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Comparing Student Problem-Solving in Math: Double-Loop vs. Multi-Representational Discourse Models

Dewi Anjani[1*], Nurma Izzati[2]

1, 2 Department of Mathematics Education, IAIN Syekh Nurjati

*Corresponding author: Jl. Perjuangan, Sunyaragi, Kec. Kesambi, Kota Cirebon, Jawa Barat, 45132, Indonesia. e-mail addresses: nurma@syekhnurjati.ac.id

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a b s t r a c t

This research was conducted at SMP Negeri 7 Cirebon with quantitative methods. Quasi-Experimental research design in the form of posttest-only control group design. This research uses a purposive sampling technique to determine the research sample. The population in this study were all class VIII SMP Negeri 7 Cirebon. The samples used were class VIII B consisting of 36 students and class VIII D consists of 36 students. Data collection technique uses a test instrument in the form of a posttest in the form of a description. The results showed that there was a significant difference between the application of the double loop problem-solving learning model and the multi representation discourse learning model on students' mathematical problem solving abilities with a significance value of 0,001 less than 0,05 (< 0,05). This difference can also be seen from the results of calculating the average mathematical problem solving ability in the experimental class 1 which applies the double loop problem solving learning model of 75,89 while in experimental class 2 which applies the multi representation discourse learning model of 64,34. So, it can be concluded that the mathematical problem solving abilities of students who apply the double loop problem solving learning model are better than the mathematical problem solving abilities of students who apply the multi-representation discourse learning model to the Pythagorean theorem material.

K e y w o r d s :
double loop problem solving; multi representation discourse; mathematical problem solving abilities

INTRODUCTION

Education is one of the most important sectors in determining the level of progress of a country. According to (Tama et al., 2018) education can broaden the knowledge and insights needed by humans. In learning activities at school, there is direct interaction between students and teachers. Not infrequently in this interaction, there is an obstacle that results in learning being ineffective due to the lack of good interaction so that learning activities cannot take place properly in understanding a material, especially understanding mathematical material. Mathematics is one of the broad sciences and has an important role in various sectors that can maximize human thinking abilities (Imam et al., 2018). Mathematics helps mold students into good people because it teaches them how to analyze and investigate problems methodically and logically. Mathematics also plays an important role in the world of education because of its benefits mathematics is a tool in developing intellectual intelligence.

The National Council of Teachers of Mathematics (NCTM) has determined competency benchmarks in mathematics that there are 5 standards on mathematical abilities that students must master including connection, communication, adaptive reasoning, productive disposition, and problem-solving. According to (Fitria et al., 2018) ability in solving mathematical problems is a deep ability to solve math problems in the form of word problems and questions that are not normally done. The activity of solving internal problems in mathematics for students is a way to receive deep abilities to complete the task (Maryanti, 2018). According to (Widhy Adnyana et al., 2021) causes the lack of results from mathematical solving on the basic ability of mathematics students because of the monotonous learning model. It shows that students do not really have good math-solving skills. The ability of students in Indonesia is still very low in working on word problems related to mathematics. This condition is shown by the results of research from the Trend in International Mathematics and Science Study (TIMSS) that the ability of junior high school students in Indonesia in working on questions mathematics is still very lacking, but in working on questions about facts and relatively good procedures. The ability in solving mathematics problems which is low will affect achievement and student learning outcomes at school.

There are 2 factors influence the ability to solve student's mathematical problems, namely internal factors and external factors. The learning model applied by the teacher when teaching is one external factor that can affect problem-solving abilities of student's of mathematics. In addition, one of the factors causing the low-level student's of mathematical problem-solving abilities are from habit factors learning that does not train mathematical problem-solving abilities. One of the ways to solve this problem is to apply an appropriate learning model. In addition to educator factors, model application factors in learning also needs to be considered. The learning model basically is a learning design that has been arranged and arranged neatly by the teacher before entering the classroom (Layali, 2020). There are many kinds of learning models that can be applied by teachers, such as the double loop problem solving, cooperative model, multi reprecentant discourse model, and others, etc. Some of these learning models are made to be able to support learning in order to create an increase in knowledge, especially in the field of mathematics. To measure the level of ability to solve mathematical problems students, it is necessary to apply a learning model that is appropriate in the effort to measure students mathematical problem solving abilities including namely double loop problem solving learning models and learning models multi reprecentant discourse.

