Research Article

The Effect of Role Playing Game Learning Media on Mathematics Learning Outcomes of Grade VIII Students at SMP Islam Cendekia Harapan Jombang

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ABSTRACT

Low mathematics learning outcomes among students are often caused by a lack of interest and active involvement in the learning process. Monotonous teaching methods and a lack of innovative media make it difficult for students to understand abstract mathematical concepts. Therefore, more interactive and enjoyable learning strategies are needed. One potential medium that can be used is Role Playing Games (RPGs), which allow students to learn while playing roles in educational scenarios. This study aims to determine the effect of using RPG learning media on the mathematics learning outcomes of eighth-grade students at SMP Islam Cendekia Harapan Jombang. This study employs a quantitative approach with a quasi-experimental design of the One Group Pretest-Posttest Design. The sample consists of 19 students selected through purposive sampling. The research instrument is a mathematics learning achievement test comprising 20 multiple-choice questions, which has been validated by experts. Data were analysed using a paired sample t-test with the assistance of SPSS. The analysis results showed a significant difference between pretest and posttest scores, with a significance level of 0.047 ($p < 0.05$). Thus, the use of RPG media was proven effective in improving students' mathematics learning outcomes. RPG was able to create a more active, engaging, and contextual learning environment, thereby fostering a deeper understanding of concepts.

Keywords: Role Playing Game; Learning Outcomes; Mathematics; Innovative Media; Mathematics Learning

1. INTRODUCTION

Mathematics is a crucial subject that plays a central role in shaping students' mindsets and equipping them to face the complex technological era. Mathematical thinking skills are essential in everyday life and for progress in various fields. However, the quality of mathematics education in Indonesia still needs significant improvement. Data shows that Indonesia's PISA score in 2022 ranked 64th out of 81 countries, indicating challenges in students' understanding of mathematical concepts (OECD, 2023). Traditional teaching methods, such as lectures, are often inadequate and can lead to boredom and a lack of enthusiasm among students in the learning process (Mubarrok, 2024). The gap between the importance of mathematics for future readiness and the low achievement of students in Indonesia highlights the urgent need for innovative pedagogical approaches. These approaches aim not only to convey content but also to foster deeper understanding, active engagement, and practical application skills, going beyond mere memorisation.

One solution that can be implemented is the use of digital technology-based learning media. Technology has become an integral part of students' lives, so utilising it in the learning process is a relevant and contextual strategy. Digital game-based learning media is one learning innovation that can increase student engagement through an interactive and enjoyable approach. This approach uses games or game elements to increase student engagement and learning outcomes (Zou et al., 2021). In Indonesia, students' interest in games is very high, with children dominating the online gaming market. This natural tendency can be effectively utilised for educational purposes. Digital games in an educational context (often referred to as educational games or game-based learning) have been proven to increase motivation, strengthen memory, and accelerate concept understanding (Wouters et al., 2013). According to Prensky (2001), digital generation students are more responsive to learning methods that combine entertainment and technology. Digital games not only present challenges but also provide immediate feedback to users, making the learning process more engaging.

Utilising students' intrinsic motivation through games is a powerful strategy for improving academic achievement. The high interest in games among Indonesian students, combined with GBL's ability to provide intrinsically satisfying experiences, creates a strong motivational synergy. This is not just about making learning 'fun' but also leveraging the innate human drive for challenge, progress, and achievement that games naturally provide (Hamari et al., 2016). RPG, with

their rich narratives and character-based experiences, can intrinsically motivate students, transforming their perception of mathematics from a dry and abstract subject into an engaging problem-solving adventure.

Based on initial observations at SMP Islam Cendekia Harapan Jombang, mathematics learning still predominantly uses conventional methods. Teachers often deliver material verbally and give exercises without visual or interactive technological approaches. This causes many students to have difficulty understanding the material and feel bored during the learning process. As a result, the average mathematics learning outcomes of students are relatively low compared to other subjects. In this context, the implementation of digital game-based learning media is seen as a strategic effort to address these issues. By using digital games, students are encouraged to learn while playing, solving problems, and making decisions in an enjoyable environment. The visual, audio, and challenge aspects of games can help students understand mathematical concepts in a more concrete way. Research by Zheng et al., (2024) shows that the use of visual and digital-based learning media can significantly improve students' mathematical thinking skills. Additionally, Prasetyo (2022) emphasises the importance of evaluating user responses to digital learning media as part of the instructional design improvement process. Thus, the integration of digital game media in mathematics learning is not only innovative but also has the potential to significantly improve learning outcomes.

