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The Effect of DMR on Students' Mathematical Problem Solving Ability and Self Efficacy

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Abstract
Problem solving ability and *self efficacy* are two important aspects that must be owned in order to learn mathematics well. This study aims to determine the effect of the Multi Representation Discourse (DMR) learning model on mathematical problem solving abilities and *self efficacy* learners. This type of research uses a quasy experiment using a posttest only control group design. The population in the study included all grade VIII junior high school students in the city of Bandar Lampung. The sampling technique used was cluster random sampling, with 50 students as respondents. The hypothesis test used in this study is manova. Based on the results of the study that the DMR model influences students' problem-solving abilities and self-efficacy, the use of the DMR learning model can improve students' mathematical problem-solving abilities, and students' self-efficacy can be increased using the DMR learning model.

Keywords: Troubleshooting, DMR Model, *Self Efficacy*.

Introduction

Mathematics can be used as a tool to form mindsets (Mahfiroh et al., 2021). Cornelius stated the importance of learning mathematics, including as a means to think logically, get used to solving everyday problems, develop creativity, recognize patterns of relationship between concepts, and increase awareness of cultural development (Marasabessy, 2020). According to Susanto, problem solving or problem solving is the process of applying previously acquired knowledge to new situations (Eppe et al., 2022; Kou et al., 2022)

Problem solving is a main activity in learning mathematics (Hidayat & Sariningsih, 2018). In line with this statement, Russefendi stated that the main skill in learning mathematics is the ability to solve problems (Mahfiroh et al., 2021). Dahar also believes that the main goal of education is the ability of students to face or solve the problems given (Mariam et al., 2019). Maimunah, Purwanto, Sa'dijah and Sisworo define problem solving as an activity of thinking in an effort to find a solution to a problem by involving knowledge and experience (Eppe et al., 2022). Meanwhile, Ulya defines problem solving as the ability to utilize existing knowledge to solve problems (Nengsih et al., 2019). The ability to solve problems is important to have as a provision for living life so that later it can be applied to various problem situations that are being faced (Siwi & Haerudin, 2019).

But in fact, the success of mastering these abilities is still difficult to achieve. This is evidenced by a survey conducted by researchers at one of the junior high schools in Bandar Lampung which showed that students' problem-solving abilities were still below the KKM. This is also supported by the results of research by Sumarmo and Fakhrudin (Somawati, 2018). Institutional survey result Internternational PISA also strengthens the statement regarding students' mathematical problem-solving abilities that have not been maximized. Indonesia ranks 73rd out of 79 countries that took part in the 2018 PISA test (Sari et al., 2022). This clearly shows that students' mathematical problem solving abilities are still far from expectation.

Students' mathematical problem-solving abilities are not maximized because during the learning process students are not used to working on HOTS questions (Marasabessy, 2020; Putra et al., 2018).). One of the internal factors of students who participate in the success of learning mathematics is self-efficacy (Kholivah

et al., 2020). Self-efficacy (SE) is a psychological aspect that influences the success of students in completing tasks and problem solving questions properly (Jatisunda, 2017). According to Bandura, self-efficacy is a person's belief in his ability and ability to carry out a series of problem-solving activities or certain tasks (Somawati, 2018). SE plays an important role in the achievement of a learning process, has a strong influence on learning activities, motivation, and also performance in carrying out assignments (Haq, 2011). A learner must have high self-confidence in his abilities and skills in carrying out his duties in order to achieve maximum learning achievement (Somawati, 2018).

To maximize students' problem-solving abilities and self-efficacy, it is necessary to use the right learning model (Pratiwi, 2016). The atmosphere of the student learning environment must be set in such a way that students are actively involved in every learning activity (Silviyani & Lestari, 2020). According to Ulvah, the participation of students in each lesson will affect students' problem-solving abilities (Putra et al., 2018). With the development of students' problem-solving abilities, it will increase students' confidence in solving problems or assignments given. An alternative learning model that can be used is the Multi Representation Discourse (DMR) learning model. DMR is a student-centered cooperative learning model in which students are required to be able to express ideas, describe ideas in writing, and exchange opinions with others(Herdiana et al., 2021). The DMR learning model is a learning that teaches how to solve a problem and develop problem-solving skills. The DMR learning model emphasizes learning in groups, helping each other and working together in finding solutions, exchanging ideas and integrating the knowledge possessed to obtain maximum learning results. Sahyudin stated that several learning stages in the DMR learning model are the preparation, preliminary, development, implementation, and closing stages(Rukiyah et al., 2020).

