

Application of the Multi-Representative Discourse Learning Model (DMR) to Numeracy Literacy Ability

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ABSTRACT

Background: The general issue in mathematics education is the suboptimal numeracy literacy skills of students, which adversely affects their learning outcomes. Improving these skills is essential for enhancing students' overall academic performance in mathematics.

Purpose: This study aims to maximize students' numeracy literacy skills through the application of the Multi-Representation Discourse (DMR) learning model. The research seeks to evaluate the effectiveness of the DMR model in improving students' numeracy literacy compared to conventional teaching methods.

Methods: The research methodology employs a quantitative approach using a quasi-experimental design. The instrument used in this study is a numeracy literacy skills test, with a sample consisting of two classes: an experimental group and a control group. Preliminary tests confirmed that the data met the criteria for normality and homogeneity, allowing hypothesis testing to be conducted using the t-test.

Results: The research findings show that $t_{\text{table}} > t_{\text{table}}$ or $3.03695 > 1.67792$, leading to the rejection of H_0 . This indicates that at a 5% significance level, the numeracy literacy skills of students using the cooperative learning model type Multi-Representation Discourse (DMR) are significantly better than those of students using conventional teaching methods.

Conclusion: The study concludes that the application of the DMR learning model significantly enhances students' numeracy literacy skills compared to conventional teaching methods. These results suggest that implementing the DMR model in mathematics education can lead to better learning outcomes for students.

KEYWORDS

Mathematics Education, Multi-Representation, Numeracy Literacy

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INTRODUCTION

Numerical literacy is one of the important skills in the 21st century that must be mastered by students (Kuloglu, 2022). Numerical literacy is a comprehensive and fundamental skill in overcoming everyday problems, this ability starts from understanding problems, using mathematical tools in order to find solutions and then utilizing solutions obtained in life (OECD & UNESCO Institute for Statistics, 2021; OECD, 2023). Numeracy literacy skills are used as a reference for assessing students' mathematical abilities in the form of PISA Assessments globally (OECD, 2019) and Minimum Competency Assessment (AKM) in Indonesia



(Ministry of Education and Culture, 2023b). PISA 2022 shows that Indonesia's average score is 366, which shows a decrease of 13 points compared to the results of PISA 2018 (OECD, 2018).

In the category of mathematical ability Indonesia obtained a score of 363 where Indonesian students who were able to solve problems at levels 5-6 were 0.1 while those who were able to reach levels 2 and below were 59.0 (OECD, 2023) (University of Reading, 2023). The average ability of Indonesian students at level 2 and below causes Indonesia to be unable to compete in the 21st century because AI computer technology is able to solve problems at this level (Kemdikbud, 2023a; University of Reading, 2023). The results of Indonesian students' PISA mathematics achievements are seen in several studies which show the low results of students' numeracy literacy skills in learning mathematics in the form of geometry, algebra, statistics (Agustiani et al., 2021; FADELA, 2023; Nisa et al., 2023; Nolaputra et al., 2018; OKTAVIANA & Murtopo, 2022; Patih et al., 2019; Prihartini, 2022). In addition, the results of the daily assessment of mathematics in the material of rows and series of students in class X SMA N 3 Batusangkar show that the average student's incompleteness reaches 70%.

One of the causes of students' low numeracy literacy skills is the application of learning in the field. Several studies related to numeracy literacy in an effort to improve students' abilities have been carried out, such as applying contextual learning models (Solekhah, 2020), PBL and PjBL learning models (Fitriani, 2023; Nolaputra et al., 2018) (Alfiany, 2023; Muslimah, 2021), cooperative learning models (Marlina, 2021). In addition to the application of learning models, research on the development of teaching materials, videos, books, comics (Ayu, 2020; LATIF, 2022; Umbara & Nuraeni, 2019). The application of learning models and the use of learning models have been carried out a lot in the implementation of the 2013 curriculum, while the implementation of the Merdeka curriculum is still small. Even though the application of various kinds of learning models in the Merdeka curriculum is important (Nari et al., 2024).

