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Scratch-Based Interactive Games to Increase Interest in Learning Mathematics for the Second Grade Elementary School Students

Iva Sarifah[1*], Akbar Sri Nugroho[2], Arita Marini[3], Gusti Yarmi[4], Desy Safitri[5], Leola Dewiyani[6]

[1,2,3,4,5] Universitas Negeri Jakarta, Jakarta, Indonesia
[6] Universitas Muhammadiyah Jakarta, Jakarta, Indonesia
*Corresponding author: ivasarifah@unj.ac.id

Abstrak

Teknologi telah berkembang pesat dan mendukung berbagai aspek kehidupan, termasuk pendidikan. Banyak sekolah terutama di negara maju sering menggunakan teknologi dalam proses pembelajarannya. Penelitian ini bertujuan untuk meningkatkan minat belajar matematika siswa kelas dua sekolah dasar melalui permainan interaktif berbasis gores. Guru kelas II menyampaikan perlunya media pembelajaran yang menarik bagi siswa. Peneliti mengembangkan game interaktif berbasis gores yang telah divalidasi oleh para ahli dan ditemukan memenuhi kriteria yang sesuai. Hasil pengujian dengan menggunakan uji t berpasangan menunjukkan adanya perbedaan rata-rata yang signifikan antara pretest dan posttest terhadap minat belajar matematika, hal ini menunjukkan bahwa penggunaan permainan interaktif meningkatkan minat belajar siswa secara positif. Selain itu, penggunaan media permainan interaktif juga memberikan pengaruh yang baik dalam meningkatkan minat belajar matematika siswa yang ditunjukkan dari hasil uji N-Gain. Oleh karena itu, penelitian ini merekomendasikan penggunaan permainan interaktif sebagai media pembelajaran praktis untuk meningkatkan minat belajar matematika di berbagai kelas dan sekolah lain. Bahkan dapat dikembangkan untuk pelajaran tambahan guna meningkatkan minat belajar siswa.

Kata Kunci: *Minat Belajar Matematika, Permainan Interaktif, Scratch*

Abstract

Technology has developed rapidly and supports various aspects of life, including education. Many schools, especially in developed countries, often use technology in the learning process. This study aims to increase the interest in learning mathematics of second-grade elementary school students through scratch-based interactive games. Second-grade teachers expressed the need for learning media that is interesting for students. The researcher developed scratch-based interactive games validated by experts and found to meet the appropriate criteria. The test results using the paired t-test showed a significant mean difference between the pretest and posttest of interest in learning mathematics, indicating that using interactive games positively increased students' interest in learning. In addition, the use of interactive games media also has a good effect in improving students' interest in learning mathematics, as shown by the results of the N-Gain test. Therefore, this study recommends using interactive games as a practical learning media to increase interest in learning mathematics in various other classes and schools. It can even be developed for additional lessons to increase students' interest in learning.

Keywords: Interest in Learning Math, Interactive Games, Scratch

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1. INTRODUCTION

Education is a necessity in human life. Because with education, humans undergo a series of development processes towards themselves in a positive direction and become fully human through teaching and training efforts (Atalay, 2015; Saripudin et al., 2021). In addition, education also plays an essential role in the development of a country. This role produces excellent and quality human resources for the country's progress. This is supported in Law No. 20 2003 concerning the National Education system (Boyadzhieva, 2016; Vastyanov et al., 2021). Furthermore, in formal and non-formal education, there are various sciences that students will learn. Thus, it is essential for students to have an interest in learning because it affects the learning process and results. Therefore, teachers need to pay

special attention to student's interest in learning so that there is no setback in learning (Al-Zoubi & Younes, 2015; Sidhu & Ying, 2017).

