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DEVELOPMENT OF INTERACTIVE GAMIFICATION BASED ON THREE DIMENSIONAL (3D) ANIMATION ON DATA ANALYSIS MATERIAL AND OPPORTUNITIES TO IMPROVE NUMERIC LITERACY OF ELEMENTARY SCHOOL STUDENTS

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Abstract

This study aims to develop and evaluate interactive gamification-based learning media integrated with three-dimensional (3D) animation to improve elementary school students' numeracy literacy, particularly in data analysis and probability materials. The research employed a Research and Development (R&D) method using the ADDIE model, which includes the stages of analysis, design, development, implementation, and evaluation. Data were collected through tests, questionnaires, observations, interviews, and documentation, involving 32 fifth-grade students. Quantitative data were analyzed using statistical techniques, while qualitative data were analyzed descriptively. The results indicate that the developed learning media is highly feasible based on expert validation, with material validation at 93%, media validation at 94%, and language validation at 91%. The effectiveness of the media is demonstrated by a significant improvement in students' learning outcomes, with the average score increasing from 48.00% in the pretest to 90.28% in the posttest. Statistical analysis shows a significance value of 0.000 < 0.05 and an N-Gain score of 0.8247 (high category), confirming the effectiveness of the media in enhancing numeracy literacy. Additionally, student and teacher responses were highly positive, indicating increased engagement, motivation, and understanding. In conclusion, the integration of gamification and 3D animation in learning media is effective, engaging, and suitable for improving students' numeracy literacy in elementary mathematics learning.

Keywords: gamification, 3D animation, numeracy literacy, learning media, elementary education, ADDIE model

INTRODUCTION

The advancement of the digital era has brought about significant changes in the learning paradigm, particularly in mathematics instruction in elementary schools. The use of information and communication technology enables more interactive, contextual, and student-centered learning (Wahyudi & Jatun, 2024)(Qohhar, 2026). In this context, mathematics education plays a strategic role in developing logical, systematic, and analytical thinking skills by strengthening numeracy literacy (Ozika, 2024). Numeracy literacy is the ability to understand, use, and communicate mathematical concepts and information in various everyday contexts (Karmeliana & Ladyawati, 2023). Globally, this ability is measured through *the Programme for International Student Assessment* (PISA), an indicator of a country's educational quality. The 2022 PISA results showed that Indonesian students' numeracy literacy score was 366, still below the global average (Yuda & Rosmilawati, 2024). This indicates that students' ability to understand and process data-based information is still relatively low.

This problem is increasingly apparent in data analysis and probability lessons in elementary schools. This material requires students to collect, present, read, and interpret data, as well as understand simple probability concepts. However, students still experience difficulty interpreting visual data such as pictograms and bar charts. This indicates that ongoing learning has not fully developed numeracy literacy skills. The low level of numeracy literacy skills cannot be separated from various factors, including limited contextual teaching materials, lack of practice questions based on *Higher Order Thinking Skills* (HOTS), and low student learning motivation.(Ain et al., 2023; Fitriani et al., 2025; Pardede, 2024). In addition, learning is still dominated by lecture methods, causing students

to be less actively involved in the learning process, resulting in low conceptual understanding. (Abduhrohman et al., 2025; Safitri et al., 2025). Students also tend to be passive and give up easily when faced with questions that require high-level thinking skills. (Fitriyani & Al Ghani, 2024; Ruhma, 2024; Taufiqiyah & Malasari, 2023). This situation is reinforced by observations at SDIT Al Khoiriyah Al Husna in Sukaraja District, Sukabumi Regency. Evaluation results showed that only 31.25% of students met the Learning Objective Achievement Criteria (KKTP), while 68.75% of students failed to meet competency standards. Interviews with teachers indicated that the low numeracy achievement was not only due to the complexity of the material but also to the limited use of innovative and interactive learning media.

