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The Effectiveness of the Problem-Based Learning Model Assisted with *Ruangguru* Application on Increasing Students' Mathematical Problem-Solving Ability

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Abstract: This study aimed to examine the effectiveness of the problem-based learning model applying the *Ruangguru* application in enhancing students' mathematical problem-solving skills. Conducted as quasi-experimental research with a quantitative approach, the study employed a Nonequivalent Control Group Design. The population consisted of eighth-grade students at SMP Negeri 2 Ajibarang, with samples selected by simple random sampling, resulting in 64 students divided into experimental (Class VIII B) and control (Class VIII A) classes. The research instrument included pretest and posttest description tests. The findings showed that students in the experimental group, exposed to the problem-based learning model applying the *Ruangguru* application, demonstrated significantly higher mathematical problem-solving abilities compared to the control group, as indicated by independent samples t-test results (significance of 0.000 ≤ 0.05). The study reported an average n-gain of 60.96% in the experimental class, suggesting a fairly effective improvement, while the control class showed a 20% n-gain, indicating less effectiveness.

Keywords: Problem-Based Learning Models; Problem Solving Abilities; *Ruangguru*

A. Introduction

One of the most common things that becomes a problem for students is that they find it difficult to solve math problems (Ufi at al, 2019). Problem is a word that cannot be separated from humans. Problems in mathematics are a series of questions or problems that contain indicators to measure student success. The problems presented usually have their own challenges so students cannot solve them with routine procedures (Goenawan & Sri, 2017) . If students do not have rules or procedures for determining answers, then a question in mathematics can become a problem.

In Permendikbud Number 58 of 2014, one of the goals that must be achieved in learning mathematics is that students can use problem solving abilities to solve problems. routine and non-routine problems both in mathematics and outside mathematics (Permendikbud, 2013). In addition, *the National Council of Teachers Mathematics* (NCTM) also states that in learning mathematics there are several abilities that students must have, namely problem solving skills, communication skills, connection skills, reasoning abilities, and mathematical representation abilities (NCTM, 2017). That is, problem solving skills are important for all students to have. According to Polya, solving mathematical problems is defined as an effort to find a way out of

a problem that is not so easy to achieve its goals immediately (Archi, 2020). Meanwhile, according to Hudoyo, problem solving is a series of processes that a person goes through in adjusting a problem until the problem is no longer a problem for him (Wahyudi & Indri , 2017). Problem solving includes at least two things, namely (1) the problem is a challenging problem and (2) the problem is a non-routine problem/no way of automatically knowing how to solve it (Ahmad & Supriyanto, 2017). From the description above, it can be easily understood that students' mathematical problem solving ability is the ability of students to solve mathematical problems using strategies and methods that have been prepared previously in order to achieve a solution.

Based on the results of the 2015 *Trends in International Mathematics and Science Study (TIMSS) and the results of the Program for International Student Assessment* (PISA) in 2018 also did not show good results where Indonesia was still ranked low (Chindi, 2021). This is line with the result of observations at SMP Negeri 2 Ajibarang through interviews with one of the mathematics teachers, Mrs. Sri Rohmawati, S.Pd. and the results of the class VIII students' *pre-test* which was conducted on September 19, 2022, obtained information that students' mathematical problem solving abilities were still in the low category with an average preliminary test result of 43.77. Seeing the difference between the urgency and the facts above, of course there are several things that affect the weak problem-solving abilities of students, including the learning model used in the learning process (Ariska, 2016).

Choosing the right learning model will have an impact on student achievement (Afifah, 2016). For Therefore, teachers must be able to apply learning models according to situations and conditions so that students can play an active role in learning (Anggraeni at al, 2010). According to Fatimah (2012) efforts to improve problem solving abilities are using *problem based learning* (PBL) models. Mathematical problem solving ability can be improved by implemented discovery learning (Mutmainah & Nuha, 2023). Using PBL models and combine with think pair share active learning methods can make students more interesting to learn mathematics (Khaq & Febriana, 2023).

Based on several research results showing that PBL has the ability to overcome these problems, including Andi's research (2018) shows that PBL has a positive and significant effect on mathematical problem solving abilities. Research by Lidya & Edi (2020) shows that with PBL there is a high and effective increase in improving mathematical problem solving abilities. In addition, research by Rini, et al (2019) also concluded that the PBL model could make students' mathematical problem solving abilities better.