Technology has developed rapidly and supports various aspects of life, including education. Many schools, especially in developed countries, often use technology in the learning process. This is due to the realization that technology benefits educators and students, such as quickly accessing learning resources and improving skills using electronic devices (Andreania & Ying, 2019; Pratamaa et al., 2023; Wibawaa et al., 2023). On the other hand, there is technology in the form of games that can be utilized in the learning process. Teachers usually use games because they are effective in lessons students find challenging and unpleasant such as math. Math is a science that is very useful in human life. Therefore, with games, teachers hope students' interest in mathematics will increase and positively impact the learning process and results (Fadella et al., 2018; Fearnley & Amora, 2020).

Games are currently developing rapidly, thus creating opportunities for teachers to use them in learning. Before using them, teachers can first improve their knowledge and skills in operating technology to make this happen. Teachers believe that games in education are very effective such as increasing students' learning activities and achieving learning objectives (Aprilliyah, 2014; Kalogiannakis & Papadakis, 2019; Lutfi & Hidayah, 2021). In addition, it is also the right solution for students to play and learn. For learning that is considered difficult and unpleasant, like math, games help students during the learning process (Ahdhianto et al., 2020; Widyasari et al., 2019). Because with games, students can capture the material provided, and learning becomes more fun (Fatimah & Santiana, 2017; Safitri et al., 2022).

Learning interest cannot be separated from students, so it influences learning. Learning interest is influential in education because students with a high interest in education are also curious and more eager to engage in learning. Thus, the learning outcomes obtained by students are better. For this to be achieved, the knowledge provided by the teacher must be fun and easy for students to understand (Ernawati et al., 2022; Mee Mee et al., 2020). Therefore, teachers are crucial in influencing students' interest in learning. Teachers' learning models are expected to increase student interest in learning (Purnomo et al., 2022; Weranga et al., 2022). In addition, the use of learning media is also needed to help develop and increase students' interest in learning (Febriani & Ratu, 2018; Rihatno et al., 2023).

Various studies related to the use of games in learning have been conducted. Game-based learning supports students by increasing interest in learning, reducing pressure, and making learning fun for them (Koskinen et al., 2023; Pranotoa & Panggabeana, 2019). The studies also show the theories and expected results of the games that have been created. However, the software used could be more straightforward for beginners in making games. In addition, the first and third studies are more directed towards language learning, while the fifth journal discusses trains.

Furthermore, there are various studies related to learning interests. Such as student interest in learning and achievement (Asikainen et al., 2022). Then, how incomplete explanations affect students' interest and learning habits (Danovitch et al., 2021). The impact of problem-based learning on students' understanding and interest (Ottenbreit-Leftwich et al., 2021). The use of STEM to attract students' interest (McIntyre et al., 2021). Finally, learning about individual interests (Schuetze et al., 2019). Various studies that have been conducted there have yet to be found using Scratch-based interactive games to increase interest in learning, especially in grade 2 elementary school mathematics. There are several reasons and advantages related to this research, such as using games has been proven effective in increasing student interest in learning.

Furthermore, Scratch has the advantage of being software that is easy to use by beginners, so teachers who are not experts in computer science can use it and even make their

games. Then, learning math itself is tricky, especially for second-grade elementary school students, because the arithmetic material given is different from before. Therefore, this research aims to find out about it.

Based on the above background, this research was conducted to provide efforts to increase interest in learning, especially in learning mathematics for second-grade elementary school students. This research itself utilizes learning media in the form of scratch-based interactive games. The learning media is expected to be useful as it should be. Thus, when the learning process occurs in math, interest in learning will increase, and student's perceptions of the lesson will become more positive. With this research, it is hoped that it can be helpful in the world of education, especially for teachers and become a reference for educators and further research.

2. METHODS

This research used the Research and Development (R&D) method and was conducted on 25 second-grade Kramat Jati 16 Elementary School students. This research uses the ADDIE model developed. This model divides the process into five development stages: Analysis, Design, Development, Implementation, and Evaluation (Astra et al., 2020). The stages is show in Figure 1.