In fact, the Independent Curriculum emphasizes student-centered, contextual learning, and integration with digital technology. (Prasetyo, 2024)Therefore , learning innovations are needed that can facilitate the visualization of abstract concepts and increase active student involvement in learning. One alternative is the use of technology-based learning media, particularly animation and gamification. Animation-based media has been proven to help students understand abstract concepts through more concrete and engaging visualizations. (Dewi et al., 2024; Hasanah et al., 2025; Nursyamsu, 2025; Widaningsih et al., 2023). Meanwhile, research Ulfa et al. (2022)proves that gaming can increase student motivation and engagement through game elements such as points, levels, and challenges . The research Chalik & Cahyani (2024)also shows that game-based learning media such as *board games* can increase the interest and motivation of elementary school students in literacy and numeracy activities. The results of the study Ailulia et al. (2022)indicate that 3D animation media based on *Plotagon* is effective in improving elementary school students' numeracy skills.

Several studies have shown that the use of game-based and animation-based media has a positive impact on mathematics learning. However, most of this research still develops gamification or animation separately. Integration of interactive gamification and three-dimensional (3D) animation, particularly in data analysis and probability materials, is still relatively rare. This situation indicates a research gap, namely the suboptimal development of learning media that comprehensively integrates gamification and 3D animation into elementary school mathematics instruction. Therefore, the development of learning media that can combine both approaches in a structured and engaging learning system is needed.

LITERATURE REVIEW

Various studies in recent years have shown that the application of technology in mathematics learning, particularly through gamification and three-dimensional (3D) animation, has a positive impact on improving the quality of learning. In general, technology-based learning innovations can increase student engagement, motivation, and conceptual understanding in mathematics learning.(Wulandari & Widiansyah, 2023: Wang et al., 2022)Research conducted by Martalia Nur'Aida et al., (2024)shows that integrating game elements into learning can create a more interactive and enjoyable learning experience. The development of game-based media has been proven to increase student active participation and encourage engagement in the learning process. Furthermore, game-based learning can also improve students' logical thinking and problem-solving skills more effectively (Devi, 2024). This is reinforced by the finding that integrating contextual elements into digital games can significantly improve students' numeracy skills (Priyani, 2022). On the other hand, the use of three-dimensional (3D) animation in learning has shown a significant contribution in helping students understand abstract concepts. 3D-based visualizations allow students to observe objects more concretely and realistically, thus facilitating the understanding of mathematical concepts (A. A. A. R. C. Putri, 2025). Other research shows that systematically and interactively designed 3D animation media can improve students' numeracy literacy through the presentation of more visual and structured information.(Cahyani et al., 2023; Husnul, 2022). In addition, the use of animated videos has also been shown to improve students' understanding of numerical information through the integration of text and visuals (Pradana, 2025).

International research findings further strengthen the effectiveness of technology use in learning. The use of digital games in *STEM -based learning* has been shown to significantly improve student learning outcomes compared to conventional methods. (Wang et al., 2022). In addition, the use of 3D animation has also been proven to increase students' intrinsic motivation and conceptual understanding (Teplá et al., 2022). Furthermore, the application of gamification elements such as leaderboards and reward systems has been proven to significantly improve students' academic performance and learning motivation (Ortiz-Rojas et al., 2025). However, most previous research has developed gamification and 3D animation separately. Research specifically integrating these two approaches into a single, cohesive learning medium is still relatively limited, particularly on data analysis and opportunity management in elementary schools. Furthermore, most studies have focused on improving motivation or learning outcomes in general, and have not specifically examined numeracy literacy improvements based on structured indicators, such as

those adapted from *the Framework. PISA* 2022. This condition indicates a research gap, namely the suboptimal development of learning media that comprehensively integrates gamification and three-dimensional (3D) animation in a single, directed learning system. Therefore, it is necessary to develop learning media that are not only technologically innovative, but also systematically designed to measure and improve students' numeracy literacy. Based on this description, this study developed learning media based on three-dimensional (3D) animation gamification on the *Canva* and *Roblox platforms* . The integration of these two platforms is expected to create more interactive, contextual, and effective learning in improving students' numeracy literacy.

