

Learning Model of Role Playing With Digital Games on Mathematics Problem-Solving Skills and Attitudes

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ABSTRACT

The purpose of this research is to describe the differences in problem-solving skills and attitudes towards mathematics learning between the use of role-playing learning models with digital games and mathematical learning models. An experimental method was employed in this research with a quasi-experimental design, involving randomly selected control and experimental groups. The results of hypothesis testing indicate that (a) the Sig. (2-tailed) value is 0.000, meaning that the Sig. (2-tailed) value < 0.05 , thus it can be concluded that H_0 is rejected, and H_a is accepted, implying that students' attitudes towards mathematics learning using the role-playing learning model with digital games are better than before its implementation. (b) The t-test results show a t-value of 2.472 with degrees of freedom (df) of 42 and a significance value of t-table 5% is 2.01. Hence, it can be inferred that the t-value (2.474) $>$ t-table (2.02), which can be interpreted as H_0 being rejected and H_a being accepted, indicating that problem-solving skills in mathematics learning with the role-playing learning model with digital games are better than before its implementation. (c) The F-test for problem-solving skills (5.866) $>$ F-table (4.07) and the F-test for attitudes (6.120) $>$ F-table (4.07). Thus, the conclusion is that H_0 is rejected, and H_a is accepted, signifying that attitudes and problem-solving skills in mathematics learning after using the role-playing learning model with digital games are better than the cooperative learning model with fraction board media.

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1. INTRODUCTION

Mathematics is a subject taught in schools as per the 2013 curriculum, and students will perceive its significant relevance in their daily lives. To ensure students can master and solve mathematical problems in their daily lives, it is crucial to emphasize their good understanding of mathematical concepts. At the elementary level, topics such as numbers and geometry are examples of what will be taught, while at higher levels, there are subjects like measurement, characteristics, meanings, and data processing (Hanisah et al., 2014). Mathematics instruction can be quite abstract for elementary schools. For students who require assistance in grasping abstract concepts, there is a need to enhance the use of media and teaching aids, which can assist teachers in delivering content more engagingly and clearly, thereby facilitating quicker comprehension by students.

According to Dienes (2007), mathematical learning consists of five stages: free play, generalization, representation, symbolization, and formalization. Brownell (2007), as cited by Khanifa (2020), views mathematics as a system comprising ideas, principles, and processes. Consequently, the relationship among

these aspects should be emphasized in children's reasoning or intelligence, not just their memory. According to Brownell, mathematics is not merely a subject based on memorization but one that emphasizes the ability to think critically.

Problem-solving skills become an essential aspect of mathematics learning (Agustina & Lestari, 2020). In general, the challenges students face are related to their difficulty in solving mathematical problems, especially word problems, as solving them requires planning the necessary steps (Nasution, A. S. & Rangkuti, 2019). They suggest that students' ability to solve mathematical problems involves solving unconventional mathematical problems with clear and accurate solutions. Problem-solving skills are needed not only when performing calculations or applying routine formulas/procedures but also when solving mathematical and other problems that require mathematical tools for resolution.

Effendi (2012) also indicates that problem-solving skills are crucial for training students to tackle various issues in the classroom and daily life. Polya, as cited by Roebyanto and Harmini (2017), defines four steps in problem-solving: understanding the problem, making a plan, executing the plan, and reevaluating and expanding on the problem. However, not all teachers use these steps in mathematics instruction. A'liyah (2016) suggests that George Polya is a key figure in mathematical problem-solving. According to Polya, solving mathematical problems requires students to go through four main steps: understanding the problem and planning to solve it. Meanwhile, Solso and Otto H. Maclin, as cited by Lubur (2021), define problem-solving as a guided thinking process to find a solution or way out of a given problem. On the other hand, Soedjadi (Fadillah, 2009) argues that the ability to solve mathematical problems is a skill that students must possess to use mathematics to address problems in mathematics, as well as in other disciplines and everyday life.