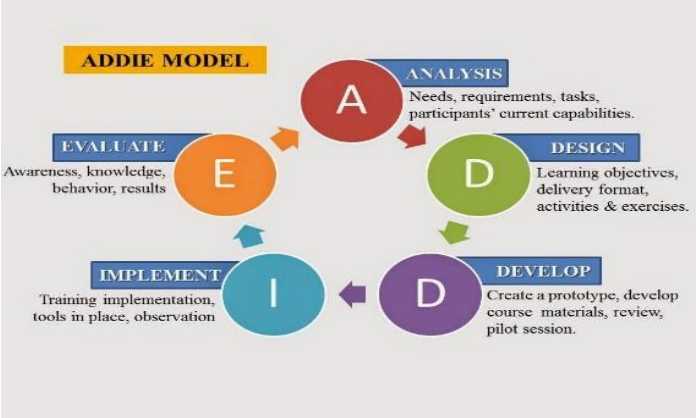

Figure 1. Stages of the ADDIE Development Model

The population of this study was students of Kramat Jati 16 Elementary School, East Jakarta, Indonesia. This study drew a sample of 25 second-grade elementary school students. This study used interview instruments and pretest and posttest questionnaires related to students' interest in learning mathematics, involving students' interest in learning, perseverance, and assessing mathematics lessons. The interview instrument was addressed to the teacher to determine students' interest in mathematics through his perspective. In contrast, the questionnaire is addressed to students to directly assess their interest in learning mathematics. For its implementation, students fill out a pretest questionnaire before being given learning media. Afterwards, students can use the learning media and continue by completing the posttest questionnaire. Finally, the pretest and posttest questionnaires will be compared to show the effect of learning media on second-grade elementary school student's interest in learning mathematics.

In this study, the normality test of data distribution was carried out through statistical analysis using the N-Gain Score method. This study used inferential statistics to test the hypothesis using the t-Test: Paired Two Sample for Means. This hypothesis was concluded based on the significance criteria with an α (alpha) level of 0.05. In addition, the Likert Scale

method with questionnaire score categories to measure and analyze the responses of media and material experts was used in this study. This measurement technique aims to determine the validity of answers from media and material experts. It was then continued with the gamification media feasibility test analyzed by the Likert Scale assessment percentage. Categories of media expert and material expert validation scores is show in Table 1. Then likert scale assessment is show in Table 2.

Table 1. Categories of Media Expert and Material Expert Validation Scores

Scale Score	Description
5	Very good
4	Good
3	Good enough
2	Not so good
1	Very Poor

Table 2. Media Eligibility Criteria based on the Likert Scale Percentage

No.	Percentage of Assessment Results	Description
1	86%-100%	Very Feasible
2	61%-80%	Worth
3	41%-60%	Decent Enough
4	21%-40%	Less Feasible
5	0%-20%	Not Feasible

3. RESULTS AND DISCUSSION

Result

Analysis of Students' Interest in Learning Mathematics

The first stage of the ADDIE model is carried out to find out what is needed to increase the interest in learning mathematics of second-grade students of Kramat Jati 16 Elementary School. To find out this, researchers conducted interviews with teachers in a structured manner. The results of the interview with the teacher showed that the interest in learning mathematics of second-grade students was quite good. This is because teachers always try to instil the importance of learning mathematics in students by doing habituation in the form of question-and-answer activities related to students' understanding of mathematics in the morning. However, when learning occurs, the teacher admits that students often do not focus and prefer to interact with their friends even though they have used learning media such as the abacus and Quizizz gamification media. So the teacher decided to use learning media towards the conventional press gradually. This is because teachers feel they need to find suitable learning media, and there are limited facilities at school.

Scratch-based Interactive Games Design

Based on the analysis above, researchers proceeded to the second stage of the ADDIE model, namely design. At this stage, researchers conducted planning to develop and test the use of Scratch-based interactive games. The planning carried out by researchers, namely determining the material and looking deeper into theories related to gamification media. Then select various elements, structures, audio, images, and typography per the learning material, the characteristics of second-grade elementary school students, and the interactive course to attract the attention and increase the interest in learning mathematics of second-grade elementary school students.