The advantages of the DMR learning model include providing opportunities for students to interact, discuss and cooperate with group mates to solve problems, foster student activity in learning, make it easier to understand subject matter, the learning process is more fun and not boring, and fosters good communication. between students and between teachers and students. The weakness of the DMR learning model is that it takes quite a long time because there is a process of discussion and information gathering and also the teacher must be able to plan learning well and prepare the supporting media needed in learning (Rukiyah et al., 2020).

The latest research that supports the DMR learning model influences the ability to understand mathematical concepts (Agustina et al., 2019), student learning outcomes (Ahmad et al., 2020), problem solving skills (Azizah & Handayani, 2020), and mathematical representation skills (Rukiyah et al., 2020). Then problem solving abilities can be improved using the SAVI learning model (Murti & Negara, 2019), the Open Ended method (Mariam et al., 2019), the Multi Representation Discourse model (Azizah & Handayani, 2020), and the Teams Games Tournament method (Silviyani & Lestari, 2020). As for previous researchers who have conducted research on self-efficacy including self-efficacy has an effect on mathematical representation abilities (Nadia & Isnarto, 2017), problem-solving skills (Kholivah et al., 2020), and ability to understand mathematical concepts (Amani et al., 2023; Rahmi, 2020).

Referring to the previous studies described above, both research regarding the use of the DMR learning model, mathematical problem solving abilities, and student self-efficacy, but no researchers have examined the effect of using the DMR learning model on students' problem-solving abilities and self-efficacy. Based on that, this article was created to discuss in more depth the influence of the DMR model on problem solving abilities and self efficacy learners.

Method

This research is a type of quasy experiment using a posttest only control group design. The population is all class VIII students in the city of Bandar Lampung. The sampling technique uses random class/cluster random sampling. The research sample consisted of 50 students with 25 students in each class, both the experimental class and the control class. The research was conducted in 4 meetings with 3 learning sessions and one meeting to carry out tests of mathematical problem solving skills and questionnaires self efficacy.

Data on mathematical problem solving abilities were collected using test instruments in the form of description questions totaling 6 items. The six items used have passed the validation stage including validity, level of difficulty, discriminatory power, and reliability. All items are also in accordance with all indicators of mathematical problem solving. The problem solving indicators refer to Polya; understand a problem, make plans/plans, do what has been planned, and re-check every step and result of problem solving (Mahfiroh et al., 2021; Quintanilla et al., 2023).

Data self efficacy students were collected by giving a questionnaire self efficacy which has been validated with a total of 27 statements. The valid questionnaire also meets all indicators of self-efficacy. Indicator self efficacy The methods used include (1) having confidence in one's own abilities, (2) having confidence in oneself's ability to adjust and dealing with difficult tasks, (3) having confidence in one's ability to face the challenges given, (4) having confidence in one's ability to complete certain tasks , and (5) confident in completing different tasks.

The data that has been obtained then goes through the data analysis stage by carrying out prerequisite tests which include the normality test using the Kolmogorov Smirnov test and the homogeneity test using the Box's M test. then do hypothesis testing using Manova.

Results and Discussion

After the learning activities and data collection processes (tests and questionnaires) were completed both in the class that used the DMR learning model (experimental class) and the class that used the direct learning model (control class), the results of the mathematical problem-solving ability test were obtained which were described in Table 1.

Table 1. Data Description of Students' Mathematical Problem Solving Ability Test Results

		Experimental Mathematical Problem Solving	Control Mathematical Problem Solving
N	Valid	25	25
	Missing	0	0
Mean		68,3333	23,0667
Median		72,0000	19,0000
Mode		74,00	48,00
Std. Deviation		13,24135	14,58136
Variance		175,333	212,616
Skewness		-,465	,748
Std. Error of Skewness		,427	,427
Kurtosis		-,758	-,730
Std. Error of Kurtosis		,833	,833
Minimum		44,00	7,00
Maximum		89,00	48,00
Sum		2050,00	692,00

Based on Table 1, it can be seen that the highest value, lowest value, middle value, mode, and mean in the experimental class are better than the control class. This shows that the problem-solving abilities of students who learn to use the DMR model are better than the problem-solving abilities of students who learn to use the direct learning model. The data from the results of the questionnaire self efficacy students are included descriptively in Table 2.