METHOD

This study used the *Research and Development* (R&D) method with the ADDIE (*Analysis, Design, Development, Implementation, Evaluation*) development model. This model was chosen because it has systematic stages and allows for evaluation and revision at each stage of product development (Molenda, 2015). The data collection technique in this study used a *mixed method approach* , namely combining quantitative and qualitative methods to obtain comprehensive data regarding the effectiveness of learning media based on three-dimensional (3D) animated gamification on the *Canva* and *Roblox platforms* . The data collection technique was adjusted to the objectives and types of data required. Tests were used to measure the improvement in students' numeracy literacy skills before and after learning. The test instrument was compiled based on numeracy literacy indicators that refer to the learning outcomes of the Independent Curriculum on data analysis and opportunities. Questionnaires were used to determine students' responses to the use of learning media, including aspects of interest, ease of use, clarity of material, visual appearance, and learning motivation. Observations were conducted to determine student involvement and activity during the learning process. Observation activities used an observation sheet that included indicators of student activity, enthusiasm, and interaction. Interviews were conducted with teachers and students to obtain in-depth information regarding experiences, advantages, and obstacles in using learning media. Documentation is carried out by collecting data in the form of photos of activities, student work results, and notes during learning as supporting data. The data analysis techniques used in this study were used to assess the feasibility and effectiveness of three-dimensional (3D) animated gamification-based learning media on *the Canva* and *Roblox platforms* . Quantitative data analysis was conducted with statistical support using *IBM SPSS Statistics 25* , and descriptive analysis was used for qualitative data.

RESULTS AND DISCUSSION

Test of Question Item Validity

A validity test was conducted to assess the feasibility of the numeracy literacy test instrument using *Pearson Product Moment correlation* through *IBM SPSS Statistics* 25. With 32 students as respondents and a significance level of 0.05, a value of $r_{tabel} = 0{,}349$. The test items were declared valid if $r_{hitung} > r_{tabel}$ α and β were positive. The results of the analysis are presented in Figure 4.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Soal_1	14,0938	58,152	,689	,714
Soal_2	14,0625	64,383	-,125	,748
Soal_3	14,0625	58,060	,712	,713
Soal_4	14,1563	57,426	,775	,710
Soal_5	14,1250	63,274	,014	,743
Soal_6	14,3125	58,351	,672	,715
Soal_7	14,1875	58,028	,692	,713
Soal_8	14,2500	58,194	,675	,714
Soal_9	14,1250	62,371	,128	,738
Soal_10	14,1563	58,330	,653	,715
Soal_11	14,3125	57,319	,816	,709
Soal_12	14,2813	61,886	,192	,736
Soal_13	14,2500	57,806	,728	,712
Soal_14	14,2500	63,097	,036	,742
Soal_15	14,3438	58,039	,730	,713
TOTAL	7,3438	15,910	1,000	,820

Figure 4 Output of Multiple Choice Question Validity Test

Based on Figure 4, out of 15 questions, 10 are valid, namely Question 1, Question 3, Question 4, Question 6, Question 7, Question 8, Question 10, Question 11, Question 13, and Question 15. Meanwhile, the other 5 questions (Question 2, Question 5, Question 9, Question 12, and Question 14) are declared invalid because the value $r_{hitung} < r_{tabel}$ or value is negative.

Reliability Test

Reliability Statistics

Cronbach's Alpha	N of Items
,922	10

Figure 6 Output of Multiple Choice Question Reliability Test

Based on Figure 6, *the Cronbach's Alpha* value obtained was 0.922 for 10 questions, which is in the very high category (0.80–1.00).

a. Difficulty Level

The level of difficulty was calculated using an index $P = \frac{B}{N}$with the following criteria: $P < 0{,}30$(difficult), $0{,}30 \leq P \leq 0{,}70$(moderate), and $P > 0{,}70$(easy). The analysis was conducted on 10 valid questions with 32 respondents using *IBM SPSS Statistics* 25. Figure 7