Development of Scratch-based Interactive Games

Furthermore, in the third stage, researchers created and developed an interactive Scratch-based game, "Learn Math with Catty". For its content, on the main menu, there are five options, namely Start to start the game, Catty to see information about it, I (info) to see information related to games, Book to see the multiplication table 1-10, and X to stop the game, as well as home which is in all five options helpful in returning to the main menu. The player can choose one of the three desired places (levels) when the game starts. In it, there are different stories and questions. In addition, using background and music in games can make players more interested or interested in playing them. Interactive games learn math with catty is show in Figure 2.

Figure 2. Interactive Games Learn Math with Catty

Implementation of Scratch-Based Interactive Games to Increase Students' Interest in Learning Mathematics

In this fourth stage, the success of the previous step can be known. For this scratch-based interactive media game, two experts tested it, namely media experts and material experts. Validation is done by distributing questionnaires to the two experts. After getting the value from the experts, researchers tested scratch-based interactive media games on second-grade elementary school students. However, researchers only conduct field tests here due to limitations in several ways. Media testing is done by distributing pretest and posttest questionnaire links along with Learn Math with Catty interactive games to students. Students are given four days to facilitate filling out the pretest and posttest questionnaires and using the media. This test begins by asking students to fill out a pretest questionnaire before using the press. After filling out the pretest questionnaire, students can use the media and continue by filling out the posttest questionnaire.

The data analysis technique for the pretest and posttest in this study used the One Group Pretest-Posttest Design. In addition, the t-Test: Paired Two Sample for Means and the N-Gain Score test are normality tests used in this study. Paired two sample for means is show in Table 3.

Table 3. Paired Two Sample for Means

	Pretest Score	Posttest Score
Mean	47.80	51.76
Variance	20.83	29.19
Observations	25.00	25.00
Pearson Correlation	0.76	
Hypothesized Mean Difference	0.00	
df	24.00	
t Stat	-5.57	
P(T<=t) one-tail	0.00	

	Pretest Score	Posttest Score
t Critical one-tail	1.71	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.06	

Base on Table 3 show the results show a significant effect of scratch-based interactive games on the pretest and posttest of second-grade students. Because the probability value is below 0.05, which is 0, Ho is rejected, and Ha is accepted. N-Gain Score test is show in Table 4.

Table 4. N-Gain Test

	Pretest Score	Posttest Score	Posttest Score-Pretest Score	Max Score-Pretest Score	N Gain Score	N Gain Score %
Mean	47.8	51.76	3.96	12.2	0.3850	38.50

Base on Table 4 the results of the N-gain test stated that the scratch-based interactive games that the researchers made and developed were in the medium criteria with an N-gain value of 0.3850. This indicates that the learning media game Learn Math with Catty is enough to increase interest in learning math for grade 2 elementary school students.

Evaluation of Scratch-Based Interactive Games on Students' Interest in Learning Mathematics

In this research, evaluation is the last stage of development. At this stage, experts conducted a formative evaluation to provide feedback that would later be used to make improvements. The media expert who validated the scratch-based interactive media games was a lecturer from the Faculty of Education, State University of Jakarta. The validated aspects are related to the development of these games. The result of validation of media experts is show in Table 6.

Table 6. Results of Validation by Media Experts

No.	Aspects	Indicator	Score	Score Table	Maximum Score	Percentage	Validation criteria
1.	Media Design	1	4	29	35	83%	Worth
		2	4				
		3	5				
		4	4				
		5	4				
		6	3				
2.	Ease of Use	7	5	16	20	80%	Worth
		8	4				
		9	4				
		10	4				
		11	4				
3.	Media Support	12	4	17	20	85%	Worth
		13	4				
		14	4				
		15	5				
Percentage of all aspects						**83%**	
Validation criteria from all aspects						**Worth**	

Based on Table 6, the results of validation by media experts fall into the appropriate category with a percentage of 83%. The material expert who validated the material in this study was a second-grade teacher at Kramat Jati 16 Elementary School. The validated aspects are related to material development. Results of validation by material experts is show in Table 7.