Table 2. Description of Questionnaire Result DataSelf Efficacy Learners

		Self Efficacy Eksperimen	Self Efficacy Kontrol
N	Valid	25	25
	Missing	0	0
Mean		78,2968	71,3344
Median		79,6300	72,2200
Mode		79,63a	63,89
Std. Deviation		5,43333	6,47784
Variance		29,521	41,962
Range		16,67	26,85
Minimum		68,52	55,56
Maximum		85,19	82,41
a. Multiple modes exist. The smallest value is shown			

Based on the table it is known that the average value, the middle value, the value that often appears, the highest score, and the lowest score of students in the experimental class are higher than the control class. This means that the results of the questionnaire self efficacy experimental class is better than the results of the questionnaire self efficacy control class. Then proceed with the first prerequisite test, namely the normality test using the test Kolmogorov Smirnov. The results of the normality test can be seen in Table 3 below.

Table 3. Normality Test Results for Mathematical Problem Solving Ability Test

Tests of Normality				
		Kolmogorov-Smirnov[a]		
	Class	Statistic	df	Sig.
Problem solving	Experiment	,166	25	,053
	Control	,156	25	,059
*. This is a lower bound of the true significance. a. Lilliefors Significance Correction				

In Table 3 it is known that the sig value in the experimental class is 0.53 and the sig value in the control class is 0.059, because all sig values in the column Kolmogorov Smirnov more than a significance level of 0.05, it can be concluded that the data on the results of tests of mathematical problem solving skills in both the experimental class and the control class have normal distribution of data.

Table 4. Results of the Normality Test of Questionnaire Results Self Efficacy Learners

Tests of Normality

		Kolmogorov-Smirnov[a]		
	Class	Statistic	df	Sig.
Self Efficacy	Experiment	,157	25	,114
	Control	,098	25	,200

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on Table 4 in column Kolmogorov Smirnov it is known that the sig in the experimental class is 0.114 and in the control class is 0.200. Because sig is more than 0.05, the data is distributed self efficacy both the experimental class and the control class are normally distributed.

Furthermore, the second prerequisite test was carried out, namely the homogeneity test using the test Box's M. The homogeneity test results are listed in the following table 5.

Table 5. Test ResultsBox's Test of Equality of Covariance Matrices

Box's M	1,667
F	,535
df1	
df2	605520,000
Sig.	,658
Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.	
a. Design: Intercept + A	

Based on Table 5, the value is known Box's M of 1.667 with a sig of 0.658. Because the sig value is more than the 0.05 significance level, it can be concluded that mathematical problem solving and self efficacy has a homogeneous variance-covariance matrix. While the homogeneity test for each data group uses the test Levene. Test results Levene listed in Table 6 below.

Tabel 6. Hasil Uji Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
Pemecahan Masalah Matematis	,318	1	48	,575
Self Efficacy	,240	1	48	,626

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ModelPembelajaran

In Table 6, the sig value in the line of solving mathematical problems is 0.575 and the sig value in the line self efficacy of 0.626. Because all sig values are more than 0.05, it can be concluded that the data variance in the mathematical problem solving data population is distributed the same (homogeneous), as is the data variance in the data population self efficacy also has a homogeneous distribution.

After the data is declared to be normally distributed and homogeneous, then the hypothesis is tested using the Manova test. The Manova test was carried out using the SPSS application. The following is the SPSS output of the Manova test results which are presented in Table 7.

Tabel 7. Hasil Uji *Multivariate*

	Effect	Value	F	Hypothesis df	Error df	Sig.
Learning Model	Pillai's Trace	,349	12,589[b]	2,000	47,000	,000
	Wilks' Lambda	,651	12,589[b]	2,000	47,000	,000
	Hotelling's Trace	,536	12,589[b]	2,000	47,000	,000
	Roy's Largest Root	,536	12,589[b]	2,000	47,000	,000

In Table 7, the row learning model sectionWilks Lambda it is known that the sig is 0.000 and because the sig value is less than 0.05, there are different results from the ability to solve mathematical problems and self efficacy between students who study using the DMR model and students who study with the direct learning model. Then a test was carried out to see the effect between subjects/variables. The results of the inter-subject influence test are described in Table 8.