In PBL the teacher invites students to actively participate in solving existing problems (Vera & Wardani, 2018). The selection of PBL to overcome weak problem-solving skills is based on Harmianto 's theory Sofyan et al in his book entitled *Problem Based Learning* in the 2013 Curriculum which states that PBL is used as a means to develop knowledge, critical thinking skills, and problem solving abilities. In addition, in this era of disruption, the use of learning models is expected to be collaborated with existing technological developments. The PBL model is one model that can be collaborated with technology. According to Nurdyansyah, PBL or also known as problem-based learning, in the process of solving the problem, can utilize *e-learning facilities* collaboratively or together (Nurdyansyah, 2016).

The use of technology is no stranger to this era of globalization, including in the field of education (Lestari, 2018). The 2013 curriculum emphasizes the use of integrated information and communication technology in every subject, including mathematics (Ai Sri, 2016). Weak use of technology in learning can be seen in class VIII SMP N 2 Ajibarang. In learning activities, teachers have not used technology to support their learning. Various attempts have been made to solve the problem, but have not yielded maximum results, especially in relation to problem solving. If it is not handled immediately, it is feared that it will affect students' mathematical problem solving abilities, thus impacting learning achievement and the quality of student learning.

One of the application-based *e-learning learning platforms* in innovation in the world of education today is *Ruangguru*. The use of *e-learning* is in accordance with the theory according to Hamadin which states that learning using *e-learning* has a positive effect on students (Lidia at al, 2019). The use of *e-learning* is also recommended to be implemented with the aim that students can improve learning skills other than the skills they acquire from conventional learning. *Ruangguru* is the largest education-based technology company in Indonesia with more than 15 million users. *Ruangguru* develops various technology-based learning services, including *virtual* class services , *online* exam platforms, subscription learning videos, private tutoring *marketplaces, and other* educational content. This is also in accordance with Nindi Silvia Rahmadani's theory which states that *Ruangguru* is a form of educational model in response to the industrial revolution 4.0 by utilizing *smartphones/gadgets* as the medium (Nindi & Mia, 2019). The use of *Ruangguru* media in the PBL model will be able to make students think critically and creatively in using technology in learning. In addition, students' knowledge of problem solving is also increasing.

B. Methods

Approach used is quantitative research. It is called quantitative research because this research will produce data in the form of numbers which will be analyzed using statistics. While the type of research used is experimental research, the experiment is given because there is a treatment *given* . *The treatment* in question is PBL learning using the *Ruangguru* application. The research design that will be used in this study is *the Nonequivalent Control Group Design* with a design according to Sugiyono (2019: 120).

$$\begin{array}{ccc} O_1 & X & O_2 \\ \hline O_3 & & O_4 \end{array}$$

Figure 1. Research Design

The treatment is marked with the symbol X, while *the pretest* is marked with the symbols O1 and O3. For *posttest* marked with symbols O2 and O4.

This research was conducted at SMP N 2 Ajibarang, Banyumas Regency and was carried out in the even semester of the 2022/2023 academic year, from 9 to 26 January 2023. In this study, the population was students of class VIII SMP Negeri 2 Ajibarang. The sampling technique that has been carried out is simple *random sampling technique* . After the lottery, the selected classes used as *samples* were class VIII A and class VIII B. The data collection

technique in this study used tests, namely *pretest* and *posttest* along with documentation. Then, the test results are classified according to the following criteria (Ika Meika, at.al 2021):

Table 1. Criteria for Mathematical Problem Solving Ability

Value (N)	Criteria
81-100	Very good
61-80	Good
41-60	Enough
21-40	Not enough
0-20	Very less

Furthermore, the data was analyzed using the t test and *n-gain test*. The t test was used to find out the average difference between the two different groups and the *n-gain test* was used to see the effectiveness of students' problem-solving abilities after being given treatment. In this study, *the n-gain effectiveness criteria* used the interpretation of *the n-gain* percentage according to Arikunto (2009):

Table 2. Interpretation Category of *N-gain Effectiveness*

Percentage (%)	Category
$n < 40\%$	Ineffective
$40\% < n < 55\%$	Less effective
$56\% < n < 75\%$	Effective enough
$n > 76\%$	Very effective