Mathematical Problem-Solving Abilities

Ability is the potential to master a skill originating from innate as well as from the results is an activity to solve a problem, whether it is related to real life or other circumstances (Asih & Ramdhani, 2019). Mathematics can be interpreted as everything related to

mathematics so that the ability to solve mathematical problems is a skill that students can use mathematical activities to be able to solve problems in mathematical and problems in life daily (Imam et al., 2018). According to Ar (Amaliyah AR & Mahmud, 2018) every student has different ways of solving building solving abilities mathematical problems from the problems assigned by the teacher. Based on the description from this, solving mathematical problems has a big influence on student's, because the ability to solve mathematical problems is a business student to be able to determine and solve the problems given to them students through ways that contain elements of deep problem-solving math learning (Muhlisin et al., 2022). According to (Nasution & Mujib, 2022) in learning mathematics the ability to solve mathematical problems received serious attention. Problem-solving ability not only train student's to work on math problems given by the teacher, but students are expected to be able to solve complex problems in society (Hasanah et al., 2022). Indicators of students mathematical problem-solving ability according to Polya include understanding the problem, planning to solve the problem, resolving the problem according to the settlement plan, and re-examining the completion steps.

The Double Loop Problem-Solving Learning Model

The double loop problem-solving learning model is a learning model that is a variation of learning to solve problems that emphasizes the search for the initial causes of a problem (Pratama & Suherman, 2018). The double-loop problem-solving learning model accommodates a difference from the cause of the emergence of the problem including the steps until the occurrence of something problem. The double loop problem solving learning model is one such model of cooperative type learning that affects the ability to solve student's mathematical problems. Learning that uses double loop problem-solving is proven to provide good results on the ability to solve mathematical problems. The double loop problem solving learning model requires students to manage their thinking skills in finding the cause of a problem that is happening (Muhammad & Purwanto, 2020).

In the application of his learning model students are encouraged to work in 2 different settlement loops (Ramadhana et al., 2018). Loop 1 is used to determine the cause of a problem and then design and deploy a temporary solution to the problem. Loop 2 is used to find the cause of a problem with more complex directions then create a design and implement to solution to the original cause of the problem. The steps of the double loop problem-solving learning model include identifying problems, detecting the main causal factors for problems, evaluating the success of temporary solutions, deciding on root cause analysis of problems, detecting the causes of more complex problems, and determining solutions to problems (Sutama, 2018).

The Multi Reprecentant Discourse Learning Model

The multy reprecentacy discourse learning model according to (Agustina et al., 2019) is a type of learning model cooperative process carried out with groups that involve various representations mastered by students so that students can express themselves according to their own language. Multi reprecentant discourse learning model is carried out by students in groups and communicate informally so that students can convey their ideas casually using the language themselves (Rukiyah et al., 2020). Representation or representation is a set of alternatives used by students to solve a problem such as graphics, pictures, symbols, and so on (Nurfaisah, Tayeb, Thamrin, Nur, Firiani, Latuconsina, Nur Khallisah, Mattoliang, 2021). Multi reprecentant discourse learning model has advantages in measuring ability in problem-solving students are encouraged to be actively think and participate in expressing their ideas orally and in writing (Herdiana et al., 2021). This certainly can measure the level of ability in solving student's mathematical problems. The steps of the multi reprecentant discourse learning model include

preparation, introduction, development, application, and closing. Use the Century Schoolbook font, 11 pts. space 1. Adjust to the writing / research used.

METHODS

The type of research in this research is experimental research with a quantitative approach. The design in this research is quasi-experimental. Quasi-experimental research is referred to as one way that can form a relationship between several variables. Research with quasi design experimental will use the whole subject of a group intact to then be given treatments (Irfan et al., 2022). Class experiment I and experiment class II were given different treatments. On class experiment I applies the double loop problem-solving learning model while in class experiment II applies the multi reprecentant discourse learning model. Both groups were given similar math posttest question to determine solving abilities in mathematical problems and find out the differences in experiment class I and experiment II.

The quasi-experimental used was the posttest only control group design. The form of this research design can be described as in the diagram above below :

Experiment class I	:	X_1	O
		.....	
Experiment class II	:	X_2	O

Information :

X_1 = Learning that applies the double-loop problem-solving learning model

X_2 = Learning that applies the multi reprecentant discourse learning model

O = Posttest student's mathematical problem-solving abilities

Population is an area consisting of objects or subjects that have certain characteristics set by the researcher to be studied then conclusions are drawn. According to Hardani the purpose of having a population is to know the number of samples used from members of the population. The population in this study namely all students of class VIII SMP Negeri 7 Cirebon with the sample in this study was taken at random.