Statistics

		Soal_1	Soal_3	Soal_4	Soal_6	Soal_7	Soal_8	Soal_10	Soal_11	Soal_13	Soal_15
N	Valid	32	32	32	32	32	32	32	32	32	32
	Missing	0	0	0	0	0	0	0	0	0	0
Mean		,59	,63	,53	,38	,50	,44	,53	,38	,44	,34
Minimum		0	0	0	0	0	0	0	0	0	0
Maximum		1	1	1	1	1	1	1	1	1	1

Figure 7 Output Level of Difficulty for Multiple Choice Questions

Based on Figure 7, the difficulty index values range from 0.34 to 0.63, placing all questions in the moderate category. Complete results are presented in Table 4.9.

b. Distinguishing Power

The discrimination index was calculated using the formula $D = \frac{B_A - B_B}{J}$, by dividing 32 students into two groups (upper and lower) of 16 students each. The analysis was conducted on 10 valid questions. The results of the discrimination test are presented in Table 4.

Table 1
Multiple Choice Question Distinguishing Power Test Results

No.	Question Code	B_A	B_B	J	D	Category
1.	Question 1	14	6	16	0.50	Very good
2.	Question 3	15	7	16	0.50	Very good
3.	Question 4	12	5	16	0.44	Very good
4.	Question 6	14	7	16	0.44	Very good
5.	Question 7	12	6	16	0.38	Good
6.	Question_8	13	7	16	0.38	Good
7.	Question 10	12	7	16	0.31	Good
8.	Question 11	14	6	16	0.50	Very good
9.	Question 13	13	7	16	0.38	Good
10.	Question 15	14	6	16	0.50	Very good

Based on Table 1, the discrimination index values range from 0.31 to 0.50, categorized as good to very good. This indicates that all test items were able to effectively differentiate between high- and low-ability students.

Description

a. Validity Test

The validity test of the short essay questions was conducted using *Pearson Product Moment* correlation through *IBM SPSS Statistics* 25. With 32 students as respondents and a significance level of α = 0.05, it was obtained $r_{tabel} = 0{,}349$. The question items were declared valid if $r_{hitung} > r_{tabel}$ and had a positive value. The results of the analysis are presented in Figure 4.10.

Correlations

		Soal_16	Soal_17	Soal_18	Soal_19	Soal_20	TOTAL
Soal_16	Pearson Correlation	1	,727**	,775**	,682**	,526**	,848**
	Sig. (2-tailed)		,000	,000	,000	,002	,000
	N	32	32	32	32	32	32
Soal_17	Pearson Correlation	,727**	1	,710**	,711**	,668**	,879**
	Sig. (2-tailed)	,000		,000	,000	,000	,000
	N	32	32	32	32	32	32
Soal_18	Pearson Correlation	,775**	,710**	1	,710**	,727**	,907**
	Sig. (2-tailed)	,000	,000		,000	,000	,000
	N	32	32	32	32	32	32
Soal_19	Pearson Correlation	,682**	,711**	,710**	1	,668**	,869**
	Sig. (2-tailed)	,000	,000	,000		,000	,000
	N	32	32	32	32	32	32
Soal_20	Pearson Correlation	,526**	,668**	,727**	,668**	1	,833**
	Sig. (2-tailed)	,002	,000	,000	,000		,000
	N	32	32	32	32	32	32
TOTAL	Pearson Correlation	,848**	,879**	,907**	,869**	,833**	1
	Sig. (2-tailed)	,000	,000	,000	,000	,000	
	N	32	32	32	32	32	32

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 8 Output of Essay Question Validity Test

Based on Figure 8, all questions have a correlation value of 0.833–0.907, so they are included in the very high category and are declared valid.

b. Reliability Test

The reliability test for the short essay questions was conducted using Cronbach's Alpha through IBM SPSS Statistics 25 on five valid questions. The results of the analysis are presented in Figure 4.11.