To find out the difference in the mean of the two different groups in this study using the t test. In the t test, the significance level (a) is 5% or 0.05 with the criteria H_0being accepted if the probability value (Sig.) > a, H_0 is rejected if the probability value (Sig.) ≤ a (Ali Anwar, 2009). The hypothesis used is as follows:

H_0: $\mu 1 = \mu 2$
H_1: $\mu 1 \neq \mu 2$
Information:
μ_1: The average value of students' mathematical problem solving abilities subjected to the PBL model assisted by the *Ruangguru* application.
μ_2 : The average value of students' mathematical problem solving abilities that are not subject to the PBL model assisted by the *Ruangguru* application.

C. Results and Discussion

1. Results

Learning process was carried out by researchers during research at SMP N 2 Ajibarang by taking samples of class VIII A and VIII B as the experimental class and control class. The instrument used in this study was a test in the form of a description with a total of 5 questions accompanied by a grid that had been prepared based on indicators of mathematical problem solving. Before in carrying out the treatment in the study, students in the experimental and control classes were given *pretest questions.* Giving *pretest* questions aims to find out and measure students' mathematical problem solving abilities before the learning process is carried out. In the experimental class and control class, *pretest questions* were given to students

totaling 32 students. The questions used are description questions, which consist of 4 questions. The following presents data on the *pretest posttest values* of the experimental class and the control class:

Table 3. *Pretest* Results and *Posttest* Experiment Class

No	Information	*Pretest*	*Posttest*
1	The highest score	45	90
2	Lowest Value	20	60
3	Amount	1027.50	2347,5
4	Average	32,11	73,36

Based on the table presented above, it can be seen that the highest, lowest, and average scores of 32 students from the experimental class *pretest*. The experimental class got the highest score of 45, the lowest score of 20, with a total of 1027.50 and an average of 32.11. In addition, the results of *the posttest* show that the experimental class got the highest score of 90, the lowest score of 60, with a total of 2347.5 and an average of 73.36.

Table 4. *Pretest* Results and Control Class *Posttest*

No	Information	*Pretest*	*Postest*
1	The highest score	40	60
2	Lowest Value	20	22.5
3	Amount	870	1335
4	Average	27,19	41,72

Based on the table presented above, it can be seen that the highest, lowest, and average scores of 32 students from the control class *pretest*. The control class got the highest score of 40, the lowest score of 20, with a total of 870 and an average of 27.19. In addition, the results of *the posttest* showed that the control class received the highest score of 60, the lowest score of 22.5, with a total of 1335 and an average of 41.72.

From this description it can be concluded that the comparison of the average *pretest results* between the experimental class and the control class obtained an average value that was almost the same or did not show a too significant difference. Meanwhile, in *the posttest results* the average value obtained was quite significant.

From this description it can be concluded that the average value of the experimental class is of 73.36 and the control class of 41.72. This shows that the average of the experimental class $>$ is the control class. From these data obtained a significant difference in value between the experimental class and the control class.

From the results of students' mathematical problem solving obtained by the experimental class and the control class obtained from the results of *the pretest* and *posttest* which are calculated in the *n-gain formula*, *n-gain* score data , and score statistics *n-gain* related to students' mathematical problem solving abilities is presented in the following table:

Table 5. Category of Experiment Class *N-Gain Acquisition*

N-Gain	**Category**	**Frequency**	**Percentage**
$0{,}70 \leq g \leq 1.00$	Tall	6	18.75%
$0{,}30 \leq g < 0{,}70$	Currently	26	81.25%
$0{,}00 < g < 0{,}30$	Low	0	0%
$g = 0$	No Upgrade	0	0%
$-1{,}00g < 0$	There was a decline	0	0%
Amount		32	100%

Based on the data above, it can be seen that 6 students (18.75%) got a high *n-gain score, 26 students (81.25%) got a* moderate *N-Gain* score , 0 students (0%) got a *N-Gain score low, 0 students (0%) got an N-Gain* score that did not increase, and 0 students (0%) got a decreased *N-Gain score.* Overall, from these data it can be concluded that *the N-Gain* problem solving ability of the experimental class is in the medium category.