In this study, researchers used cluster random technique sampling to determine the sample from the existing population. The technique is used because all classes in the population have the same characteristics homogeneous or relatively homogeneous. Made class the samples are two selected classes of class VIII B as the experimental class I with the application of the double loop problem-solving learning model and class VIII D as an experimental class II with the application of the multi reprecentant discourse learning model. The independent variable in this the study is the learning model double loop problem-solving and multi reprecentant discourse learning model which is denoted as (X).

The variable dependent that is used in this study is the solving ability mathematics which is denoted as (Y). Data collection technique are carried out during learning on going. The instruments and techniques of data collection in this research is test and documentation. In this study, researchers used a test in the form of posttest essay questions. This is done to determine the ability to solve problems for mathematical students between those whose learning applies the learning model double loop problem-solving and students whose learning applies the multi reprecentant discourse learning model. In this study documentation is used as supporting data so that the problem solving ability test student's mathematical results are more reliable, so notes are made in the form of pictures of test results and research activities.

The test instrument was tested using a validity test to find out the feasibility of the instrument used. The test said has validity if the results are following the criteria that have been determined. The instrument is said to be valid if the instrument has high validity measure. The instrument has a high validity measure means the instrument can measure something that should be measured such as to measure math-solving ability. In addition to testing the validity, the instrument was also tested with a reliability test to obtain measurement results consistent and fixed (does not change) which means if it is done many times on the same sample. The results obtained are relatively consistent and fixed. In addition to the validity and reliability test, the instrument was also tested with different power tests to show how many test items were able to distinguish between student's from the high group and student's from the low group. In addition, it is also tested with a difficulty level test to measure how difficult or easy it is to test items.

RESULT AND DISCUSSION

This research was conducted at SMP Negeri 7 Cirebon wich is located on Jl. Ciremai Raya No. 65 Kecapi, Kec. Harjamukti, Cirebon City. Research take a sample of two selected classes of class VIII B as many as 36 students as the experimental class I apply the double loop problem solving learning model and class VIII D as many 36 students as an experimental class 2 that applies the model multy reprecentacy discourse learning. Researchers provide tests for measure student mathematical problem solving abilities.

After getting the posttest scores in the experimental class I, the researcher then do a recapitulation of KKM achievement with a KKM score of 75 can be seen in the following table:

Table 1
Summary of Achievement of KKM Experiment Class I

Information	The Number of Students	Descriptions
Passed	22	61%
Not pass	14	39%
Amount	36	100%

Based on Table 1 shows that as many as 22 astudents get the vales is more than KKM if it is percentaged by 61%, while as many as 14 students score less than KKM if it is percentaged at 39%. Descriptive statistical analysis can be seen in the following table:

Table 2
Description of Experimental Class Data I

	N	Range	Min statistic	Max statistic	Mean	Std. Deviation statistic	Variance statistic
DLPS learning model	36	56	40	96	75,89	14,319	205,045
Valid N	36						

Based on Table 2 it can be concluded that of the 36 students in the class experimental obtained an mean of 75,89, standard deviation of 14,319, variance value 205,045 with a range of 56 and a minimum value of 40 and a maximum value of 96. The average value of each indicator of solving ability students mathematical problems are as follows:

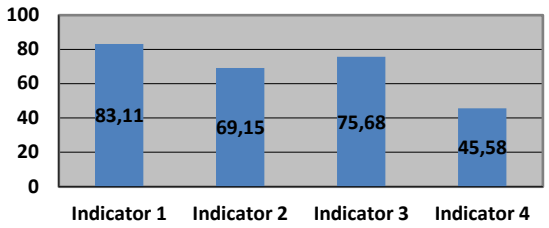

Figure 1
Average Class Students Mathematical Problem Solving Ability Indicators Experiment I