Reliability Statistics

Cronbach's Alpha	N of Items
,917	5

Figure 9 Output of Essay Question Reliability Test

Based on 9, the Cronbach's Alpha value obtained was 0.917 which is included in the very high category (0.80–1.00).

c. Difficulty Level

The difficulty index is calculated using the formula $P = \frac{B}{N}$, with a maximum score for each item of 2. The analysis was carried out using *IBM SPSS Statistics* 25 and the results are presented in Figure 4.12.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Soal_16	32	0	2	1,00	,803
Soal_17	32	0	2	,84	,884
Soal_18	32	0	2	1,03	,933
Soal_19	32	0	2	,84	,884
Soal_20	32	0	2	,75	,916
Valid N (listwise)	32				

Figure 10 Output of Difficulty Level of Essay Questions

Based on Figure 10, the difficulty index obtained ranges from 0.38 to 0.52, so that all questions are in the medium category.

d. Distinguishing Power

The discrimination index was calculated using a formula $D = \frac{\bar{X}_A - \bar{X}_B}{\text{Skor Maksimum}}$ that divided 32 students into upper and lower groups of 50% each. The results of the discrimination test are presented in Table 8.

Table 2
Distinguishing Power of Essay Questions

No.	Question Code	Upper Mean	Lower Mean	Maximum Score	D	Category
1.	Question 16	1.62	0.38	2	0.62	Very good
2.	Question 17	1.50	0.19	2	0.66	Very good
3.	Question_18	1.87	0.19	2	0.84	Very good
4.	Question 19	1.50	0.19	2	0.66	Very good
5.	Question_20	1.38	0.13	2	0.63	Very good

Based on Table 2, the discrimination index value is in the range of 0.62–0.84, categorized as very good. This indicates that all test items are able to optimally differentiate between high-ability and low-ability students. Thus, all short essay test items are declared suitable for use without revision and are able to accurately measure students' numeracy literacy skills in learning using 3D animated gamification-based learning media on *the Canva* and *Roblox platforms* .

Essay

a. Validity Test

Pearson Product Moment correlation through *IBM SPSS Statistics* 25. With 32 students as respondents and a significance level of α = 0.05, the obtained $r_{tabel} = 0{,}349$. The question items are declared valid if $r_{hitung} > r_{tabel}$ and have a positive value. The results of the analysis are presented in Figure 11

Correlations

		Soal_21	Soal_22	Soal_23	Soal_24	Soal_25	TOTAL
Soal_21	Pearson Correlation	1	,889**	,829**	,857**	,818**	,934**
	Sig. (2-tailed)		,000	,000	,000	,000	,000
	N	32	32	32	32	32	32
Soal_22	Pearson Correlation	,889**	1	,932**	,902**	,816**	,966**
	Sig. (2-tailed)	,000		,000	,000	,000	,000
	N	32	32	32	32	32	32
Soal_23	Pearson Correlation	,829**	,932**	1	,865**	,795**	,941**
	Sig. (2-tailed)	,000	,000		,000	,000	,000
	N	32	32	32	32	32	32
Soal_24	Pearson Correlation	,857**	,902**	,865**	1	,819**	,947**
	Sig. (2-tailed)	,000	,000	,000		,000	,000
	N	32	32	32	32	32	32
Soal_25	Pearson Correlation	,818**	,816**	,795**	,819**	1	,907**
	Sig. (2-tailed)	,000	,000	,000	,000		,000
	N	32	32	32	32	32	32
TOTAL	Pearson Correlation	,934**	,966**	,941**	,947**	,907**	1
	Sig. (2-tailed)	,000	,000	,000	,000	,000	
	N	32	32	32	32	32	32

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 11 Essay Question Validity Test Output

Based on Figure 11, all questions have a correlation value of 0.907–0.966, so they are included in the very high category and are declared valid.

b. Reliability Test

The reliability test for the essay questions was conducted using *Cronbach's Alpha* using *IBM SPSS Statistics* 25 on five valid questions. The results of the analysis are presented in Figure 4.14.

