibawa et al., 2023). Similarly, Saputra (2018), Darta and Saputra (2018), and Darta et al. (2021) reported that

technology-supported mathematics learning can foster students' self-regulated learning, representation, reasoning, and self-efficacy.

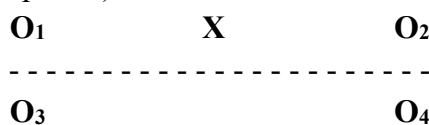
One digital medium that can support interactive learning is Quizizz. Quizizz is a game-based learning application that can make classroom activities more engaging, enjoyable, and participatory (Purba, 2019; Amornchewin, 2018). In mathematics learning, Quizizz has also been reported to help improve participation, motivation, and students' problem-solving practice through interactive exercises and feedback (Fadhlorrohman et al., 2020; Nugrahani et al., 2021; Rahim & Rahman, 2022). More specifically, Anugerah et al. (2023) and Saputra et al. (2024) showed that Quizizz-assisted learning can support the improvement of students' mathematical connection and communication abilities.

Based on the literature above, previous studies have shown the positive contribution of PBL and Quizizz to mathematics learning, yet this study specifically focuses on the integration of Problem-based Learning assisted by Quizizz to improve junior high school students' mathematical problem-solving ability in statistics material. The novelty of this study lies in examining that combination in a quasi-experimental comparison with conventional learning. Accordingly, the objective of this study is to determine whether the mathematical problem-solving ability of students who receive the Problem-based Learning model assisted by Quizizz is better than that of students who receive the conventional learning model.

RESEARCH METHODS

This research is quantitative. This study aims to analyze the use of the Problem-based Learning model assisted by Quizizz on the mathematical problem-solving abilities of students in the experimental class. Therefore, this research is experimental.

To see the effect of using the learning model, the researcher used one control class using a conventional learning model, namely direct instruction, according to the learning that is usually carried out in the school. So this study uses a non-equivalent control group design (Non-equivalent Control Group Design). The non-equivalent control group design, according to Sugiyono (2021, p. 118), is as follows.



Information :

- O₁ : Pretest of experimental class
- O₂ : Posttest of experimental class after being given treatment of the Problem-based Learning model assisted by Quizizz
- O₃ : Pretest of control class
- O₄ : Posttest of the control class after being given the treatment of the conventional model
- X : Treatment of Problem-based Learning model assisted by Quizizz
- : Samples were not taken randomly

Each group is selected by random assignment to determine the experimental class and the control class. First, both classes will be given a pretest (O₁ & O₃). After that, in the experimental class, treatment will be given with the Problem-based Learning model assisted

by Quizizz, while in the control class, using the conventional model, namely direct instruction. After the learning process is complete, both classes will be given a posttest (O2 & O4). Then the results of the posttest will be compared with the results of the pretest to see the improvement in the comparison of the two classes that have been given their respective treatments. In this case, the independent variable is the Problem-based Learning model assisted by Quizizz, and the dependent variable is the mathematical problem-solving ability and self-efficacy of students.

The subject of this study was class VIII in one of the state junior high schools in the West Bandung district. The samples to be taken were two classes. The first class is the experimental class, and the second class is the control class. The sampling was carried out using a purposive sampling technique, which is based on teacher considerations. The experimental class chosen was class VIII D, and the control class was class VIII C. Both classes were selected by random assignment. The object of this study is seen from the cognitive aspect, namely, the ability to solve mathematical problems. The main focus of this study is the use of the Problem-based Learning model assisted by Quizizz in improving students' mathematical problem-solving abilities.

RESULTS AND DISCUSSION

This study aims to determine the mathematical problem-solving ability of students who are treated with the Problem-based Learning model assisted by Quizizz, as well as students who are treated with the conventional model. The results of this study are based on mathematical problem-solving ability test data. The results of the data are based on the calculation of the posttest scores of students for each variable, which are then processed and analyzed using descriptive statistics and inferential statistics with the help of IBM SPSS Statistics 23 for Windows software. The results of the descriptive statistics are presented in Table 1 below.

Table 1. Descriptive Statistics of Posttest Data

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Experiment	28	16.00	22.00	19.7143	1.71825	2.952
Control	28	12.00	21.00	17.8571	2.12070	4.497

Based on Table 1, the mean difference between the experimental class and the control class is 1.88571. The two classes above also show that the standard deviation in the control class is greater than the experimental class. This means that the data distribution in the experimental class is greater than the control class. To see a more significant difference, it is necessary to conduct prerequisite tests, namely the normality test and the homogeneity test. After that, an inferential statistical test is carried out, namely the t-test or Mann-Whitney test. The following are the results of the normality test with a significance level of 5% on the posttest data of the experimental class and control class presented in Table 2.