Furthermore, the *n-gain* value data for the mathematical problem solving abilities of control class students can be categorized based on the criteria presented in the following table:

Table 6. Category of Control Class *N-Gain Gain*

N-Gain	**Category**	**Frequency**	**Percentage**
$0{,}70 \leq g \leq 1.00$	Tall	0	0%
$0{,}30 \leq g < 0{,}70$	Currently	7	21.88%
$0{,}00 < g < 0{,}30$	Low	25	78.13%
$g = 0$	No upgrade _	0	0%
$-1{,}00g < 0$	There was a decline	0	0%
Amount		32	100%

Based on the data above, it can be seen that no student (0%) got a high *n-gain score* , 7 students (21.88%) got a medium *n-gain score, 25 students (78.13%) got a n-gain score low gain , 0 students (0%) got n-gain* scores that did not increase, 0 students (0%) got *n-gain scores* that decreased. Overall, from these data it can be concluded that *the n-gain* problem solving ability of the control class is in the low category.

From the data on the results of students' mathematical problem solving on the *Pythagorean material* that has been achieved by students in the experimental class using the PBL learning model *assisted by the Ruangguru* application to improve mathematical problem solving abilities obtained from *the pretest* and *posttest results* which are calculated using the *n-gain formula. Based on the results of n-gain* calculations in the experimental class, it is known that in the experimental class it has an *n-gain value* with the highest value of 0.85, the lowest value 0.38, and an average value of 0.61 which means there is an increase in students' mathematical problem solving abilities.

Pythagorean material that has been achieved by students in the control class using conventional learning models obtained from the results of *the pretest* and *posttest* which are calculated using the *n-gain formula. Based on the results of n-gain* calculations in the control class, it is known that the control class has an *n-gain value* with the highest value of 0.42, the

lowest value of 0.03, and the average value of 0.20 which means there is an increase in mathematical problem solving abilities student.

Based on the data described above, it is shown that the results of the *n-gain score* for the experimental class have or there is a moderate increase which obtains an average *n-gain* of 0.61, while in the control class it has or there is a low increase which obtains an average the average *n-gain* is 0.20.

the n-gain effectiveness of learning with the PBL model assisted by the *Ruangguru* application can be known by interpreting the results of the *n-gain score*. If the *n-gain score* obtained by students in the experimental class is presented in the form of a percentage and then interpreted with an interpretation of *the n-gain score*, it will look like the following table:

Table 7. Distribution of *N-Gain Interpretation* Experiment Class

No	*N-Gain* (%)	Category	Frequency
1	*N-gain*≤ 40%	Ineffective	1
2	40% < *N-Gain*≤ 55%	Less effective	5
3	55% < *N-Gain*≤ 75%	Effective enough	24
4	*N-Gain*> 75%	Effective	2
Amount			32

Based on table 7 above, learning in the experimental class was found to be ineffective for 1 student, less effective for 5 students, quite effective for 23 students, and effective for 3 students. The average percentage value obtained in the experimental class is 60.96% with a fairly effective category.

Furthermore, the interpretation of *the n-gain effectiveness* of learning that does not use the PBL model assisted by the *Ruangguru* application can be known by interpreting the results of the *n-gain score* . If the *n-gain score* obtained by students in the control class is presented in the form of a percentage and then interpreted with an interpretation of *the n-gain score,* it will look like the following table:

Table 8. Interpretation Distribution of Control Class *N- Gain*

No	*N-Gain* (%)	Category	Frequency
1	*N-gain*≤ 40%	Ineffective	30
2	40% < *N-Gain*≤ 55%	Less effective	2
3	55% < *N-Gain*≤ 75%	Effective enough	0
4	*N-Gain*> 75%	Effective	0
Amount			32

Based on table 8 above, learning in the control class was found to be ineffective for 30 students, less effective for 2 students and quite effective for 0 students. The average percentage value obtained in the control class is 20% in the ineffective category.