Reliability Statistics

Cronbach's Alpha	N of Items
,966	5

Figure 12 Essay Question Reliability Test Output

Based on Figure 12, *the Cronbach's Alpha* value was 0.966, which is in the very high category (0.80–1.00). Complete results are presented in Table 4.16.

c. Difficulty Level

The level of difficulty is calculated using an index $P = \frac{B}{N}$with a maximum score of 4. The analysis was carried out using *IBM SPSS Statistics* 25 and the results are presented in Figure 4.15.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Soal_21	32	0	4	,84	1,298
Soal_22	32	0	4	,94	1,390
Soal_23	32	0	4	1,00	1,320
Soal_24	32	0	4	,94	1,413
Soal_25	32	0	4	,91	1,445
Valid N (listwise)	32				

Figure 13 Output of Essay Question Difficulty Level

Based on Figure 13, a difficulty index ranging from 0.21 to 0.25 is obtained, so that all questions are in the difficult category. Complete results are presented in table 4.17.

d. Distinguishing Power

The discrimination index was calculated using a formula $D = \frac{\bar{X}_A - \bar{X}_B}{\text{Skor Maksimum}}$that divided 32 students into upper and lower groups of 50% each. The results of the discrimination test are presented in Table 12.

Table 3
Distinguishing Power of Essay Questions

No.	Question Code	Upper Mean	Lower Mean	Maximum Score	D	Category
1.	Question_21	1.73	0.06	4	0.42	Very good
2.	Question_22	2.00	0.00	4	0.50	Very good
3.	Question_23	2.00	0.12	4	0.47	Very good
4.	Question_24	1.93	0.06	4	0.47	Very good
5.	Question_25	1.93	0.00	4	0.48	Very good

Based on Table 3, the discrimination index value is in the range of 0.42–0.50, categorized as very good. This indicates that all test items are able to optimally differentiate between high-ability and low-ability students. Thus, all essay test items are declared suitable for use without revision and are able to measure numeracy literacy skills, especially in the higher-order thinking aspect. Overall, the results of the validity, reliability, difficulty level, and discrimination power tests indicate that the instrument has met the eligibility criteria, so it is ready to be used in the implementation stage to test the effectiveness of three-dimensional (3D) animated gamification-based learning media on *the Canva* and *Roblox platforms* . Based on the results of the instrument feasibility test, the research continued to the implementation stage.

Implementation of Learning Using *Canva* and *Roblox Media*

The learning process was conducted using 3D animated gamification-based learning media on the *Canva* and *Roblox platforms* for data analysis and opportunities in fifth grade with 32 students. The learning process was conducted using a *deep learning approach* with a *problem-based learning* (PBL) model. In the introductory stage, the teacher presented contextual problems to activate students' prior knowledge. Furthermore, in the core stage, the material was delivered using *Canva media* that was designed visually and interactively, including data collection, pictograms, bar charts, and opportunities. Through the PBL model, students were actively involved in discussions,

questions and answers, and problem solving, making learning more meaningful. In the closing stage, evaluation was conducted through the *Roblox platform* in the form of a level-based interactive game. This activity encouraged students to think critically in solving problems that referred to numeracy literacy indicators, namely *formulate* , *employ* , and *interpret* . Overall, the use of *Canva* and *Roblox media* was able to increase student engagement, motivation, and understanding. Learning became more interactive and effective in developing students' numeracy literacy skills.

***Pretest* Results**

Table 4
Student *Pretest* Results

Aspect	*Pretest*
Number of Students	32
Total Score	1536
Average Score	48.00%
Highest Score	58
Lowest Score	34

(*Source: processed data, appendix p.160*)

Based on table 4, the average *pretest score* was 48.00% with the highest score being 58 and the lowest being 34. These results indicate that students' initial abilities in data analysis and probability materials are still relatively low. Most students have not been able to understand, process, and interpret data optimally, especially in the numeracy literacy indicators of *the formulate* , *employ* , and *interpret aspects* . Therefore, more innovative and interactive learning is needed to improve students' understanding.