The application of cooperative models can improve students' numeracy literacy skills. There are many types of cooperative learning models including Multi-representation Discourse DMR learning. This model has not been widely applied in mathematics learning even though this model is a cooperative learning model that contributes to students' numeracy literacy skills.

RESEARCH METHODOLOGY

The research method used is a type of experimental research with a quantitative paradigm. The form of the research design is Control Experiment Design. The treatment given to the experimental group was the application of the *Dirkursus Multy Reprerentacy* (DMR) type cooperative learning model while in the control group using a conventional learning model with the design, namely:

Table 1 : Randomized Control Group Only Design Research Design

Group	Treatment	Posts
Eksperimen	X	T ₁
Control	O	T ₂

Caption (Florida, 2012):

- X : Learning with a Dirkursus Multy Reprerentacy (DMR) type cooperative learning model
- O : Conventional Learning
- T₁ : Numeracy literacy ability in the experimental classroom
- T₂ : Numeracy literacy ability in the control class

Time and Place of Research

The population in this study is all X SMAN 3 Batusangkar, Lima Kaum District, Tanah Datar Regency, West Sumatra Province for the 2023/2024 Academic Year.

Target/Research Subject/Population and Sample

Using the simple random sampling technique, two classes were taken randomly. The first class taken as the experimental class is X.E.5 and the second class taken is class X.E.4 as the control class. In obtaining data on students' numeracy literacy skills by applying the DMR learning model, data collection was carried out using students' numeracy literacy ability tests.

Data Analysis Techniques

The data analysis technique uses several tests, namely: normality test, homogeneity test and hypothesis test. The numeracy literacy indicators used in this study are indicators according to Han, et al. (2017), namely (1) Using various kinds of mathematical numbers and symbols to solve daily problems, (2) Analyzing information displayed in various forms, and (3) Interpreting the results obtained and using for decision-making.

RESULT AND DISCUSSION

Descriptive Research Results

From the results of the final test carried out, the calculation of the average score was obtained $\bar{x}$, Variance (S^2), and standard deviations (s) For both sample classes are stated in the following table:

Table 2: Final Test Results						
Class		N		S^2		Lowest Score
Eksperimen	77.5	20	125.22	11,1	91.	58.3
Control	63.95	23	291.38	7,07	87,	33.33

From table 2, it can be seen that there is a difference in the average score between the experimental class and the control class. The average score of the class that received *the Multi Representation Discourse* (DMR) learning model was better than the average score of the class that received the conventional learning model where the experimental class had an average of 77.5 while the average for the control class was 63.59. With the highest score of 91.7 in the experimental class and the lowest score of 58.3, while in the control class the highest score was 87.5 and the lowest score was 33.33 (Verma & Abdel-Salam, 2019).

Inferential Research Results

Before the hypothesis test is carried out, the normality test and the variance homogeneity test on the test results of the two sample classes.

a. Normality Test

Based on the results of the normality test conducted on the sample class, the following are obtained:

Table 3 : Results of the Normality Test					
Class			Result	Information	
Eksperimen	0.109	0.269	$L_0 \leq L_{tabel}$	Normally distributed	
Control	0.116	0.264	$L_0 \leq L_{tabel}$	Normally distributed	

Based on the normality test above, it can be concluded that the two classes are distributed normal.

b. Homogeneity Test

The homogenies test aims to see whether the two sample classes have homogeneous variances or not. After conducting a homogeneity test on both samples, the following were obtained:

Table 4 Homogeneity Test Results

Class	$X_h < X_t$				Results
Eksperimen	3.63	3,841	3,638496	<	Homogeneous
Control	8496	4588	3,8414588		Samples

Based on the homogeneity test above, it can be concluded that both classes have homogeneous variances.

c. Hypothesis Test

After conducting a normality test and a variance homogeneity test on the final test, it was found that both classes were normal and homogeneous. Furthermore, a hypothesis test was carried out using a t-test at a real level of 0.05.