On the other hand, learning outcomes are an important indicator in assessing the success of a learning process. Improved learning outcomes indicate that the strategies or media used have been able to accommodate students' needs and learning styles. Therefore, measuring the impact of digital game media use on learning outcomes is important in evaluating the effectiveness of this learning approach. Beyond the academic aspect, the use of digital game media also has the potential to develop 21st-century skills in students, such as critical thinking, problem-solving, and collaboration (Nisa, 2022). This aligns with the direction of the Merdeka Belajar policy initiated by the Ministry of Education, Culture, Research, and Technology, where learning should foster creativity, innovation, and the maximum utilisation of technology. Selecting the appropriate learning media can be key to creating an active, participatory, and meaningful learning environment. Educational digital games are not only focused on entertainment but also integrate pedagogical elements aligned with the intended learning objectives. Research by Gee (2003) shows that well-designed games can be highly effective learning tools, as they combine intrinsic motivation, cognitive challenges, and context-based learning. RPGs, as a form of educational games, allow students to engage in the learning process through simulations that resemble real-life or contextual situations.

Role-Playing Games (RPG) Learning Media are a learning model focused on problem-solving (Agustin et al., 2024). In the context of gamification, RPG are games set in a fictional world where players take on the role of a character and are responsible for portraying that role within the narrative, with actions guided by formal rules (Nurcahyo et al., 2025). Educational game-based learning media According to Ningsih et al. (2016), Role Playing Games are games, either online or computer-based. Students, as players, pretend to be characters going on adventures. Role Playing Games can be interpreted as software that presents challenges and entertainment according to planned rules, making it seem as though students are portraying one or multiple characters. Role-playing games can be used to present interesting learning materials with the help of animations, images, and sounds. This can attract the attention of students. In role-playing games, students become the main characters who will complete the tasks in the game. Role-playing games are also games that focus on the storyline, so they can bring students into the desired story situation. The combination of narrative and problem solving in RPG is very important. The definition of role-playing emphasises 'playing a character' and 'events in the story', while RPG explicitly focus on problem-solving and involve players taking on roles in a fictional world with rules (Saputra et al., 2023). This demonstrates that RPGs uniquely combine narrative immersion (role-playing) with structured problem-solving (game mechanics). This dual nature means that RPGs can make abstract mathematical problems tangible and relevant by embedding them in engaging stories, thereby enhancing engagement and the application of mathematical concepts in a 'real-world' context.

Previous studies have shown that the use of RPG in learning can improve students' academic performance. Role-playing games were developed by Sari et al. (2014) for the Chemistry subject on Atomic Structure for Grade 10 high school students. A similar development was conducted by Santosa & Kustijono (2015) for the Physics subject on Heat. Educational game-based RPG learning media can also be used in mathematics lessons. Research by Shofa & Surjono (2018) proves that RPGs can significantly increase student engagement and improve mathematics learning outcomes. This underscores the importance of exploring the use of RPGs across various educational levels. Through this study, the author aims to empirically examine the impact of digital game-based learning media on the mathematics learning outcomes of eighth-grade students at SMP Islam Cendekia Harapan Jombang. This research is important to provide scientific contributions to the development of technology-based learning media that are more effective and relevant to students' current needs. Therefore, it is important to conduct research on the effectiveness of digital game media as one of the interactive learning strategies in improving student learning outcomes. The results of this study are expected to serve as a reference for teachers, learning media developers, and education policymakers in adopting digital approaches in the teaching and learning process. Considering the urgency of the issue and the potential solutions through digital game media, this study is aimed at gaining a deeper understanding of the impact of using digital game-based learning media on students' mathematics learning outcomes, as a concrete step toward improving the quality of education in the current digital transformation era.

2. RESEARCH METHOD

This study is a quantitative study with a quasi-experimental approach using a One Group Pretest-Posttest Design, in which students are given a pretest, then receive treatment in the form of mathematics learning using Role Playing Game (RPG) media, and finally given a posttest to see the improvement in learning outcomes. The study was conducted at SMP Islam Cendekia Harapan Jombang with 19 eighth-grade students from the 2024/2025 academic year selected through purposive sampling. The independent variable in this study was RPG-based learning media, while the dependent variable was students' mathematics learning outcomes. The instruments used were a mathematics learning achievement test consisting of 20 questions that had been validated by experts, as well as an observation sheet of student activities as supporting data. Data collection was conducted through the administration of pre-tests and post-tests, and the data obtained were analysed using a paired sample t-test with the assistance of SPSS. The analysis results were used to determine whether there was a significant difference between learning outcomes before and after the treatment. This study was also conducted in accordance with research ethics, such as obtaining school permission, maintaining student data confidentiality, and ensuring that the learning process remained consistent with the applicable curriculum.