***Posttest* Results**

Table 5
Student *Posttest* Results

Aspect	*Posttest*
Number of Students	32
Total Score	2889
Average Score	90.28%
Highest Score	100
Lowest Score	81

(*Source: processed data, appendix p. 160*)

Based on table 5, the average *posttest score* was 90.28% with the highest score being 100 and the lowest being 81. These results show that students' abilities have increased significantly compared to before learning. Most students were able to understand, process, and interpret data effectively, as well as solve probability problems accurately. This indicates that students' numeracy literacy skills, particularly in *the formulate* , *employ* , and *interpret aspects* , have developed optimally. Therefore, the use of 3D animated gamification-based learning media on *the Canva* and *Roblox platforms* is effective in improving student learning outcomes.

***Pretest* and *Posttest* Results**

Table 6
Students' *Pretest* and *Posttest* Results

Aspect	*Pretest*	*Posttest*
Number of Students	32	32
Total Score	1536	2889
Average Score	48.00%	90.28%
Highest Score	58	100
Lowest Score	34	81

(*Source: processed data, appendix p. 160*)

Based on Table 6, there was an increase in the average student score from 48.00% in *the pretest* to 90.28% in *the posttest* . Furthermore, the highest score increased from 58 to 100, and the lowest score increased from 34 to 81.

Normality Test of *Pretest* and *Posttest Results*

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	,103	32	,200*	,966	32	,399
Posttest	,079	32	,200*	,968	32	,458

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Figure 14 Output of Normality Test of *Pretest* and *Posttest Results*

Based on Figure 14, the significance values for the pretest and posttest data are each greater than 0.05, indicating that both data are normally distributed. Therefore, the data meets the assumption of normality, and further analysis can use parametric testing, namely *the paired sample t-test* .

Paired *Sample t-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	Pretest - Posttest	-42,281	,772	,136	-42,560	-42,003	-309,874	31	,000

Paired Sample t-Test* Output *Pretest* and *Posttest

Based on Figure 15, a significance value of 0.000 < 0.05 was obtained, indicating a significant difference between the pretest and posttest scores. The average difference value of -42.281 indicates an increase in student learning outcomes after treatment. Thus, H_0 is rejected and H_1 is accepted, so it can be concluded that the use of learning media has a significant influence on improving students' numeracy literacy skills.

N-Gain Test

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Skor	32	,67	1,00	,8247	,09610
Ngain_Persen	32	66,67	100,00	82,4665	9,60986
Valid N (listwise)	32				

***N-Gain* Test Output**

Based on Figure 16, the average N-Gain value was 0.8247, which is included in the high category. This indicates a significant increase in students' numeracy literacy skills after using learning media. Furthermore, the average N-Gain value in percentage form of 82.47% is also in the high category, so it can be concluded that the learning media used is effective in improving student learning outcomes.

Discussion

Characteristics of Learning Media

The 3D animated gamification-based learning media on the Canva and Roblox platforms are interactive, visual, and game-based (gamification). Canva is used as a systematic and contextual delivery medium, while Roblox is used as a game-based evaluation medium through a system of levels, challenges, scores, and feedback. These characteristics are reinforced by the results of the material expert validation of 93%, indicating that the material presentation is in accordance with learning outcomes and is systematically arranged. Furthermore, the media expert validation of 94% indicates that the visual appearance and interactivity of the media meet the criteria for good learning media, while the linguist validation of 91% indicates that the language use is communicative and appropriate to student characteristics. Theoretically, visual and digital characteristics in learning media have been proven to increase student motivation and understanding (Sukmanasa et al., 2017; Muzamil et al., 2023). In addition, gamification elements encourage students' active involvement in learning through exploratory activities and problem solving (Windiyani et al., 2023; Hidayatulloh et al., 2024). This technology integration is also in line with the TPACK approach which supports 21st century learning (Novita et al., 2022). Thus, the characteristics of the media developed are not only attractive, but are also supported by the quality of material, appearance and language that have been validated and are in accordance with modern learning theories.