After the *n-gain test was carried out*, then the t-test was carried out to find out the average difference between the experimental class and the control class. However, beforehand, prerequisite tests were carried out, namely normality and homogeneity tests. The normality test aims to determine whether the data used is normally distributed or not. In this study using the

Kolmogorov-Smirnov formula. A data is said to be normally distributed if the probability value (Sig.) is ≥ more than the alpha value (α). However, if the probability value (Sig.) < the alpha value (α) then the data is not normally distributed. The normality test results can be seen in the following table:

Table 9. Normality Test Results

	Kolmogorov-Smirnov [a]		
Class	**Statistics**	**df**	**Sig.**
Experiment	080	32	.200 *
Control	.134	32	.155

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Based on the normality test with the Kolmogorov-Smirnov test using SPSS 16.0 software, according to the table above, it is known that the probability value (Sig.) in the experimental class is $0.200 \geq \alpha$ (0.05) and the probability value in the control class is $0.155 \geq \alpha$ (0 , 05). From these results, it can be concluded that the data in the experimental and control classes are normally distributed.

After the data is normally distributed, then it is done. Homogeneity test to find out whether the data used comes from a population that is or not. A data is said to be homogeneous if the value of Sig. ≥ 0.05 indicates that the data is homogeneous. If the value of Sig. <0.05 indicates that the data is not homogeneous (Joko Subando, 2019). Following are the results of the homogeneity test :

Table 10. Homogeneity Test Results

		Levene Statistics	**df1**	**df2**	**Sig.**
NGain	Based on Means	1,087	1	62	.301

After the data is normally distributed and comes from a homogeneous or the same population. Following are the results of the SPPS 16.0 t test:

Table 11. T Test Results (Independent Samples Test)

		Levene's Test for Equality of Variances		**t-test for Equality of Means**		
		F	**Sig.**	**Q**	**df**	**Sig. (2-tailed)**
N Gain	Equal variances assumed	1,087	.301	15,331	62	.000
	Equal variances not assumed			15,331	61,553	.000

Based on the results of the homogeneity test that has been carried out which obtained the results as shown in the homogeneity test table, the Sig value was obtained. $0.301 \geq \alpha$ (0.05) it can be seen that the data comes from a homogeneous population. Because the data is

homogeneous, the results of the t test in the table above can be determined by looking at the value of the Sig column. (2-tailed) and the line of equal variances assumed is worth $0.000 \leq 0.05$, H_1 is accepted, so there is a significant difference in the average mathematical problem solving abilities of class VIII students between classes subjected to the PBL model *assisted by the Ruangguru* application with those who are not subject to models.

2. Discussion

Mathematical problem solving ability is a student's ability to solve mathematical problems using strategies and methods that have been prepared beforehand in order to achieve a solution. According to Krulik and Rudnick " *It* [*problem solving*] *is the means by which an individual uses previously acquired knowledge, skill, and understanding to satisfy the demands of an under familiar situation.* (Al Kusaeri, 2019) . This statement can be interpreted that problem solving is part of the process of solving unusual or unfamiliar problems (situations) where a person will use the knowledge, skills and understanding that he has previously possessed. Polya explained that in solving problems, 4 components are needed, namely understanding the problem, making a plan or strategy, implementing the plan, and checking again (Sri, at.al. 2010) . Problem solving abilities must be owned by students because they remember how important these abilities are to deal with problems in everyday life (Ruseffendi, 1991). It is hoped that by having this ability students will be able to implement procedures to solve the problems they face both within the scope of mathematics and in everyday life.

To measure students' mathematical problem solving abilities, this study used several test instruments. The tests given consist of two types, namely *pretest* and *posttest. The pretest* was given to the experimental class and control class before learning or being given treatment. *Posttest* was given to the experimental class and control class after learning or treatment was given by the researcher. The types of *pretest and posttest* questions used to measure students' mathematical problem solving abilities are in the form of description questions consisting of 4 items. Then, before the question is used for research, it is tested first in other classes to find out whether the question is valid and reliable to be used as a research instrument.

Furthermore, the solving ability of students at SMP N 2 Ajibarang is still relatively low. This can be seen from the results of the preliminary test conducted on September 19, 2022, which resulted in an average test result of 43.77. The low ability of students' problems is also caused by an unsuitable learning model used by teachers to be able to explore problem solving abilities in students (Samosir and Surya, 2017). To overcome this we need a learning model that can improve students' mathematical problem solving abilities. One learning model that can be used to improve mathematical problem solving abilities is PBL (Riyanto, 2009).