Table 2. Posttest Data Normality Test Results

	Shapiro-Wilk		
	Statistic	df	Sig.
Experiment	0.933	28	0.073
Control	0.931	28	0.067

It can be seen in Table 2 that the Shapiro-Wilk test of posttest data in the experimental class has a significance value of 0.073 (≥ 0.05) and the control class has a significance value of 0.067 (≥ 0.05); then H_0 is accepted, H_a is rejected. So it can be concluded that both classes are normally distributed. Then continued with the homogeneity test can be seen in Table 3 below.

Table 3. Posttest Data Homogeneity Results

Levene Statistic	df1	df2	Sig.
1.062	1	54	0.307

From Table 3. Above, it can be seen that the significance value produced is 0.307 (≥ 0.05), then H_0 is accepted, and H_a is rejected. So it can be concluded that both classes have the same variance (homogeneous). Because both classes are normally distributed and homogeneous, it is continued with a t-test is used to determine the significant differences between the two classes that receive different learning model treatments. The results of obtaining posttest data using the t-test with the help of IBM SPSS Statistics 23 for Windows software are presented in Table 4 below.

Table 4. Posttest Data t-Test Results

	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
Post test Equal variances assumed	1.062	0.307	3.600	54	0.001	1.85714	0.51581	0.82300	2.89128

Based on Table 4, it can be seen that the significance value for the posttest comparison between the two classes is 0.001. Because $0.0005 < 0.05$, H_a is accepted and H_0 is rejected. Thus, it can be concluded that the mathematical problem-solving ability of students who received the Problem-based Learning model assisted by Quizizz is better than that of students who received the conventional model.

The posttest analysis in this study addressed the hypothesis that the mathematical problem-solving ability of students who received the Problem-based Learning model assisted by Quizizz would be better than that of students who received the conventional model. The experimental class was class VIII D, whereas the control class was class VIII C.

After both classes received different learning treatments for four meetings, both classes were given a posttest to measure their mathematical problem-solving ability. Based on the descriptive statistics in Table 1, the average score of the experimental class was higher

than that of the control class. In addition, the t-test result in Table 4 produced a significance value of 0.0005, indicating a statistically significant difference between the two classes.

The results of students' answers in answering the mathematical problem-solving ability test questions in the experimental class can be seen in Figure 1.

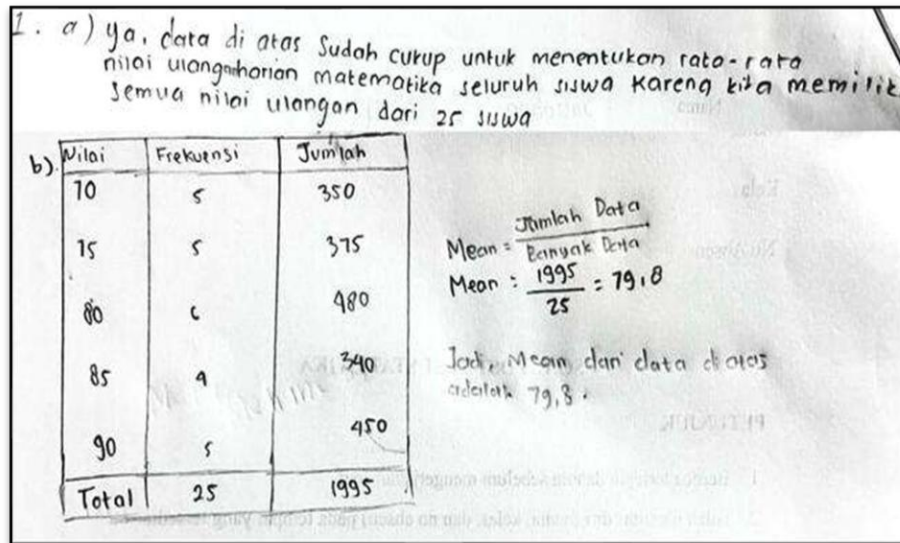


Figure 1. Answer to Posttest Question No. 1 Experimental Class

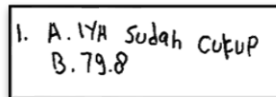


Figure 2. Answer to Posttest Question No. 2 Control Class

In Figure 1, it can be seen that students in the experimental class who received the Problem-based Learning model assisted by Quizizz were able to identify data sufficiency and understand the problems given. This can be seen from the answers of students in the experimental class, who first calculated the amount of data and matched it with the information on the number of students in the question. After students were able to identify the sufficiency of the existing data, which was 25 values from 25 students, they continued to question 1b, calculating the average value correctly. As for students in the control class who received the conventional learning model, they immediately answered the average value results and only answered "enough" without giving a clear reason. So that students who were able to meet the first indicator of mathematical problem-solving ability, namely identifying data sufficiency, were in the experimental class.