Table 8. Inter-subject Influence Test Results

Tests of Between-Subjects Effects						
Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Learning Model	Mathematics Problem Solving	829,222	1	829,222	7,524	,009
	Self Efficacy	605,938	1	605,938	16,953	,000

Based on Table 8, the mathematical problem solving line has a sig value of 0.000. Because the sig value is less than 0.05, it can be concluded that there are differences in the problem solving abilities of students between those who learn using the DMR learning model and students who learn using the direct learning model. As for the row self efficacy it can be seen that the sig value is 0.000 and because the sig value is smaller than the significance level of 0.05, it can be concluded that there is a difference self efficacy between students who study with the DMR learning model and students who learn using the direct learning model.

The use of the DMR learning model has a positive influence on students' problem-solving abilities. In the DMR learning model the learning process is carried out by carrying out a lot of discussion activities, working

together to exchange thoughts, knowledge, and experiences between students in order to solve the problems given. Through such learning, students will find it easier to solve given math problems because they are looking for solutions to problems together, not working independently. Students will exchange ideas to determine the most appropriate solution to solve the problem.

During the process of finding solutions to problems there will be a transfer of knowledge between members of the discussion group so that the knowledge possessed by students will be better. The learning atmosphere in learning using the DMR model is not boring because each student is actively involved in various learning activities such as issuing ideas, communicating ideas in writing from what is thought, listening to ideas and opinions of other students, and conducting discussions both between group members and between students. with teacher. Giving problems at each meeting and group discussion activities that are carried out continuously will provide a lot of additional knowledge and experience for students in solving problems. This certainly has an impact on increasing students' mathematical problem solving abilities.

It is different from learning in classes that use direct learning models, where more learning activities are carried out by teachers than students. The teacher plays an active role in the learning process, the teacher provides subject matter and gives several examples of questions related to the material being studied, students listen and make notes about what the teacher has said, then the teacher will provide practice questions if there is still enough study time. So that during learning passive students and students tend to fixate on how to solve the problems given by the teacher as an example problem so that if given a problem outside the sample questions given by the teacher students will experience difficulties because so far the process of solving problems in learning students only follow problem-solving method used by the teacher without students being given the opportunity to carry out the problem-solving process using their own way. Such learning makes students minimal in problem solving experience because so far students have only followed the method of solving problems used by the teacher. This causes the mathematical problem solving abilities of students who learn to use the DMR learning model to be better than students who learn to use the direct learning model.

In addition to having an effect on mathematical problem-solving abilities, the use of the DMR learning model also has an effect on students' self-efficacy. In learning the DMR model students are required to carry out various activities including expressing ideas or opinions, writing down ideas they have, conducting question and answer discussion activities and presenting the results of the discussion. To be able to carry out these various activities, students must have self-confidence that with their knowledge and abilities students are able to solve the problems given. The activity of expressing and writing ideas requires students to have confidence in themselves that the ideas put forward can help the process of finding solutions to the problems they face. In discussion activities to solve problems, students must be sure that they and group members are able to solve the problems given. With high confidence in his ability to solve problems can provide maximum learning outcomes. Meanwhile, for students who study using the direct learning model, students are more dependent on the teacher. This is because during learning the teacher plays more roles while students are used to receiving material from the teacher. So that when students are given math problems, they lack confidence in their ability to solve problems because during the direct learning process students are used to following the problem solving method exemplified by the teacher. It makes self efficacy students who learn using the DMR model are better than students who learn using the direct learning model.

The findings in this study are in line with the findings of Azizah and Handayani who obtained the result that students' mathematical problem solving abilities were better by learning to use the DMR learning model (Azizah & Handayani, 2020). In addition, the research conducted by Herdiana, Zakiah and Sunaryo also gave the same results, namely the use of the DMR learning model had an effect on students' mathematical problem solving abilities (Herdiana et al., 2021).

Conclusion

Based on the research that has been done, the research results show that the problem-solving abilities of students who carry out the learning process with DMR are better than direct learning, as well as the resultsself efficacy. Of course, the application of DMR can improve student learning outcomes.

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