Mathematics instruction encompasses various aspects, such as cognitive, affective, and psychomotor. Clearly, its aim is to develop students' problem-solving skills. Impressively, it tends to foster precision and patience in problem-solving, particularly with a large number of students. On the other hand, applying mathematical concepts learned in daily life is a goal from a psychomotor perspective (Pratomo, 2016). The lack of engaging media is one reason for students' low ability in dealing with fractions, connecting ideas, and appreciating students' opinions. Therefore, teachers must be creative in creating and utilizing teaching media to help students learn mathematics. Students should easily find learning media in their environment (Lakoro, 2009). Lakoro (2009) claims that using education-based learning can lead to effective media use to facilitate the learning process. Learning media serves as a useful facilitator in enhancing the effectiveness and efficiency of achieving learning objectives. In this context, the use of mass media in education benefits both teachers and students. Teachers must ensure that the media used are appropriate and representative. On the other hand, using media can also help students overcome boredom when receiving lessons (Arsyad, 2011). According to Lestar, Ariani, and Ashadi (2013), the general goal of using educational media is to assist teachers in delivering messages or topics in a way that students can easily understand, find engaging, and enjoyable.

Given the rapid advancements in science, technology, and globalization in the modern era, several computer applications such as Geogebra, Microsoft PowerPoint, Mathematica 7, Adobe Flash, Macromedia Flash, Construct 2, and others should be utilized by Indonesian educators to develop teaching materials, especially in mathematics. Moreover, considering the impact of globalization and the progress of the times, it is not surprising that students now use Android devices to support their learning and overcome the perception that mathematics is boring (Natasya, 2019). Educational games containing educational content, also known as educational games, are a means to stimulate students' activities during learning and can be used to optimize the understanding of related topics (Wildana et al., 2020).

According to Karnad and Nuri, Trianto's (2007) learning model possesses four characteristics, namely (1) logical theoretical rationality, (2) rationality, (3) behavior, and (4) learning environment. Meanwhile, according to Tobeng et al.'s top-ranked model, as cited by Setiawan and Widdiharto (2009), a good learning model has five features, namely (1) scientific methods, (2) specially designed learning outcomes, (3) predetermined learning environments, (4) referenced learning criteria, and (5) implementation methods.

Role-playing as a learning model is one way to address these issues. Komalasari (2010) discovered that role-playing increases students' interest and allows them to better understand topics by developing their imagination. In role-playing, students take on the roles of living or non-living entities, developing imagination and empathy. The advantages of using role-playing models include: 1) students' freedom to make choices and express themselves, 2) the ease of adapting to various situations and times, 3) teacher monitoring of student performance during play through observation, and 4) making learning enjoyable and stimulating for students (Basri, 2017). Additionally, according to Dai, C. et al. (2023), game-based digital mathematics learning

environments offer students the opportunity to master conceptual understanding and develop their mathematical thinking. Similar research was conducted by Kencana Sari (2018), whose findings showed that the proper use of role-playing learning models improved students' learning outcomes in terms of knowledge, attitudes, and skills. In terms of knowledge, scores increased from 48 with an average score of 67, dramatically rising to 93 with an average score of 85. In terms of skills, the average increased from 62 to 75.32. While Kencana Sari's research focused on learning outcomes, this study focuses on behavior and problem-solving skills.

In addition to cognitive learning, teachers should also pay attention to affective learning, which focuses on students' attitudes and behaviors. An important attitude for students is self-confidence, which can be developed through various school activities such as discussions, asking teachers about difficulties, and openly communicating ideas (Saputra & Prasetyawan, 2018). Attitude itself consists of several components, including two attitude components according to Azwari Nasution, M.I. (2019), namely: (1) cognitive components and (2) affective components.

Meanwhile, Yara in Agustina, T.B. and Sumartini, T.S. (2021) suggests that attitude is an intriguing concept that focuses on how someone thinks, acts, and behaves. Attitude encompasses behavior, tendencies, or readiness toward something that occurs, including the inclination to adapt or reject social situations. In other words, attitude is a conditioned response to social events. Based on the explanations provided, this research has several objectives. In other words, (a) comparing the results of third-grade students' mathematical problem-solving skills using the role-playing learning model with digital games to those not using role-playing with digital games. (b) Describing the attitudes of third-grade students towards mathematical learning using the role-playing learning model with digital games compared to those not using role-playing with digital games. (c) Describing the problem-solving skills and attitudes in mathematics class III using the role-playing learning model with digital games that outperform the collaborative model with decimal board media.