The results of the t-test in both sample classes are as follows:

Table 5 : Results of Hypothesis Test

Class	N	$\bar{X}$	t_{hitung}	t_{tabel}
Eksperimen	20	77.5	3,03695	1.67792
Control	23	63,95		

Based on the table above, it is obtained that $t_{hitung} > t_{tabel}$ or $3,03695 > 1,67792$ so H_0 rejected, meaning at a significant level of 5% (Verma & Abdel-Salam, 2019).

Discussion of Abilities (Literacy, Numeracy and DMR)

The steps of the Multi Representation Discourse (DMR) learning model carried out are:

Preparation Stage

Teachers prepare learning modules and LKPD that are used in learning. At the beginning of the lesson, the teacher greets and regulates the conditions of the students to learn, then asks the students to pray and read the Quran before learning. Students sit in their respective places and start praying and continue by reading the Quran. After that, the teacher gave the students an aperception by reassociating the prerequisite material, namely the Two-Variable Linear Equation System (SPLDV). Students understand the concept of SPLDV well so that they are able to answer all the questions given. After that, the teacher conveyed the learning objectives, namely the Two-Variable Linear Inequality System (SPtLDV) using the Multi Representation Discourse (DMR) learning model.

Preliminary Stage

At this stage, the teacher arouses students' interest in learning by exploring and conveying the benefits of learning SPtLDV material. Students have a high curiosity to know how to get maximum profits in sales. After arousing students' curiosity and interest in learning, the teacher divided students into five groups consisting of 4-5 students in one group, groups were formed based on students' abilities. Students are given LKPD which is used for multi-representation learning and sits according to their respective group members.

After that, the teacher directed the students to read the instructions for using the LKPD. Students and their group mates read the instructions for using the LKPD and continue to discuss the material presented while being guided by the student handbook. After that, students have a discussion about the given problem. At this stage, the teacher guides students so that they are able to understand and solve the given problems (Amani et al., 2023; Budarsini et al., 2018). At this stage, students are used to using various mathematical tools in the form of numbers and symbols to help solve mathematical problems and develop their numeracy literacy.

