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Efek DMR terhadap Kemampuan Matematis Peserta Didik

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ABSTRACT

This research aims to evaluate the impact of the DMR model on students' mathematical representation, reasoning and reversible thinking abilities. This research uses a quasi-experimental design with a posttest only control design. The population consisted of class Data was collected through description tests and analyzed using normality, homogeneity and Multivariate Analysis of Variance (Manova) tests. Manova results show that students who use the DMR model have better mathematical representation, reasoning and reversible thinking abilities compared to students who use the conventional model (direct instruction). Therefore, the DMR model is suitable for use in the classroom learning process. The DMR learning model can be considered as an alternative choice for training students' mathematical representation, reasoning and reversible thinking abilities.

Keywords: *DMR, Representation, Reasoning, Reversible Thinking*

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PENDAHULUAN

Education is very important in human life, and mathematics is a crucial part. Mathematics learning needs to be organized to be more active, creative, effective and fun to improve achievement (Agustiana, Supriadi, & Komarudin, 2019). Mathematical ability standards expressed by NCTM, such as communication, connection, problem solving, reasoning, and representation, are an important focus in the learning process (Destiana, Sumarni, & Adiastuti, 2020).

When studying mathematics, students need to develop skills in representing mathematical problems, because this representation is an important basis for thinking and solving mathematical problems. According to Putri, Munandar, & Zulkarnaen (2021), each student has a different natural way of representing and solving mathematical problems, as well as in receiving, processing and understanding information. NCTM as mentioned in the research of Miladiah, Nurhaida, & Karimah (2020) also emphasizes the importance of representation in mathematics learning. However, in reality students' mathematical representation abilities are still low. According to Fajriah, Utami, & Mariyam (2022), this low ability is caused by several factors, such as students' lack of understanding of the problem, lack of skills in making pictures to solve problems, lack of skills in making mathematical models, and difficulty in making correct conclusions.

Meanwhile, mathematical reasoning abilities are very important for developing scientific attitudes in students. However, unfortunately, mathematical reasoning in Indonesia is still low, as stated by Wahyudin (Vivied Eka Pratiwi & Joko Soebagyo,

2022), who found that one of the reasons students fail to understand mathematical material well is because they have difficulty using appropriate reasoning in solving problems. . This is also in line with Sumartini's findings (Nurfitriyanti, Kusumawardani, & Lestari, 2020) that the lowest average percentage of Indonesian students occurs in the cognitive domain, especially at the reasoning level, only reaching 17%. Akmal (Destiana, Sumarni, & Adiastuti, 2020) added that the lack of student involvement in learning because educators do not involve them is also the cause of students' low mathematical reasoning abilities.

In learning mathematics, problem solving abilities are key for students. One indicator of problem-solving ability explained by Polya is "looking back" to double-check the correctness of the answer. This indicator contributes to low mathematical problem solving abilities because it requires the ability to think in reverse or reversible thinking (Palalas, 2022).

Kang and Lee (Maf'ulah, et al., 2019) explain that reversibility is the ability to reverse one's thinking back to the starting point after carrying out mental activity. An example of reversible thinking skills carried out by students is when completing mathematical operations such as addition-subtraction, multiplication-division, as well as materials that involve the concept of reversibility such as inverse, derivative and integral functions. When facing a problem, it is important for us to consider various possible solutions rather than just fixating on one solution (Bharata, Sutiarso, Noer, & Kurniawati, 2022). By using reversible thinking skills, students are invited to consider opposing points of view to reduce the risk of errors in decision making (Purwaningrum & Sutrisno, 2022). According to Siregar & Ananda (2023), students can be considered to have reversible thinking abilities if they are able to differentiate between problems in a problem, for example from solving the first equation to the next equation or vice versa. The low ability of reversible thinking in students is caused by a lack of understanding of these skills when working on mathematical problems.

Based on three mathematical abilities - representation, reasoning, and reversible thinking - these are important abilities for students when studying mathematics at school, because the three are interrelated in solving mathematical problems. Educators need to create learning that can facilitate the development of these three abilities in students. Interaction between educators and students is very important in learning to achieve the desired learning goals. However, unfortunately, there are many learning processes in schools where interaction between educators and students is lacking. According to Pratiwi, Bahri, & Pratiwi (2021), learning activities do not only focus on the transfer of knowledge from teachers to students, but also on motivating students to learn actively in order to achieve better behavior changes.

An appropriate learning model is needed in the process of teaching and learning activities. One learning model that can support this is the multiple representation discourse model (DMR), which is part of a cooperative learning setting. DMR emphasizes the discussion process to find solutions to problems and reach agreement among all group members. Therefore, this model is effective in encouraging students to participate actively and interactively in learning (Novita, 2022). In line with Rostika's opinion (in Tiyas, Bintoro, & Purwaningrum, 2020), the multi-representational discourse model is a model that is carried out in groups and uses representations to develop students' problem-solving abilities.