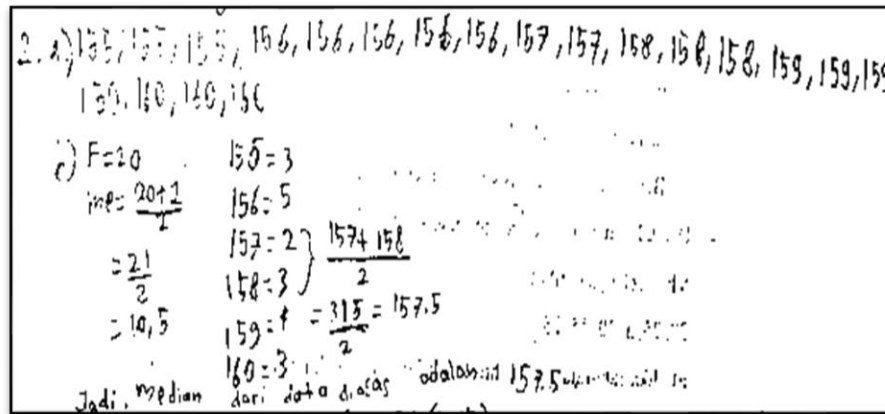


Figure 3. Answer to Posttest Question No. 2 Experimental Class

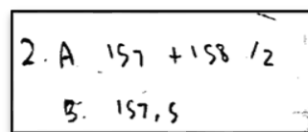


Figure 4. Answer to Posttest Question No. 2 Control Class

In Figure 3, it can be seen that students in the experimental class can construct a mathematical model to determine the median, such as first sorting the data based on its frequency, adding up the frequencies, and then determining the median value. Meanwhile, students in the control class immediately write down the median value without constructing a model and explaining the process. This shows that students in the control class do not yet understand how to form a mathematical model presented in a frequency distribution table. So that students who can meet the second indicator, namely creating a mathematical model of a situation or everyday problem and solving it, are in the experimental class that receives the Problem-based Learning model, assisted by Quizizz.

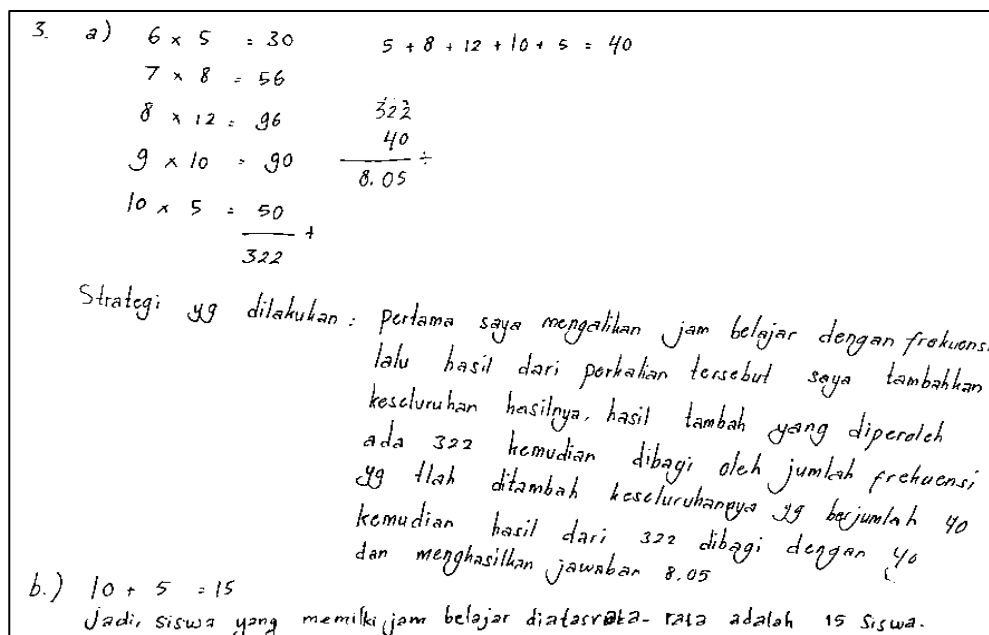


Figure 5. Answer to Posttest Question No. 3 Experimental Class

3). a).