2. METHOD

This research method employs an experiment, which is used to identify the effects of a specific treatment. The research design utilizes a quasi-experimental or pseudo-experimental design that includes both control and experimental groups but cannot exercise complete control over external variables that may affect the experiment, as per Sugiyono (2018). The study includes randomly selected control and experimental groups, with the research design scheme as follows:

Table 2.1 Research Design

Class	Pretest	Treatment	Protest
Eksperiment Class	O1	X	O2
Control Class	O1		O2

Explanation:

Kel Eks = Experimental Group

Kel Kontrol = Control Group

O1 = Pretest of attitude and problem-solving ability for both the experimental and control groups

X = Treatment (mathematics learning using the role-playing learning model with digital games)

O2 = Post-test of attitude and problem-solving ability

The survey location is SD Matahari in Jepuh Village, Mojolaban District, Sukoharjo Regency, and the survey was conducted in January 2023. The survey subjects include all third-grade students at SD Matahari school. This research uses the random sampling technique, which selects sample members randomly from the population without considering population strata (D. Sugiyono, 2013). There are two types of variables used: independent and dependent variables. According to Arikunto (1998), variables are attributes that reflect or describe a certain concept or structure. Arikunto further explains that the dependent variable is the phenomenon studied and investigated, while the independent variable is a factor that can be measured independently and is related to the dependent variable. This research has two variables:

1. Independent Variable: Role Playing Model and Digital Games (X)

Role-playing as a teaching method uses media during the learning process. Using games in the classroom can motivate students and enhance their thinking, creativity, and engagement in learning. Games as a learning medium have benefits such as enjoyment, entertainment, and interest, allowing active student participation, providing immediate feedback, and helping students overcome learning difficulties. Games are also flexible, suitable for various educational purposes, and not difficult to create in large quantities (Sadiman, n.d.). Learning with games as a medium has advantages such as being enjoyable, engaging, and interesting. Active student participation is achieved during the learning process. Instant feedback is provided to students playing the game. Students have the opportunity to solve real-world problems. Games provide real experiences that can be repeated, allowing correction of any operational errors. Games also help students improve their communication skills and assist students struggling with traditional learning methods. The flexible nature of games allows for improvisation of educational goals and is relatively easy to create in large quantities (Sadiman, n.d.).

2. Dependent Variable: Problem-Solving Ability (Y)

Dahar (2006) stated, "problem-solving is an activity performed by humans that involves concepts and previous regulations and is not a generic skill" (p. 138). So, when someone successfully solves one problem, they have developed a new skill that can be used to solve other related problems. Another expert who also supports the concept of mathematical problem-solving is Montague (Fadillah, 2009), who holds the opinion that mathematical problem-solving is a cognitive and complex activity involving a series of processes and strategies.

Mathematical problem-solving skills encompass complex cognitive activities that demand students' ability to face and solve problems using various processes and strategies. Training students to solve problems in mathematics should not only make them capable of solving problems but also accustomed to dealing with the complexity of everyday life problems. Data collection methods for this research use specialized equipment depending on the research needs. This is done by the researchers before attempting the treatment. Four types of data are used in this research:

1. Test

There are pre-tests and post-tests. The author obtained research data based on student scores from these tests, and subsequently, based on the research data, the author will apply the role-playing model with digital media.

a. Pre-test

The pre-test was conducted by the author in both the experimental and control groups. The pre-test scores of the student groups were analyzed by the author to understand the differences.

b. Treatment

In the next step, the author administered the treatment after the pre-test was completed. The experimental group used the role-playing model with digital games.

c. Post-test

The post-test is the final step after the treatment is administered. The researcher administered the post-test to the students in the experimental group.

Table 2.2 Test Grid for Students' Mathematical Problem-Solving Abilities

Lesson Content - GPA (Indeks Prestasi Kumulatif) - Indicators - Question Format - Question Number - Question Weight

Lesson Content	GPA	Indicators	Question Format	Item Question	
				Question Number	Question Weight
Mathematics	3.5.1 Solving problems and finding the results of addition and subtraction with the same denominator (C4)	Presented with story problems, students can determine the sum of fractions with the same denominator	Description	1,2,4,5,6	5
		Presented with story problems, students can determine the	Description	3	1

Lesson Content	GPA	Indicators	Question Format	Item Question	
				Question Number	Question Weight
		sum of fractions with the same denominator Description Presented with story problems, students can determine the result of subtraction with fractions with the same denominator			

2. Questionnaire

A questionnaire is a data collection method by asking questions to respondents and writing down their explanations. The pre-test and post-test are conducted using the options "strongly agree," "agree," "disagree," and "strongly disagree."