According to the research results of Adnyana, Suarsana, & Suharta (2021), students who apply the DMR learning model show better mathematical problem solving abilities compared to those who are taught using conventional learning. This

can be seen from the students' mathematics problem solving data collected through essay tests and analyzed using a one-sided t test at a significance level of 5%, which shows a t.count value of 1.79, while t.table is 1.67. Apart from that, it also shows that students who study with the DMR learning model have a better understanding of concepts and self-efficacy compared to those who study with the direct learning model (Amani, Pratiwi, & Anggoro 2023).

Based on the background explained previously, the researcher formulated the scope of the problem in this research to investigate the influence of students' mathematical representation, reasoning and reversible thinking abilities through the application of the DMR learning model. This research focuses on evaluating students' mathematical representation, reasoning and reversible thinking abilities.

METHOD

This research is a quantitative research with an experimental design using Quasi Experimental Design, especially a posttest only control design. In a quasi-experimental design, there are at least two sample groups: an experimental group that receives treatment and a control group that does not receive treatment. Researchers divided these groups without randomizing and referring to existing groups. The population in this study were all class XI students at MAN 1 Central Lampung for the 2023/2024 academic year. The sample consisted of 70 students, of which 35 students in class XI.3 were the experimental group and 35 students in class XI.6 were the control group. The sample class consists of two classes, with the experimental class using the DMR model and the control class using the conventional model, namely direct instruction. Sampling was carried out using the cluster random sampling technique.

The data collection method in this research uses description tests and observations. The test instrument is used to measure students' mathematical representation, reasoning and reversible thinking abilities in the composition of functions and inverse functions. Before being given to students, the test questions are tested first to ensure validity, reliability, level of difficulty and distinguishing power. After going through validity and reliability tests, the instrument was declared valid and reliable. The data obtained was then analyzed by carrying out prerequisite tests such as normality tests and homogeneity tests. Hypothesis testing in this research uses the Multivariate Analysis of Variance (Manova) test.

RESULTS AND DISCUSSION

Analysis of student ability data involves posttest data analysis, which is carried out after learning. Learning activities were carried out in both sample classes. DMR learning is applied in the experimental class, while the control class uses a conventional learning model, namely direct instruction. After that, a posttest was carried out, the results of which are shown in the following table:

Table 1. Data Description of Mathematical Representation Ability

Data	Experimental Class Posttest	Control Class Posttest
Rata-Rata	80,80	64,97
Maximum Score	100	92
Minimum Score	50	42

Table 2. Data Description of Mathematical Reasoning Ability

Data	Experimental Class Posttest	Control Class Posttest
Rata-Rata	83,69	68,91
Maximum Score	100	100
Minimum Score	58	43

Table 3. Capability Data Description*Reversible Thinking* Mathematical

Data	Experimental Class Posttest	Control Class Posttest
Rata-Rata	78,83	63,34
Maximum Score	100	96
Minimum Score	46	38

Figure 1. Post-Test Results for Representation, Reasoning and Reversible Thinking Abilities

From Table 1, it can be seen that the average posttest score for the experimental class is higher than the average posttest score for the control class. The average posttest score for the experimental class was 80.80 while the control class was 64.97. This shows that the mathematical representation abilities of students in the experimental class are better than those in the control class.

Based on Table 2, descriptively, the mathematical reasoning abilities of students in the experimental class are also better than those in the control class. The average mathematical reasoning score for the experimental class was 83.69 while the control class was 68.91.

From Table 3, it can be seen that the reversible mathematical thinking ability of students in the experimental class has an average value of 78.83, while in the control class it is only 63.34. This shows that there are differences in mathematical representation, reasoning and reversible thinking abilities between the experimental class and the control class, where students who use the DMR learning model are superior to students who use the direct instruction learning model.

Next, normality testing of representation, reasoning, and abilities was carried out*reversible thinking* mathematical students.

Table 4. Normality Test Calculation Results

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	Df	Say.	Statistic	df	Say.
Representation	Experiment	.097	35	.200*	.956	35	.176
	Control	.123	35	.200*	.964	35	.297

Reasoning	Experiment	.104	35	.200*	.954	35	.148
	Control	.124	35	.192	.980	35	.755
Reversible Thinking	Experiment	.135	35	.109	.960	35	.233
	Control	.143	35	.068	.959	35	.220

Based on Table 4, the p-Value value in testing the normality of the mathematical representation for the experimental class and control class is 0.200 and 0.200. Meanwhile, the p-value in testing the normality of mathematical reasoning for the experimental class and control class is 0.200 and 0.192. The p-value in the reversible mathematical thinking normality test for the experimental class and control class is 0.109 and 0.069. With an α value of 0.05, it can be concluded that the data from the test results of mathematical representation, reasoning and reversible thinking abilities for the experimental class and control class are normally distributed. Next, testing was carried out for the homogeneity of students' mathematical representation, reasoning and reversible thinking abilities.

Table 5. Homogeneity Calculation Results

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Say.
Representation	.004	1	68	.952
Reasoning	.655	1	68	.421
Reversible Thinking	1.527	1	68	.221

Based on Table 5, the homogeneity test results show the value*p-Value* representation ability 0.952 > 0.05, reasoning 0.421 > 0.05, and*reversible thinking* 0.221 > 0.05 so it can be concluded that the data comes from the same or homogeneous variant.