6	5	= 30
7	8	= 56
8	12	= 96
9	16	= 144
10	20	= 200
	50	
	40	322

b). $\bar{x} = \frac{322}{40} = 8.05$

Figure 6. Answer to Posttest Question No. 3 Control Class

In Figure 5, it can be seen that students in the experimental class can describe the strategy used to determine the average, which is continued by calculating the average value, and then they can calculate the number of students whose study hours are above the average. However, in Figure 6, it can be seen that students in the control class did not use the strategy that would be used. Even in question 2b, students instead determined the average, while question 2b was to determine the number of students. This shows that students in the control class have not understood the problems given. So, the use of the Problem-based Learning model assisted by Quizizz has been proven to be able to help students in choosing and implementing problem-solving strategies effectively.

4. a. 20, 25, a, 30, 15, 25
 $\bar{x} = \frac{\text{jumlah seluruh data}}{\text{Banyak data}}$
 $25 = \frac{20 + 25 + a + 30 + 15 + 25}{6}$
 $25 = \frac{115 + a}{6}$
 $6 \times 25 = 115 + a$
 $150 = 115 + a$
 $-a = 115 - 150$
 $-a = -35$
 $a = 35$

15, 20, 25, 25, 30, 35
 $Q_1 = 20$
 $Q_2 = \frac{25 + 25}{2} = 25$
 $Q_3 = 30$
 Jadi, $Q_1 = 20$
 $Q_2 = 25$
 $Q_3 = 30$

4. b. J kuartil = $Q_3 - Q_1 = 30 - 20 = 10$
 s kuartil = $\frac{Q_3 - Q_1}{2} = \frac{30 - 20}{2} = \frac{10}{2} = 5$
 Jadi, J kuartil dari data diatas adalah 10
 s kuartil dari data diatas adalah 5

Figure 7. Answer to Posttest Question No. 4 Experimental Class

4. a. 20, 25, a, 30, 15, 25, $Q_1 = 20$
 15, 20, 25, 25, 30, $Q_2 = 25$
 $Q_3 = 25$

b. J kuartil = $25 - 20 = 5$
 s kuartil = $\frac{5}{2} = 2.5$

Figure 8. Answer to Posttest Question No. 4 Control Class

In Figure 7, students in the experimental class can understand the given questions, that the value of "a" needs to be found first because the average value is known. Then, after the data is complete, students sort the data and determine the quartile value correctly. However, in Figure 8, it can be seen that students in the control class immediately determine the quartile value without checking again whether the data is complete. So it produces the wrong answer. Thus, it can be concluded that students in the experimental class who received

the Problem-based Learning model assisted by Quizizz met the fourth indicator of mathematical problem-solving ability, namely explaining or interpreting results according to the problem, and checking the correctness of the results or answers.

5. a. $\frac{30}{100} \times 300 = 90$ b. yang paling banyak adalah yang Nasi
 $\frac{15}{100} \times 300 = 45$ c. $90 + 45 + 60 + 105 = 300$
 $\frac{20}{100} \times 300 = 60$ Japi terbukti bahwa Jumlah Siswa adalah
 $\frac{35}{100} \times 300 = 105$ 300

Figure 9. Answer to Posttest Question No. 5 Experimental Class

5. nasi = 35 a. 70% = 220
 Roti = 20 b. nasi
 sereal = 15 c. $300/2 = 150/2 = 75, 20 = 20$
 tidak = 30

Figure 10. Answer to Posttest Question No. 5 Control Class

In Figure 9, students in the experimental class were able to answer the questions correctly; they multiplied each percentage in the question by the total of all students to obtain the number of students from each breakfast category. Then they verified the total students by adding up the results obtained from the number of students based on the breakfast category. However, in Figure 10, students in the control class gave random answers without a solution, although in question 5b, students answered correctly. The students' answers seemed to be just guessing and relying on assumptions. This shows that students in the control class have not been able to apply mathematics meaningfully. So that students who can meet the fifth indicator of mathematical problem-solving ability, namely applying mathematics meaningfully, are in the experimental class that receives the Problem-based Learning model assisted by Quizizz.

Overall, the results indicate that the mathematical problem-solving ability of students in the experimental class was better than that of students in the control class. This finding is consistent with previous studies showing that problem-based learning contributes positively to students' mathematical problem-solving ability (Irfan et al., 2022; Farera et al., 2020). Thus, the use of the Problem-based Learning model assisted by Quizizz can be interpreted as an effective alternative for strengthening students' mathematical problem-solving ability compared with conventional learning.

CONCLUSION

Based on the results of the analysis obtained from the results of the research that has been carried out, it can be concluded that the mathematical problem-solving ability of students who receive the Problem-based Learning model assisted by Quizizz is better than students who receive the conventional learning model.

In this study, the use of the Problem-based Learning model assisted by Quizizz can improve students' mathematical problem-solving abilities in statistics material. So it is recommended that further researchers use the same learning model to improve other mathematical abilities, such as mathematical reasoning abilities or mathematical communication abilities at the high school level.

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