Table 2.3 Questionnaire Grid for Student Attitudes

No.	Aspect	Question Number		Total
		(+)	(-)	
1.	Cognitive, which is related to knowledge, perspectives, and beliefs about attitude objects.	1,16,17,18	2,5,7,12,25	9
2.	Affective, which is related to the feelings of liking, disliking, pleasure, displeasure, emotions of an individual, and evaluation of attitudes.	4,6,13,19,20	3,8,9,10,12,15	11
3.	Conative, which is related to behavior and specific ways of acting that are related to attitude objects.	14,21,22	11,23,24	6

1. Observation

According to Sugiyono (2018), observation is a data collection technique with specific characteristics when compared to other techniques. Moreover, observation is not limited to humans but also extends to other natural objects. Through observation activities, researchers can study behavior and the meanings behind that behavior.

2. Documentation

Documentation involves data obtained from document sources such as magazines and books. In this research, the author obtained data from books and journals. In the document analysis, the author analyzed several magazines and books that discuss the effectiveness of the role-playing learning model with digital games. The data obtained from the research is then analyzed using various tests:

3. Validation Test

Validation test assesses how well the measuring instrument used for the measurement actually measures what it is intended to measure. Ghozali (2006) states that an efficacy test is used to measure the effectiveness of a

questionnaire. A survey is considered valid if the survey questions can effectively measure what the survey aims to measure.

4. Reliability Test

Reliability test is a method of data collection to determine the consistency in measurement (Yusup, 2018). A reliable instrument provides trustworthy data.

5. Normality Test

The normality test aims to determine the distribution of data values for a group or variable to determine whether the data is normally distributed or not.

6. Homogeneity Test

Homogeneity test is one of the tests used to determine whether two or more data groups in the research are homogeneous or not.

Hypothesis Testing

Hypothesis 1

H₀ = Students' attitudes in mathematics learning using the role-playing learning model with digital games are not better than before its implementation.

H_a = Students' attitudes in mathematics learning using the role-playing learning model with digital games are better than before its implementation.

Hypothesis 2

H₀ = Students' ability to solve problems in mathematics learning using the role-playing learning model with digital games is not better than before its implementation.

H_a = Students' ability to solve problems in mathematics learning using the role-playing learning model with digital games is better than before its implementation.

Hypothesis 3

H₀: Attitudes and problem-solving skills in mathematics learning after using the role-playing learning model with digital games are not better than the cooperative learning model with fraction boards.

H_a: Attitudes and problem-solving skills in mathematics learning after using the role-playing learning model with digital games are better than the cooperative learning model with fraction boards.

3. RESULTS AND DISCUSSION

A. Data Description

The research results provide an overview and analysis of the material. In the data description, data for each variable are processed and reported after calculation. Regarding the stages of the role-playing learning model (Komalasari, 2010), they are as follows:

1. The teacher prepares or creates a scenario.
2. Request some students to study the scenario before learning.
3. The teacher forms a group consisting of 5 students.
4. Determine the qualifications to be achieved.
5. Assigned students are invited to perform the scenario.
6. Each student in the group observes the scenario.
7. After the presentation is completed, each student is given a worksheet to discuss the performance of each group.
8. Each group communicates its conclusions.
9. The teacher draws general conclusions.

Table 3.1 Pretest Data for Problem-Solving Skills in the Experimental and Control Classes

Group	Ideal Value	Lowest Value	Highest Value	Mean
Experiment	60	14	59	40,5
Control	60	17	58	42,6

After conducting the pretest, the author conducted teaching before finally administering the post-test to the students. The calculations reveal that the average post-test score for the experimental group is 49.5, with the

highest score being 60 and the lowest being 41. The average pretest score for the control group is 43.04, with the highest score being 56 and the lowest being 21.

Table 3.2 Post-Test Data for Problem-Solving Skills in the Experimental and Control Classes

Group	Ideal Value	Lowest Value	Highest Value	Mean
Experiment	60	41	60	49,5
Control	60	21	56	43,04

The post-test results for problem-solving skills show that the average score in the experimental class is 49.5, which is higher than the control class at 40.2. The experimental class has the lowest score of 41, while the control class has the lowest score of 21. The difference between the two classes is 20. The highest score in the experimental class is 60, and in the control class, it is 56. The highest scores in both classes have improved compared to the previous test with the same questions and the same student abilities. From this data, it can be concluded that there is a difference in the average problem-solving skills in mathematics between the experimental and control classes.