Eligibility of Learning Media

The feasibility of the learning media was reviewed based on the validation results of material, media, and language experts, which all showed a very feasible category, with percentages of 93%, 94%, and 91%, respectively. From the material aspect, the media was in accordance with the learning outcomes and learning objectives. From the media aspect, the visual display, navigation, and interactivity were assessed as very good. Meanwhile, from the language aspect, the use of language was assessed as communicative and easy to understand. These results were reinforced by teacher responses of 95.16% and student responses of 93.24%, which were categorized as very good. These findings are in line with research stating that interactive technology-based learning media can improve the quality of learning and student engagement (Pursitasari et al., 2024; Novita et al., 2022; Setiawan et al., 2024). Thus, the developed learning media is not only theoretically feasible based on expert validation, but also practically feasible based on user acceptance.

Effectiveness of Learning Media

The effectiveness of the learning media is demonstrated by a significant increase in student learning outcomes, from an average of 48.00% in the pretest to 90.28% in the posttest, as well as an N-Gain value of 0.8247 (high category) and statistical test results showing a significance of 0.000 < 0.05. This effectiveness is also supported by the quality of the media that has been validated by experts. The high validation of material experts (93%) indicates that the learning content is relevant, while validation of media experts (94%) indicates that interactivity can increase student engagement. Language validation (91%) also supports students' ease of understanding of the material. These results are in line with research showing that the use of technology-based learning media and contextual activities can improve students' numeracy literacy (Rahayu et al., 2024; Setiawan et al., 2024; Sofyan et al., 2025). Furthermore, activity-based learning and problem-solving have also been shown to improve students' critical thinking skills (Hidayatulloh et al., 2024; Windiyani et al., 2023). Thus, the effectiveness of learning media is not only demonstrated by improved learning outcomes but also by the quality of the media, which meets eligibility standards.

Student and Teacher Responses

The responses of students and teachers to the learning media showed very positive results, with a percentage of 93.24% for students and 95.16% for teachers, which is included in the very good category. This response is in line with the results of media expert validation of 94%, which indicates that the appearance and interactivity of the media are attractive and easy to use, as well as the validation of language experts of 91% who support the clarity of communication in the media. This finding is also supported by research stating that technology-based learning media and gamification can increase student motivation, engagement, and learning experience (Setiawan et al., 2024; Pursitasari et al., 2024). Thus, the positive responses from students and teachers indicate that the learning media is not only theoretically feasible, but also effective and well accepted in learning practice.

CONCLUSION

Based on the research results and discussion, the following conclusions can be drawn:

1. The characteristics of 3D animated gamification-based learning media on the Canva and Roblox platforms are interactive, visual, and game-based. Canva is used as a systematic and contextual delivery medium, while Roblox is used as a gamification-based evaluation medium through a system of levels, challenges, scores, and feedback. These characteristics can increase student engagement and help students understand the concepts of data analysis and opportunity more concretely.
2. The feasibility of learning media based on three-dimensional (3D) animation gamification on the Canva and Roblox platforms was declared very feasible based on validation results from material experts at 93%, media experts at 94%, and language experts at 91%. The media developed meets the aspects of material suitability, display quality, interactivity and language clarity, so it is suitable for use in mathematics learning in elementary schools.
3. The effectiveness of learning media in improving students' numeracy literacy is shown by a significant increase in learning outcomes, namely from an average of 48.00% in the pretest to 90.28% in the posttest. The results of statistical tests show a significance value of 0.000 < 0.05, and an N-Gain value of 0.8247 which is included in the high category, so that learning media is proven to be effective in improving students' numeracy literacy skills.
4. Student and teacher responses to the learning media were very positive, with 93.24% of students responding and 95.16% of teachers responding, both of which fall into the excellent category. This demonstrates that the

learning media is easy to use, engaging, and able to increase student motivation and engagement in the learning process.

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