3. RESULTS AND DISCUSSION

After the RPG learning media and research instruments were assessed as valid, they were then used in data collection for the research. A pre-test was conducted before the RPG learning media was implemented. During the learning process, students understood the material directly through the RPG learning media. The implementation took place in the computer lab to facilitate the learning process for both students and teachers. With computers, students were more free to use the media, so they felt like they were playing a game. It was hoped that students would be more enthusiastic in the learning process. After the learning process is complete, students are asked to complete post-test questions. Similar to the learning process that utilises RPG learning media, the post-test also applies in the same way. This is expected to reduce students' tension or anxiety when facing tests. So, by playing games, students also complete SPLDV questions. Although the questions are in multiple-choice format, in practice, students are asked to write down the solution process on the provided sheet.

After conducting the pre-test, treatment, and post-test, the first step in data processing is to perform a descriptive test on the pre-test and post-test data of students' mathematics learning outcomes. Descriptive statistical data processing is carried out with the help of the SPSS programme to obtain the maximum, minimum, average, standard deviation, and variance values. The descriptive test was conducted to determine the comparison of students' learning outcomes on the pretest and posttest. This was aimed at comparing and determining the difference between the two tests. The following table shows the results of the descriptive statistical analysis of the students' pretest and posttest scores.

Table 1. Descriptive Statistics Results of the Pretest and Posttest

Statistics		Pre-Test	Post-Test
N	Valid	19	19
	Missing	0	0
Mean		10.26	40.00
Std. Deviation		25.082	32.489
Variance		629.094	1055.556
Minimum		0	0
Maximum		100	100

Based on the statistical data provided, it can be concluded that learning using RPG media shows positive and significant results. This is evident from the drastic increase in the average (mean) score of participants, from 10.26 on the pre-test to 40.00 on the post-test. This increase of nearly 30 points indicates that most participants experienced a substantial improvement in understanding or skills. However, the increase in the standard deviation and variance from 25.082 to 32.489 indicates that the distribution of scores on the post-test has become wider. This means that not all participants experienced the same improvement. Some participants achieved very high scores, while others only experienced a small improvement, or perhaps none at all. This condition reflects the varying effects of RPG learning media on each student and the need for further evaluation to understand the factors influencing each student's learning success. Before testing the hypothesis, data normality was tested using the SPSS computer program. Data normality was tested using the Kolmogorov Smirnov test with $\alpha = 0.05$. The guidelines for deciding on data normality are as follows.

H0 is accepted if the Asymp.Sig (2-tailed) value > 0.05

H0 is rejected if the Asymp.Sig (2-tailed) value < 0.05

The normality test output is presented in Table 2 below.

Table 2. One-Sample Kolmogorov-Smirnov Test Output

		Pre_Test	Pos_Test
N		19	19
Normal Parameters	Mean	10,2632	40,0000
	Std. Deviation	25,08174	32,48931
Most Extreme Differences	Absolute	,396	,200
	Positive	,396	,200
	Negative	-,341	-,126
Test Statistic		,396	,200
Asymp. Sig. (2-tailed)		,000	,044

Table 2 shows that the pre-test probability value is $0.000 < 0.05$, so H_0 is rejected, meaning that the data is not normally distributed. The post-test probability value is $0.044 < 0.05$, so H_0 is rejected, and the data is not normally distributed. Since the data obtained is not normal, data transformation is performed. The results of the normality test after data transformation are presented in **Table 3**.

Table 3. One-Sample Kolmogorov-Smirnov Test Output

		Pre_Test	Pos_Test
N		5	18
Normal Parameters	Mean	3,4485	40,0000
	Std. Deviation	,82006	32,48931
Most Extreme Differences	Absolute	,141	,200
	Positive	,141	,200
	Negative	-,103	-,126
Test Statistic		,231	,141
Asymp. Sig. (2-tailed)		,200	,200

Table 3 shows that the pre-test probability value is $0.200 > 0.05$, so H_0 is accepted, meaning that the data is normally distributed. The post-test probability value is $0.200 > 0.05$, so H_0 is accepted, meaning that the data is normally distributed. The hypothesis test was conducted using a paired samples t-test to determine the effect of the treatment. The paired samples t-test was performed using SPSS for Windows version 20.0. The testing criterion was to reject H0 if the significance was < 0.05. The output of the paired samples t-test is presented in **Table 4.**

Table 4. Output of the Paired Samples T-Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre_Test - Pos_Test	-,94370	,74439	,33290	-1,86798	-,01942	-2,835	4	,047

Based on the results of data analysis using the paired sample t-test, a significance value (2-tailed) of 0.047 was obtained, which is smaller than the significance threshold $\alpha = 0.05$. This indicates that there is a significant difference between the pre-test and post-test scores of students after using the Role Playing Game (RPG) learning media. The average difference in learning outcomes was -0.94370, indicating a significant improvement in students' learning outcomes after the RPG was applied in mathematics learning. Thus, it can be concluded that the RPG medium has a positive effect on the mathematics learning outcomes of eighth-grade students at SMP Islam Cendekia Harapan Jombang.