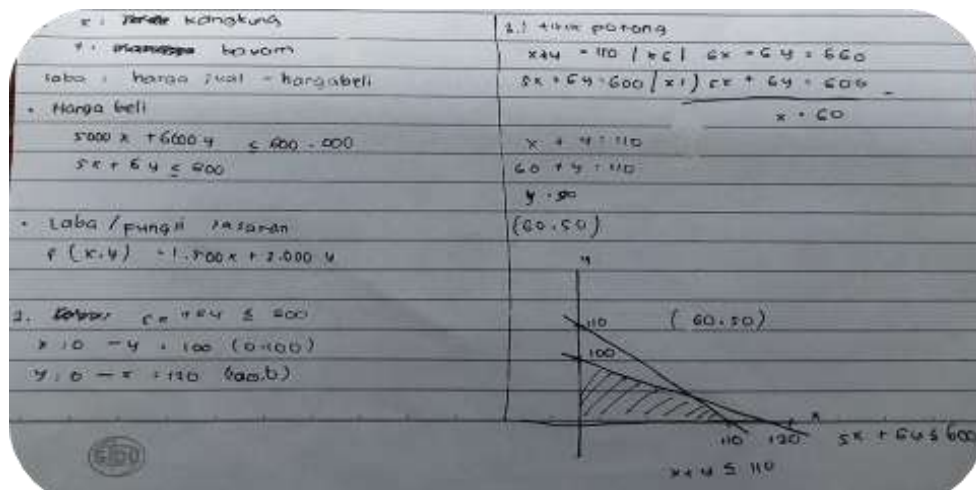


Figure 1: Students' Numeracy literacy ability on indicator 1

Development Stage

At this stage, the teacher asks students to complete the exercises given in the LKPD. Students pay attention to the questions contained in the LKPD and then work on the questions by discussing and writing in the columns that have been provided. Students and group members discussed, analyzed and exchanged ideas to solve the problems they were working on. After that, the teacher asked students to design steps and stratigraphy used in solving the given problem (Azizah & Handayani, 2020; Budarsini et al., 2018; Ramadhan & Hidayah, 2022). At this stage, students are able to identify information on the problem and are able to find the correct strategy. However, students have difficulty in completing the strategies used. By accompanying and providing guidance to students, until finally students are able to solve problems well.

Students' numeracy literacy skills develop during learning at the development stage of the second indicator of numeracy literacy skills, namely analyzing information displayed in various forms, and interpreting the results obtained and using for decision-making (Salvia et al., 2022). The numeracy literacy ability in this indicator can be seen in the results of the student numeracy literacy ability test, namely:

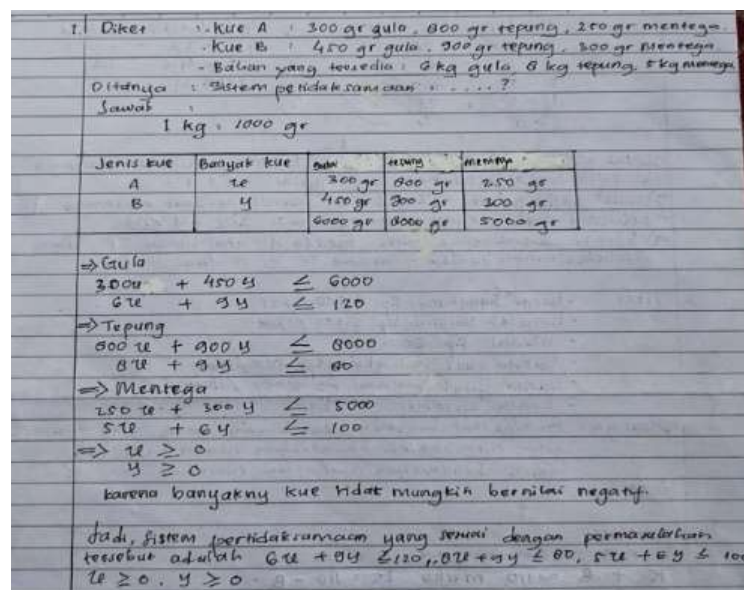


Figure 2 : Numeracy Literacy Ability of Students indicator 1 and 2

Deployment Stages

At this stage, the teacher asks each group to make a report in the form of a conclusion on the problem that has been discussed to be presented to the class. Students complete their work

according to the given time and do group percentages in front of the class. When students in one group explained, students from other groups responded by giving questions or suggestions in receiving the percentage. With the activities in this step, students are trained for indicator 3 numeracy literacy skills, namely interpreting the results obtained and using them for decision making.

Closing Stage

At this stage, the teacher guides the students to draw conclusions to the problem that has been discussed. Students are able to draw conclusions about the material they have learned today. Then the teacher gave appreciation to the group that was the best in the learning process. Finally, the teacher closed the learning by saying alhamdulillah.

CONCLUSION

Conclusion

Based on the research that has been carried out in class X of SMAN 3 Batusangkar, and the results of the analysis and discussion that has been carried out, it can be concluded that students' numeracy literacy ability with the application of the Multi Representation Discourse (DMR) type cooperative learning model is better than the student's numeracy literacy ability by applying the conventional learning model.

Suggestion

This study has just analyzed the application of the Multi Representation Discourse Learning Model to 3 indicators of numeracy literacy ability. The next researcher can conduct an analysis of numeration literacy skills in indicators according to PISA.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

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