Based on Figure 1 shows that the average ability indicator solving students mathematical problems in experimental class I, namely indicator 1 the ability to understand the problem is 83,11 on questions number 1 and number 6, indicator 2 of the ability to plan problem solving, namely 69,15 on the questios number 2 and number 8, indicator 3 ability to solve problems accordingly plan, namely 75,68 in questions number 3, 5, and 7 as wel as indicator 4 the ability to check again is 45,58 on questions number 4 and 9. After getting the posttest scores in the experimental class II, the researcher then do a recapitulation of KKM achievement with a KKM score of 75 can be seen in the following table:

Table 3
Summary of Achievement of KKM Experiment Class II

Information	The Number of Students	Descriptions
Passed	11	31%
Not pass	25	69%
Amount	36	100%

Based on Table 3 shows that as many as 11 astudents get the vales is more than KKM if it is percentaged by 31%, while as many as 25 students score less than KKM if it is percentaged at 69%. Descriptive statistical analysis can be seen in the following table:

Table 4
Description of Experimental Class Data II

	N	Range	Min statistic	Max statistic	Mean	Std. Deviation statistic	Variance statistic
DMR learning model	36	45	40	85	64,34	13,090	171,350

Based on Table 4 it can be concluded that of the 36 students in the class experimental obtained an mean of 64,34, standard deviation of 13,090, variance value 171,350 with a range of 45 and a minimum value of 40 and a maximum value of 85. The average value of each indicator of solving ability students mathematical problems are as follows:

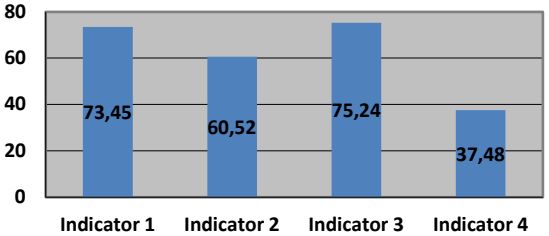

Figure 2

Average Class Students Mathematical Problem Solving Ability Indicators Experiment II

Based on Graph 2 shows that the average ability indicator solving students mathematical problems in experimental class I, namely indicator 1 the ability to understand the problem is 73,45 on questions number 1 and number 6, indicator 2 of the ability to plan problem solving, namely 60,52 on the questios number 2 and number 8, indicator 3 ability to solve problems accordingly plan, namely 75,24 in questions number 3, 5, and 7 as wel as indicator 4 the ability to check again is 37,48 on questions number 4 and 9.

To find out the comparison of problem solving abilities mathematical experiment class students I and II, can be analyze statistically using SPSS 20 software. Statistical test were carried out in this study including prerequisite test and hypothesis test. Prerequisite test is used for know the distribution of the data obtained is normally distributed and homogeneous or no. Next, a hypothesis test is carried out to find out if there is whether or not differences in students mathematical problem solving abilities in experimental class I and II using the t-test for two independent samples. After carrying out the prerequisite test with the help of SPSS 20 software, the results prerequisite test obtained on posttest scores in experimental classes I and II are as follows:

Table 5
Experimental Class Normality Test I and Experimen II

	Kolmogorov-Smirnov			Shafiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
DLPS	0,139	36	0,077	0,940	36	0,052
DMR	0,100	36	0,200	0,958	36	0,184

Based on Table 5 above can be seen the class normality test experiments I and II were tested using the Shapiro-Wilk test with levels significance of 5%, then normal distribution of data is obtained. It can be seen at the significance level in the experimental class I with the application of the double loop problem solving learning model of 0,052 which is greater than 0,05 (> 0,05), as wel as the experimental class II with the application of the multy reprecentacy discourse learning model of 0,184 which is greater than 0,05 (> 0,05). So, the data is normaly distributed. Then do the test homogeneity and t-test for two independent samples, then the results are obtained as follow:

Table 6
Homogenity Test and Independent Sample Experiment Class I and Experiment Class II

		Leven's Test for Equality of Variances		T-Test for Equality of Means				
		F	Sig.	t	df	Sig.	Mean	Std. Error
Nilai Akhir	Equal variances assumed	0,001	0,971	3,555	70	0,001	11,389	3,204
	Equal variances not assumed			3,555	70	0,001	11,389	3,204

Based on Table 6 can be seen the significance values on Leven's Test for Equality of Variances, namely 0,971 more than 0,05 (> 0,05), then it can be it was concluded that the variances of experimental class I and II data was homogeneous. Then, for the two independent samples t-tes refers to the significance values which is contained in the Equal Variances Assumed table, namely the value obtained significance of 0,001 is less than 0,05 (< 0,05). Therefore, it can be concluded that there is a significant difference between the application of the double loop problem solving learning model and the multy reprecentacy discourse learning model.