The results of the study indicate that the use of Role Playing Game (RPG)-based learning media has a positive and significant impact on improving the mathematics learning outcomes of eighth-grade students at SMP Islam Cendekia Harapan Jombang. This is evident from the results of the paired sample t-test statistical test, which shows a significance

value of 0.047 (p < 0.05). This means that there is a significant difference between the pretest and posttest scores after the implementation of RPG media, indicating that RPG is capable of improving students' understanding of mathematics material.

This finding reinforces previous research by Farid & Khabibah (2021), who developed an Android-based RPG for two-variable linear equation systems. The results showed that the media was valid, feasible, and effective in improving learning outcomes. As an interactive learning medium, RPG encourages students to actively engage in the learning process, both cognitively, affectively, and socially. In a similar context, Hasanah et al. (2025) demonstrated that the role-playing model is effective in improving mathematical problem-solving skills because it provides students with the opportunity to explore real-life roles and situations related to the learning context.

The concept of transformational play proposed by Barab et al. (2010) explains that educational games such as RPG can integrate the relationship between individuals, content, and the learning context, so that students not only learn the material theoretically but also through meaningful experiences. This is reinforced by De Freitas (2006), who emphasises that the use of games and simulations supports learning by increasing student engagement and providing contextual and reflective learning experiences. In line with Vygotsky (1978), RPG provide a zone of proximal development (ZPD) that allows students to develop their potential through social interaction in a structured learning environment. In RPGs, students not only learn individually but also collaboratively, thereby sharpening their critical thinking and communication skills. Rieber, Luke, and Smith (1998) assert that the constructivist approach can be effectively implemented through enjoyable and educational play activities.

In line with the development of educational technology, RPG as part of digital game-based learning is considered effective in increasing student motivation and academic achievement (Hainey et al., 2016; Naldince et al., 2024). The Role-Playing Model can significantly improve student learning outcomes in problem-based learning because students are directly involved as active subjects in the learning process. Papastergiou (2009) found that digital games have great potential in improving learning effectiveness and students' interest in subject matter. This is reinforced by Prensky (2001), who noted that digital natives are more easily able to absorb information through interactive and technology-based media. During the implementation of RPG media, researchers observed that students showed high enthusiasm, were more active in discussions, and found it easier to understand the material through the storyline and roles they played. RPG indirectly places students in contextual situations where they must apply mathematical concepts to solve challenges within the game. This aligns with the principles of constructivism, where students build their own knowledge through direct experience (Piaget, in Woolfolk, 2010).

Research by Kristiawan & Hariati (2024) shows that the application of gamification in digital media can enhance student participation and engagement in citizenship education. The implications of this research expand the understanding that gamification, including RPG, has flexibility in its application across various subjects, including mathematics. Arifah et al. (2025) add that learning media developed contextually and based on local culture can enhance students' connection to the taught material. RPG can also be developed in the local context of students, strengthening their emotional and personal engagement in the learning process.

In a broader study, Young et al. (2012) in a review of serious gaming trends stated that RPG can support 21st-century learning, such as collaboration, communication, and complex problem solving. Ramadhan & Kusuma (2025) showed that local board games such as 'SEMESTA' are effective in improving elementary school students' geometric problem-solving skills, which shows a similar pattern to digital RPGs. These findings reinforce the findings of Tüzün et al. (2008) that computer games can improve the academic performance and learning motivation of primary school students in geography education. Thus, RPGs have proven to be not only an entertaining learning tool but also an educational medium capable of building active student engagement, deepening conceptual understanding, and encouraging the development of 21st-century skills. Therefore, the integration of RPGs into the mathematics learning process at the junior high school level is highly recommended, especially in creating a fun, challenging, and meaningful learning environment.

4. CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the Role Playing Game (RPG) learning media has a significant effect on improving the mathematics learning outcomes of eighth-grade students at SMP Islam Cendekia

Harapan Jombang. This is demonstrated by the results of the paired sample t-test, which yielded a significance value of 0.047 (p < 0.05), indicating a significant difference in learning outcomes between before and after the intervention. RPG creates an interactive, enjoyable, and contextual learning environment, thereby enhancing students' motivation, active engagement, and understanding of mathematical concepts. By directly involving students in meaningful learning scenarios, RPG also supports the development of students' social and cognitive skills. Therefore, RPG-based learning media can be used as an alternative innovative strategy to improve the quality of mathematics learning at the secondary education level.

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