According to Gunantara, et al. problem-based learning or PBL is a learning model that involves students in solving real-world problems (Gunantara at al , 2014). The 2013 curriculum emphasizes the use of communication and information technology to be integrated in each subject both inside and outside the classroom (Atan , 2017). The use of learning models is expected to be collaborated with existing technological developments. The PBL model is one model that can be collaborated with technology. According to Nurdyansyah, PBL or also known as problem-based learning, in the process of solving the problem, can utilize *e-learning facilities* collaboratively or together (Nurdyansyah, 2016). The form of the use of technology

used in this study is the collaboration of the PBL model using the *Ruangguru* application . This is in accordance with Nindi Silvia Rahmadani's theory which states that *Ruangguru* is a form of educational model in response to the industrial revolution 4.0 by utilizing *smartphones/gadgets* as the medium. (Nindi & Mia, 2019).

Several studies have revealed the potential for PBL in collaboration with technology to have a positive impact on students, including research by Royyana, et al (2021) which stated that the use of the PBL model assisted by the echo application duran can improve mathematical problem solving abilities. The results of research conducted by Nurul Hasanah, et al (2019) showed that video-assisted PBL had an influence on student learning outcomes. In addition, research conducted by Elok & Meyta, (2021) also concluded that with the help of *cabri software* 3D V2, the PBL model can improve students' numeracy literacy skills.

Based on the results of the research that has been done, the experimental class and the control class have relatively the same ability to solve mathematical problems before being given treatment. This is in line with the results of the pretest which showed that the average pretest score in the experimental class was 32.11 and in the control class was 27.19. In contrast to the results of the pretest, posttest results of the experimental class and the control class have different mathematical problem solving abilities after being given treatment. This is consistent with the posttest results which show that the average posttest score for the experimental class is 73.36 and that for the control class is 41.72.

To find out the level of effectiveness of the learning model carried out in the experimental class and the control class, an interpretation of the *n-gain* test was carried out. In the experimental class, learning uses the PBL model using the *Ruangguru* application. Whereas in the control class the learning does not use the PBL model using the *Ruangguru* application. *The n-gain* test results in the experimental class to get a percentage *n-gain* of 60.96% with a fairly effective interpretation, while the control class obtained a percentage *n -gain* of 20% with the interpretation that it is not effective in improving mathematical problem solving abilities.

Furthermore, to see an increase in students' mathematical problem solving abilities before and after being given treatment, an *n-gain test was carried out* in the experimental class and the control class. The experimental class obtained an average n-gain of 0.6096 which means it is in the medium category. Meanwhile, the control class obtained an average n-gain value of 0.20, which means it is in the low category.

This is also consistent with the output of the independent sample t test (t-test) using SPSS 16.0 software, showing a Sig.(2-tailed) value of $0.000 \leq 0.05$. Based on data on the average scores of students' math solving abilities, the average *n-gain,* and the t-test, it can be concluded that the average math problem-solving abilities of Grade VIII students who were subjected to the PBL learning model assisted by the *Ruangguru* application were better than those who were not subjected to the learning model. PBL assisted by the *Ruangguru* application.

D. Conclusion

Based on the research and findings that have been described in the discussion during the research activities that have been carried out by researchers, in general researchers can conclude that the use of the PBL learning model has an effect and is quite effective in increasing

students' mathematical problem solving abilities in class VIII Pythagorean material at SMP N *2* Ajibarang . This can be seen from the *n-gain results* which show that there are differences between the experimental class and the control class. *n-gain* results the experimental class obtained an average of 0.6096 which was included in the medium category and the average *n-gain result* for the control class obtained 0.20 which was included in the low category. From these data it can be seen that the average *n-gain value of* the experimental class is higher than that of the control class. The results of *the n-gain* interpretation also show that the experimental class gained 60.96% in the fairly effective category and the control class gained 20% in the ineffective category. The influence of the learning model can be seen by the results of the t test which obtains a probability value (Sig.) of 0.000 <0.05 which means H_0 it is rejected and H_a accepted. That is, there is a significant effect on the experimental class compared to the control class.

Suggestions for future researchers, it is suggested to be able to develop research results and refine the deficiencies that exist in this research, and to be able to cover a wider range of material.

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