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Concept Understanding Skills and Mathematical Problem-Solving Skills in Algebraic Materials: The Effect of DMR Learning Model Assisted by Dragonbox Puzzle Game During The Covid-19 Pandemic

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Abstract

This article aims to find out the concept understanding skills and mathematical problem-solving skills of junior high school students in Bandar Lampung after being treated using Multi-Representation Discourse (DMR) learning assisted by DragonBox puzzle games within one semester of learning. The data analysis performed was the One-way Multivariate Analysis of Variance (MANOVA). The results showed that during the COVID-19 pandemic, the DMR model assisted by math games had a better effect on concepts understanding skills and mathematical problem-solving skills of students' math problems both partially and simultaneously.

Keywords: DMR (Multi Representation Discourse) Model; DragonBox puzzle game; Mathematical Concepts Understanding; Mathematic Problem-solving.

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Introduction

Educational problem persistently tasked to educators is creating learning innovations to increase students' learning interest and learning outcomes. Classroom learning requires educators to be more creative and innovative in the implementation of the teaching and learning process (Hanifah et al., 2019). There are many impacts of low learning interest, such as students' concepts understanding skills and mathematical problem-solving skills. One of the skills or expertise in understanding and explaining an action or atmosphere of a class that has general characteristics known in mathematics is called conceptual understanding (Fahrudin et al., 2018). Mathematical problem-solving skills are the skills to understand problems, compile a solution plan, carry out a solution plan, and check back on a given mathematic problem (Ariani et al., 2017; Krisdiana et al., 2018). Mathematics concept understanding is essential because students with good understanding can solve problems and apply the learning to the real world.

The world is currently being ravaged by the COVID-19 pandemic. In Indonesia, its impacts are felt by all people. A study pointed out that the COVID-19's impacts exist in various fields, such as social, economic, tourism, and education (Dewi, 2020). A community survey during the Covid-19 pandemic reveals that the role of learning media is the most important aspect in the teaching and learning process. If the learning process is not fun, it might be caused by the lack of media in learning (Wahyuningtyas & Shinta, 2017). Games are a learning medium that has several advantages. They are entertaining and fun to do (Sudirman, 2002).

The learning process using DMR can improve the concept understanding because it is interrelated. Learning media can make students more happy and enthusiastic during the learning (Anggraeni et al., 2020). Furthermore, Wijaya (Wijaya, 2019) concludes that one of the steps of

the DMR learning model is to use learning media so that it can motivate and foster students' learning interest.

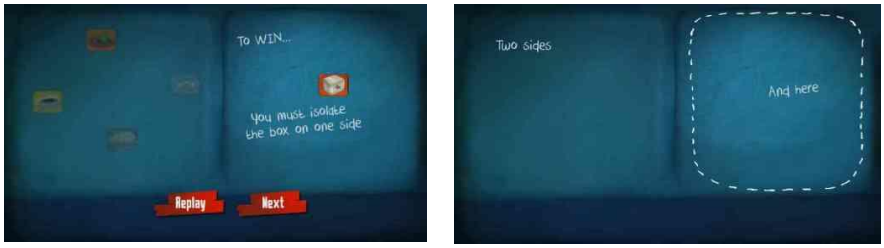
DMR or Multi-Representation Discourse is a cooperative learning model so that students can be more active (Johnson et al., 2010). It is a scientific discipline that investigates the relationship between forms and functions of verbal communication (Renkema, 1993). Thus, DMR learning is beneficial to make the learning more meaningful, ease the students to obtain learning material, create a pleasant atmosphere, activate the students, establish good communication between teachers and students, improve the problem-solving skills, nurture self-trust, foster curiosity, improve good communication skills, and improve social skills (Rostika & Junita, 2017).

Implementing the DMR model can lead to several advantages, among other learning becomes more meaningful for students so that it will have a positive impact on students' conceptual understanding, students become active during the learning process, good communication can be built between students and teachers and the learning environment, and students can foster self-confidence and curiosity (Budarsini et al., 2018). Ahmad and Domu (Ahmad et al., 2020) (Domu et al., 2020) discover that DMR is effective because students are more flexible in using learning resources. It also facilitates discussion in groups. However, DMR also encountered obstacles where not every student is active in learning and time management.

The indicators of mathematical concepts understanding used in this study refer to indicators stated by the Ministry of Education and Culture. The indicators contain the concept restating skills, the skills to provide examples and not examples, the skills to present concepts in various forms of mathematical representation, the skills to use, utilize, and select certain procedures, and the skills to apply concepts or algorithms to problem-solving (Ningsih, 2016). Problem-solving is one of the goals in learning activities seen from the aspect of the curriculum (Cahyani & Setyawati, 2016). Problem-solving skills indicators are based on Amir's thinking, namely: able to clarify unclear concept terms, can formulate and analyze problems, can organize ideas systematically and analyze deeply, and can find additional information from other sources (Gunantara et al., 2014).