After the process of implementing the learning model in each class the experiment was completed, at the end of the meeting students were asked to fill out posttest. From the results of the posttest, the mean value of each experimental class was calculated. In the experiment class I obtained a mean value of 75,89 for 22 students passed the KKM with a percentage of 61%, while the mean value in the class experiment II, namely 64,34 as many as 11 students passed the KKM with a percentage of 31%. The results of the average indicator of the mathematical problem solving ability students in the experimental class I who apply the double loop problem solving learning model in Graph 1 obtained the highest average, namely on indicator 1 ability to understand the problem is 83,11 in question number 1 and number 6, and the lowest average is on indicator 4 of the ability to examine again, namely 45,58 on questions number 4 and number 9. While the results are the average indicator students mathematical problem solving abilities in the experimental class II applying the multy reprecentacy discourse learning model in Graph 2 obtained the highest average, namely on indicator 3 abilities solve the problem according to plan, namely 75,24 in questions 3, 5, and 7, and the lowest average is on indicator 4 abilities check again, namely 37,48 on questions number 4 and number 9. From both classes in the experiment, the average student answered incorrectly in indicator 4.

After the normality test was carried out with the help of SPSS 20 software obtained data normally distributed in table IV. 7. Seen in the Shapiro test –wilk with a significance level of 5% or equivalent to 0,05, the data is distributed normal. This can be seen in the significance value of the experimental class I with the application of the Double Loop Problem Solving learning model is equal to 0,052 which is greater than 0,05 (> 0,05), as well as the experimental class II with the application of the Multy Representation Discourse learning model of 0,184 which is greater than 0,05 (> 0,05), so the data is normally distributed.

Then a homogeneity test was carried out to find out whether the data experimental class I and II are homogeneous or not. This study uses test homogeneity in the form of Levene's test with the test provisions if the significance value (α) < 0,05, then Ho is rejected and if the significance value (α) ≥ 0,05, then Ho is accepted. So if the value of Ho is accepted then the data obtained is homogeneous. In Table IV 8 can be seen the significance value in Levene's Test for Equality of Variances, namely of 0,971 more than 0,05 (> 0,05), it can be concluded that the data variance experimental class I and II are homogeneous.

After the data is normally distributed and the variance is homogeneous then T-test was carried out by two independent samples until the test aimed at determine whether or not there is a significant difference between the experimental class I with the application of the Double Loop Problem Solving learning model and class experiment II with the application of Multi Representation Discourse to students' mathematical problem solving ability and independent two-sample t-test refers to the Equal Variances Assumed table, namely the significance value is obtained

Based on the results of previous studies, that amon the application of the double loop problem solving learning model with the multy reprecentacy discourse learning model, both are the same able to solve students mathematical problem solving abilities. Previously had described in the literature review that each model has advantages and

disadvantages. But in this researcher, solving ability students mathematical problems with the application of the multy reprecentacy discourse is lower than the ability to solve problems students mathematics with the application of the double loop problem solving learning model.

CONCLUSION AND IMPLICATION

Conclusion

Based on the results of research on the comparison on the double loop problem solving learning model with the multy reprecentacy discourse learning model on problem solving ability student mathematics conducted at SMP Negeri 7 Cirebon, conclusions were obtained as follow mathematical problem solving of students in experimental class I which applies the double loop problem solving learning model to Pythagorean theorem material shows a mean score 75,89 and as many as 22 students passed the KKM with a percentage of the 61%. Mathematical problem solving of students in experimental class II which applies the multy reprecentacy discourse learning model to Pythagorean theorem material shows a mean score 64,34 and as many as 11 students passed the KKM with a percentage of the 31%. From the results of the t-test of two independent samples, the sig value was obtained 0,001 less than 0,05 (< 0,05) then there is a significant difference between the application of the double loop problem solving learning model with the multy reprecentacy discourse learning model.

Implication

Based on result of this study, the following implications can be stated selection of the right learning model can affect abilities possessed by student's, especially on student's mathematical problem-solving abilities in mathematics lessons. Based on the result research, there are differences in student's mathematical problem-solving abilities between classes that apply the double-loop problem-solving learning model with that apply the multi reprecentant discourse learning model.

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