Once it is known that the data is normally distributed and has homogeneous variance, then hypothesis testing is carried out using Manova. The first test carried out was the influence test between subjects or variables. The results of testing the influence between subjects or variables are summarized in Table 6.

Table 6. Results of Inter-Subject Influence Test

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Say.
Learning model	Representation	4384.514	1	4384.514	27.034	.000
	Reasoning	3818.414	1	3818.414	26.079	.000
	Reversible Thinking	4196.629	1	4196.629	23.911	.000

Based on Table 6, the results of the influence test between subjects obtained values*p-Value* representation ability 0.000 < 0.05, reasoning 0.000 < 0.05, and*reversible thinking* 0.000 < 0.05, so it can be seen that the application of the DMR model has a significant effect on each of the representation, reasoning and*reversible thinking* mathematical students.

Next, to find out the differences in representation, reasoning, and abilities*reversible thinking* mathematics in the experimental and control classes, which can be seen by paying attention to Wilks' lambda analysis. The results of the analysis using SPSS can be seen in Table 7.

Table 7. Multivariate Test Results

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Say.
Intercept	Pillai's Trace	.987	1724.091[b]	3.000	66.000	.000
	Wilks' Lambda	.013	1724.091[b]	3.000	66.000	.000
	Hotelling's Trace	78.368	1724.091[b]	3.000	66.000	.000
	Roy's Largest Root	78.368	1724.091[b]	3.000	66.000	.000
Learning model	Pillai's Trace	.464	19.050[b]	3.000	66.000	.000
	Wilks' Lambda	.536	19.050[b]	3.000	66.000	.000
	Hotelling's Trace	.866	19.050[b]	3.000	66.000	.000
	Roy's Largest Root	.866	19.050[b]	3.000	66.000	.000

The calculation results show that the application of the DMR model has a significant effect on representation, reasoning, and abilities*reversible thinking* mathematical students. It can be seen that the value of Wilks' Lambda is 0.000 with a significance value of 5% so that 0.000 < 0.05 which shows that there is an influence of the DMR model on the ability of representation, reasoning and*reversible thinking* mathematical students.

The research results show that the application of the DMR model has an influence on students' mathematical representation, reasoning and reversible thinking abilities. Descriptive data from these three abilities shows that the experimental class has a higher average score compared to the control class. Apart from that, of these three abilities, mathematical reasoning abilities have a higher average than representation and reversible thinking abilities.

The research results show that the application of the DMR model has an influence on students' mathematical representation, reasoning and reversible thinking abilities. Descriptive data from these three abilities shows that the experimental class has a higher average score compared to the control class. Apart from that, of these three abilities, mathematical reasoning abilities have a higher average than representation and reversible thinking abilities. This is in line with research (Shomad, Rukmigarsari, & Faradiba, 2021) which shows that problem solving, representation and reasoning abilities are interrelated. The research results also show that representation and reasoning abilities together have a significant influence on mathematical problem solving, where the influence reaches 91%.

According to Rukiyah, Widiyastuti, & Thahir (2020), one of the learning models that can be applied in the learning process is the multi-representational discourse learning model. The multi-representation discourse learning model (DMR) aims to shape the character of students by using various representations in the learning process, so that it is appropriate to use in the learning process. According to Fortune, Djadir, & Djam'an (2018) the use of the DMR learning model has been proven to have a positive impact on learning, namely, it can improve student learning outcomes. The syntax of the DMR learning method is preparation, introduction, development, application, and conclusion. where this model emphasizes learning in heterogeneous groups, helping each other, working together to solve problems, uniting opinions, to obtain optimal group and individual success.

This is different from the control class which uses a direct instruction model, where learning is still focused on the teacher. The learning process begins with the delivery of material by the teacher, followed by explaining the material to students, providing example questions, and giving students the opportunity to ask questions if there is something they do not understand. Even though some students looked active and asked questions when the research explained the material or gave practice questions about composition of functions and inverse functions, there were still many students who lacked focus, chatted, didn't pay attention, and didn't take notes. This is because teachers focus more on delivering material and giving assignments, thus making students passive in learning.

When given an assignment, only a few students were seen working on it independently, while others relied on their friends' abilities by copying their answers. This causes students to become less confident in their own abilities because they continue to depend on their friends. As stated by Fortune, Djadir, & Djam'an (2018), research results show that students who are taught using the DMR type cooperative model have higher posttest scores compared to students who apply the conventional learning model. This finding is in line with research by Azizah & Handayani (2020) which found that the average problem solving abilities of students taught using the DMR model and the direct instruction model were different, with the problem solving abilities of students taught using the DMR model being better than those taught using the DMR model. direct instruction.

CONCLUSION

From the research results and discussions that have been presented, it can be concluded that the DMR learning model influences students' mathematical representation, reasoning and reversible thinking abilities. The experimental class that used the DMR learning model showed better mathematical representation, reasoning and reversible thinking abilities than the control class students who used the conventional learning model, namely direct instruction. Therefore, the DMR learning model can be considered as an alternative choice for training students' mathematical representation, reasoning and reversible thinking abilities.

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