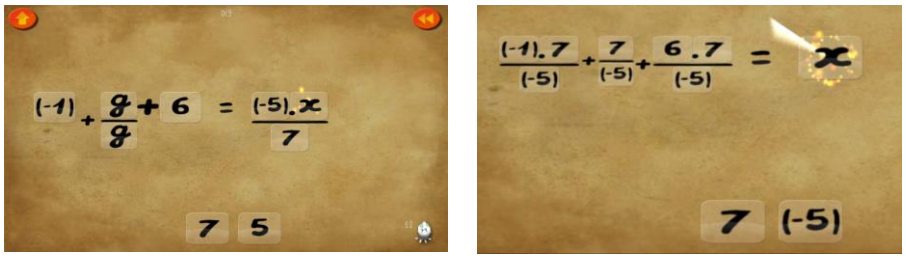
There have been many studies regarding the application of DMR combined with learning media in the form of games and other techniques to improve the concepts understanding skills and mathematical problem-solving skills, one of which is conducted by Asmara (Asmara & Asnawati, 2020; Rukiyah et al., n.d.; T et al., 2020; Wijaya, 2019). However, there has been no research that combines the DMR learning model with the DragonBox Algebra puzzle math game media.

DragonBox Algebra puzzle game (Sylviani & Permana, 2020) provides a fun but meaningful mathematics learning. In this game, there will be 2 sides containing several cards and a DragonBox. To win, the students have to remove all the cards on the side that contains the DragonBox, so that only Dragonbox is left on that side.



Picture 1. ***DragonBox Algebra Puzzle Game***

This game is interesting because the card elimination technique is similar to mathematical concepts, such as by dividing or multiplying the cards. The following is an example of mathematical equations:



Picture 2. ***DragonBox Algebra Puzzle Game***

DragonBox Algebra puzzle games indirectly teach mathematical concepts and mathematical problem-solving to students. A doctoral research result provides a tagline for this game, namely "Brilliant, kids don't even know that they are doing math"(Cates, 2018). This game is highly recommended for teaching conceptual problems and solving math problems. This game is specifically designed for algebraic material so that the researcher chose to use this game to assist the DMR learning model.

Many similar studies using DragonBox as a learning medium have been carried out, namely (Cates, 2018; Long & Aleven, 2017; Siew et al., 2016; Sylviani & Permana, 2020; Teofani et al., 2020). However, there has not been a single study that specifically uses the DragonBox puzzle game media combined with the DRM learning model to see its effect on students' concepts understanding skills and mathematical problem-solving skills. The novelty of this research is the use of the DragonBox puzzle game media in DRM learning to assess the effect of the game on the concepts understanding skills and problems solving skills. Therefore, the researchers were interested in seeing whether the DMR learning assisted by the DragonBox puzzle game influence junior high school students' concepts of understanding ability and mathematical problem-solving skills in algebraic material during the COVID-19 pandemic.

The Research Methods Research

The data collected in this research were in the form of quantity (numbers) so it is called quantitative research. The type of experiment employed was a quasi-experimental design with posttest only control group design using 2x2 factorial design. The population in this study were all junior high school students in Central Lampung Regency. The sampling technique used was cluster random sampling. The sample in the study consisted of 64 students divided into two classes, 32 students in the experimental class and another 32 students in the control class. The experimental class students were given treatments in the form of DMR learning assisted by the

DragonBox puzzle game for one semester. The data analysis technique in this study was the Multivariate Analysis of Variants (MANOVA) with a critical value of α = 5%.

The Results of the Research and the Discussion

The results in this study came from tests of conceptual understanding and problem-solving skills given to the experimental class (the class that applied the DMR model assisted by the DragonBox puzzle game) and the control class (the class that applied the expository model). The following is a description of the analysis of the test results.

Table 1. Data Description of Mathematical Concept Understanding Skills and Problem-solving Skills

Value	Xmax	Xmin	Concept Understanding			Problem-solving		
			$\bar{X}$	Std. Dev	N	$\bar{X}$	Std. Dev	N
Experimental Class								
Post-Test	100	63	80.23	7,940	22	84.94	10,326	22
Control Class								
Post-Test	94	50	72.73	7,356	22	70.74	11,793	22

Based on Table 1, the experimental class had a better post-test score than the control class. This can be seen from the average score of mathematical concept understanding skills (80.23) and mathematical problem-solving skills (84.94).

The data normality test and homogeneity test had been performed before performing the hypothetical test. If the data analyzed is normally distributed, then parametric statistical techniques can be used. Contrary, if the analyzed data is not normally distributed, then nonparametric statistical techniques can be used. The first step taken was analyzing the normality test data using the Kolmogorov-Smirnov test. The results are presented in Table 3.