Table 7. Results of Validation by Material Experts

No.	Aspects	Indicator	Score	Score Table	Maximum Score	Percentage	Validation criteria
1.	Material quality	1	4	19	25	76%	Worth
		2	4				
		3	5				
		4	3				
		5	3				
2.	Material coverage	6	4	19	25	76%	Worth
		7	5				
		8	3				
		9	4				
		10	3				
3.	Material benefits	11	3	18	25	72%	Worth
		12	3				
		13	4				
		14	4				
		15	4				
4.	Linguistics	16	3	15	25	60%	Decent Enough
		17	3				
		18	3				
		19	3				
		20	3				
Percentage of all aspects						**71%**	
Validation criteria from all aspects						**Worth**	

Based on Table 7, the results of validation by material experts fall into the appropriate category with a percentage of 71%. The media and materials are included in the feasible category from the results obtained. However, this scratch-based interactive game must be improved to make it more suitable. Therefore, suggestions from experts are needed in developing this media. Furthermore, various aspects that must be improved are in the linguistic elements, such as font size and sentence usage. Then, the lack of some game elements also needs to be considered again so that students are more interested in playing it.

Discussions

This research is based on the needs analysis submitted by the second-grade teacher at Kramat Jati 16 Elementary School, Kramat Jati District, East Jakarta, showing the need for learning media to increase students' interest in learning mathematics. As an alternative, interactive games are an attractive option for students (Li & Chu, 2021; Wibowo, 2017). In this study, researchers created and developed scratch-based interactive games that are easy to use and interesting for second-grade students.

Before being used by students, the scratch-based interactive media games were validated by experts and met the eligibility criteria. The paired t-test results show a

significance value (2-tailed) of 0.00, which rejects Ho and accepts Ha, indicating a difference in the average interest in learning mathematics between the pretest and posttest. Thus, the use of interactive games has a positive impact on increasing the interest in learning mathematics of second-grade elementary school students (Andarwulan et al., 2021; Laura et al., 2020).

It is in line with previous study that examined the effects of students' construction of computer-based educational games, using Scratch, on their mathematical equation-solving performance and their attitudes towards learning mathematics with the assistance of technology (Chiang & Qin, 2018). The results indicated significant improvements in students' equation-solving performance and in their attitudes towards learning mathematics with the assistance of technology. It also supported by other study aims to develop the potential of prospective teachers or students to create ICT-based interactive media in mathematical games, using the ADDIE model of Analysis, Design, Development, Implementation, and Evaluation to see and guide students in making better products (Bernard & Setiawan, 2020). The results of the study that there is a positive influence when using media based on the average class and there is also an increase in the ability to solve the context of mathematical problems using the scratch program language based on a decrease in the indicators of student difficulties.

In addition, the N-Gain test results showed a value of 0.3850, indicating that using interactive games media reasonably increases students' interest in learning mathematics. the results of this study can encourage the development and implementation of similar character programs in other schools to improve the quality of student character. The results of the research can provide insights into education policies regarding the effectiveness of character education programs and provide a basis for better policy changes related to character integration in the school curriculum.

Research results may be difficult to generalize broadly because of the focus on certain schools and may not be representative of the entire school population in a given country or region. Budget and other resource constraints may have affected the study design and sample size, as well as the ability to conduct in-depth and thorough analyses. Therefore, this study recommends using interactive games as learning media to increase students' interest in mathematics in other classes and schools. It can even be developed for additional lessons to increase students' interest in learning.

4. CONCLUSION

This research is based on a needs analysis conveyed by class II teachers at SDN Kramat Jati 16, Kramat Jati District, East Jakarta, indicating the need for instructional media to increase students' interest in learning mathematics. In addition, the results of the N-Gain test showed a value of 0.3850 which indicated that the use of interactive game media sufficiently increased students' interest in learning mathematics.

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