After conducting the post-test, the researcher administered an attitude questionnaire to the experimental class using an immersive learning model with digital games. The questionnaire was distributed at the beginning and end of the experimental class. There were 25 statements in this questionnaire, with 12 positive statements and 13 negative statements. After analyzing the results of the student attitude questionnaire, positive changes were observed. For example, in question number 3, aimed at assessing students' attitudes towards mathematics learning, which stated, "I feel upset when mathematics class begins." The initial average score was 2.75, indicating that quite a few students felt upset when mathematics class started. At the end of the teaching period, the researcher administered the same questionnaire again, and it was found that the average score for question number 3 had decreased to 2. This suggests that teaching mathematics using the role-playing learning model with digital games had a positive impact on students' feelings when mathematics class begins.

B. DATA ANALYSIS

At the end of the research, the author conducted data analysis to test the hypotheses. The results of the research hypotheses are as follows:

Hypothesis 1

Tabel 3.3 Paired Samples Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_S_E - Post_S_E	-4.500	3.940	.881	-6.344	-2.656	-5.107	19	.000

Based on Table 3.3, it can be observed that the Sig. (two-tailed) value is 0.000, which means that Sig. (two-tailed) < 0.05. Therefore, it can be concluded that H₀ is rejected, and H_a is accepted, indicating that the students' attitude towards mathematics learning using the role-playing learning model with digital games is better than before implementation.

Hypothesis 2

Tabel 3.4 Independent Samples Test

Independent Samples Test										
Levene's Test for Equality of Variances				t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
KPM	Equal variances assumed	7.864	.008	2.474	42	.017	6.308	2.550	1.162	11.455

Based on the table above, the t-test results yield a t-value of 2.474 with degrees of freedom (df) of 42, and the significance value (ttabel) at 5% is 2.02. Thus, it can be concluded that the t-value (2.474) is greater than the ttabel (2.02), which means that H₀ is rejected and H_a is accepted, indicating that problem-solving skills in mathematics learning using the role-playing learning model with digital games are better than before implementation.

Hypothesis 3

Tabel 3.5 Anova Test

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
KPM	Between Groups	434.128	1	434.128	6.120	.017
	Within Groups	2979.508	42	70.941		
S	Between Groups	175.273	1	175.273	5.866	.020
	Within Groups	1254.908	42	29.879		

In the table above, it can be seen that the F-value for Problem-Solving Skills is 6.120, while the F-value for Attitude is 5.866. Both variables have the same degrees of freedom between groups and within groups, with 1 as N₁ and 42 as N₂. Therefore, we can determine that the F-table value is 4.07.

Based on the decision-making above, the F-value for problem-solving skills (5.866) is greater than the F-table value (4.07), and the F-value for attitude (6.120) is also greater than the F-table value (4.07). Thus, it can be concluded that H₀ is rejected, and H_a is accepted, meaning that attitudes and problem-solving skills in mathematics learning after using the role-playing learning model with digital games are better than the cooperative learning model with fraction board media.

4. CONCLUSION

In conclusion, this research has successfully achieved its objectives and tested its hypotheses, yielding several significant findings. These findings have practical implications for both educators and researchers.

Firstly, it is evident that the implementation of the role-playing learning model with digital games has a significantly positive impact on students' attitudes towards mathematics. The Sig. (2-tailed) value of 0.000, which is lower than the conventional threshold of 0.05, signifies a notable improvement in student attitudes.

Secondly, this innovative approach also proves to be effective in enhancing students' problem-solving skills in mathematics learning. The calculated t-value (2.474) exceeds the t-table value (2.02), demonstrating the positive influence of this teaching method on students' problem-solving abilities.

Furthermore, when compared to the cooperative learning model with fraction board media, the role-playing learning model with digital games exhibits a comparative advantage. Not only does it enhance problem-solving skills, but it also fosters more positive attitudes towards mathematics, as supported by the F-values for problem-solving skills (5.866) and attitude (6.120), both surpassing their respective F-table values (4.07).

These findings provide a strong rationale for educators to consider the incorporation of the role-playing learning model with digital games in their teaching practices. This approach shows promise in positively influencing students' attitudes and problem-solving skills in mathematics, thereby contributing to a more engaging and effective learning environment. Moreover, these results open avenues for future research to delve into the nuanced dynamics of integrating digital games in diverse educational contexts, offering the opportunity to further refine and enhance teaching methods.

In closing, this research emphasizes the importance of innovative teaching approaches in shaping the educational landscape. The observed positive outcomes hold the potential to advance the field of education by highlighting the effectiveness of technology-enhanced learning models in inspiring student engagement and skill development. This study invites further exploration and experimentation, making a valuable contribution to the ongoing evolution of mathematics education.

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