Table 2. Normality Test Results

Variable	Experiment Class	Control Class	Conclusion
Problem-solving	0.346	0.405	Normal Distribution
Concept Understanding	0.757	0.839	

Based on Table 3, the normality test obtained a significance value. Therefore, the data for the two skills came from populations that were normally distributed. The next step was analyzing whether the two groups had homogeneous variances. The homogeneity test was performed using Lavenne's test. The results of the homogeneity test are presented in Table 4.

Table 3. Homogeneity Test Results

Variable	Sig.	Conclusion
Concept Understanding	0.477	Homogeneous
Problem-solving	0.560	

Table. 3 shows that the concepts understanding skills and mathematical problem-solving skills data were homogeneous. After the prerequisite tests had been carried out, the hypothesis testing was performed using a parametric test, namely the Multivariate Analysis of Variance

(MANOVA) test. The first test was a test of influence between subjects/variables (partially). The results of the test can be seen in table 4.

Table 4. Partial MANOVA Test Results

Category	Skills	Sig.	Conclusion
DragonBox assisted DMR	**Concept Understanding**	0.02	H0 is rejected
	Problem-solving	0.00	H0 is rejected

Based on Table 4, the mathematical concept understanding skills' p-value was less than 0.05, so it can be concluded that there was an effect of the DMR learning model assisted by DragonBox puzzle games on students' concept understanding skills during the COVID-19 pandemic. The p-value of the mathematical problem-solving skills was less than 0.05, so it can be concluded that there was an effect of the DMR learning model assisted by DragonBox puzzle games on students' mathematical problem-solving skills during the Covid-19 pandemic.

After knowing the results of the hypothesis testing for each skill, then the influence between subjects/variables simultaneously was tested. The results can be seen in Table 6.

Table 5. Simultaneous MANOVA Test Results

Manova's Hypothesis		Sig.	Conclusion
DMR assisted by DragonBox	Wilks' Lambda	0,000	H0 is rejected

The p-value of the MANOVA test using the Wilks' Lambda method in Table 6 was 0.000 with a significance level of 0.05. It can be concluded that there was an effect of the DMR learning model assisted by the DragonBox puzzle game on the concepts understanding skills and mathematical problem-solving skills during the COVID-19 pandemic.

The results obtained by the researchers have similarities with the results of previous studies conducted by Agustina (T. Agustina et al., 2019). The primary difference is that the previous research only looks at the mathematical concept understanding skills, while this research is focused on mathematical concept understanding and problem-solving skills. Research conducted by Tristiyanti (Tristiyanti & Afriansyah, 2016) investigates the model's effect on students' mathematical problem-solving skills. Agustina (L. Agustina, 2016) investigates the effect of conceptual understanding and mathematical problem-solving skills using different learning models.

Based on the research results, the application of the DMR learning model in the experimental class affected students' conceptual understanding and problem-solving skills better compared to the control class that applied the expository learning model. The control class uses the expository method emphasizes the process of delivering material verbally from a teacher to students, students are not required to find the material to be studied. In contrast to DMR assisted by mathematical games, students are required to form communication between students to find explanations of the material to be studied and assisted by mathematical games to facilitate the learning process.

DMR learning model assisted by the DragonBox puzzle game helps students to solve problems in groups within a fun atmosphere. The students are not overwhelmed and can accept the material confidently. The DMR learning model integrated with mathematical games can train students to communicate between groups to exchange ideas. This learning model also makes it easier for students to understand the lesson because of group cooperation and a less stressful atmosphere. The weakness of the DMR learning model is that it takes a long time to be applied.

In mathematics learning, concept understanding is an important aspect that must be mastered by students because it is the basis for students to master mathematical problem-solving skills. Therefore, concept understanding skills cannot be forced, meaning that teachers must continue to help and provide stimulus when mathematical concepts and logic are being delivered. Students will not be able to solve math problems if they are left alone. Students are said to understand a concept if they can define concepts, identify and give examples or not examples of concepts, develop mathematical connection skills between various ideas, understand how mathematical ideas are related to each other so that a comprehensive understanding is built, and use mathematics in contexts outside of mathematics.

Important mathematical concepts and procedures can be taught through problem-solving (Walle, 2007). Problem-solving skills focus on developing students' higher-order mathematical thinking. For this reason, students need to be trained to do independent learning through problem-solving processes. Problem-solving plays an important role in mathematics education, especially in algebra, and most of the learning occurs as a result of the problem-solving process. Problem-solving is an integral part of all mathematics learning (NCTM, 2000). The need to seek answers to questions given in the classroom is problem-centered learning so that students are encouraged to carry out the problem-solving process and contribute to the use of different solutions and strategy development.

Conclusion and Suggestion

Based on the results of the analysis and discussion, it can be concluded that the DMR learning model assisted by the DragonBox puzzle game on algebraic material affected junior high school students' conceptual understanding and mathematical problem-solving skills, both partially and simultaneously. The application of the DMR learning model assisted by the DragonBox puzzle game better-affected students' conceptual understanding and mathematical problem-solving skills compared to conventional learning, either partially or simultaneously.

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