

THE EFFECTIVENESS OF AN ANDROID-BASED NUMBER LEARNING GAME APPLICATION ON ELEMENTARY SCHOOL STUDENTS' NUMERACY SKILLS

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ABSTRACT

This study investigates the effectiveness of an Android-based number learning game application in enhancing the numeracy skills of elementary school students at SD Negeri 74 Ambon. Using a pre-experimental design with a one-group pretest-posttest format, a total of 60 students from grades IV, V, and VI participated. Data were collected through a numeracy skills assessment administered before and after the intervention. The results indicate a significant improvement in the students' numeracy skills, with average scores increasing from 62.10 in the pretest to 82.05 in the posttest, yielding a mean N-Gain of 0.53, categorized as moderate. These findings suggest that the integration of engaging digital game-based learning significantly contributes to students' understanding and application of numerical concepts. The study highlights the potential of utilizing educational technology to foster an interactive learning environment conducive to enhancing student learning outcomes.

Keywords: *Android-based learning, numeracy skills, game-based learning, elementary education, educational technology.*

A. Introduction

In today's digital era, the use of information technology in education, especially at the elementary level, has become crucial. One growing phenomenon is the use of Android-based educational game applications to improve students' numeracy skills. While these technological advances offer great potential for increasing student interest and motivation in learning, significant issues remain regarding their effectiveness in

achieving optimal learning outcomes. There are indications that traditional learning methods have failed to maintain student engagement, particularly in mathematics (Dorris et al., 2024).

Lack of basic numeracy skills has a significant impact on students' readiness to enter the next level of education, resulting in difficulties in learning more complex concepts (Oktariswan et al., 2022). In other ways, the use of interactive

educational game applications has the potential to effectively improve these skills, as demonstrated in research showing that educational game media significantly improves student learning outcomes. Initial feedback from the implementation of Android-based educational games shows encouraging results, with measurable improvements in students' numeracy skills (Eldiana et al., 2025).

Integration of technology in learning, including game-based applications, can address the challenges of modern education by offering more effective alternative solutions (Saleh, 2018).

Although there are a number of studies on the effectiveness of educational game applications, there is still a research gap, especially regarding applications designed specifically for numeracy learning in elementary schools (Rusdiyanto & Kurniawan, 2025).

Based on existing research, a more innovative approach to mathematics education in elementary schools is needed. Well-designed learning game applications can play a significant role in improving students' numeracy skills, which in turn is

reflected in increased motivation and learning outcomes.

B. Research methods

This study involved students at State Elementary School 74 Ambon as subjects. The sample consisted of fourth, fifth, and sixth grade students selected using total sampling, given the relatively limited population and the fact that all students met the criteria for being research subjects.

The total sample size was 60 students, consisting of:

- a. Class IV: 20 Students
- b. Class V: 20 Students
- c. Class VI: 20 Students

1. Type and Design of Research

This study employed a quantitative approach with a pre-experimental research type using a one-group pretest–posttest design. This design was used to determine the effectiveness of the Android-Based Number Learning Game Application on students' numeracy skills by comparing students' abilities before and after being given the treatment (Maulyda et al., 2021).

The research design can be described as follows:

$$O_1 - X - O_2$$

Information:

O_1 = Numeracy ability pretest

X = Treatment using Android-based learning game applications

O_2 = Posttest of numeracy ability

2. Place and Time of Research

This research was conducted at State Elementary School 74 Ambon during the even semester of the current academic year. The study lasted four weeks, encompassing preparation, treatment implementation, and pretest and posttest data collection.

3. Research Population and Sample

The population in this study was all students in grades IV, V, and VI of SD Negeri 74 Ambon. The sampling technique used was total sampling, so the entire population was used as the research sample.

The number of samples in this study was 60 students, consisting of:

- a. Class IV: 20 Students
- b. Class V: 20 Students
- c. Class VI: 20 students

4. Research Variables

The variables in this study consist of:

- a. independent variable (X): Android-based number learning game application

b. Dependent variable (Y):

Elementary school students' numeracy skills

5. Data Collection Techniques and Instruments

Data collection was carried out using a numeracy ability test which was prepared according to the numeracy indicators of elementary school students. The test consists of multiple choice questions and short answers that cover:

- a. Number recognition,
- b. Basic arithmetic operations,
- c. Simple numeracy problem solving.

The test instrument was administered twice: as a pretest before treatment and as a posttest after treatment. In addition to the test, an observation sheet was used to support data on student engagement during learning (Hilmaliani, 2024).

6. Research Procedures

The research procedure is carried out through several stages as follows:

- a. Conduct initial observations and coordination with the school.
- b. Give a pretest to students to determine initial numeracy abilities.

- c. Carry out learning using Android-based learning game applications according to the learning schedule.
- d. Give a posttest to students after all treatments are completed.

Collecting and processing research data (Susanto et al., 2022).

7. Data Analysis Techniques

The research data were analyzed using descriptive analysis and gain analysis (N-Gain).

- a. Descriptive analysis is used to determine the average value, minimum value, maximum value, and categories of students' numeracy abilities.
- b. N-Gain analysis is used to determine the level of improvement in students' numeracy skills after treatment, with the formula:
$$N\text{-Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Posttest Score} - \text{Pretest Score}} \times 100$$

Score =
$$N\text{-Gain} = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Posttest Score} - \text{Pretest Score}} \times 100$$

(Sulaiman et al., 2025).

The results of the N-Gain calculation are categorized as follows:

- a. $N\text{-Gain} \geq 0,70$: tinggi

- b. $0,30 \leq N\text{-Gain} < 0,70$: sedang
- c. $N\text{-Gain} < 0,30$: rendah

C. Research Results and Discussion

Research Results

Table 1. Pretest, Posttest, and N-Gain

Results for Each Student

No.	Student Code	Pretest	Posttest	N-Gain	Categor
1.	S-01	60	90	0,75	Tall
2.	S-02	62	88	0,68	Currently
3.	S-03	58	86	0,67	Currently
4.	S-04	64	92	0,78	Tall
5.	S-05	61	85	0,62	Currently
6.	S-06	63	84	0,57	Currently
7.	S-07	59	80	0,51	Currently
8.	S-08	65	88	0,66	Currently
9.	S-09	60	82	0,55	Currently
10.	S-10	62	90	0,74	Currently
11.	S-11	61	83	0,56	Currently
12.	S-12	58	78	0,48	Currently
13.	S-13	64	86	0,61	Currently
14.	S-14	60	84	0,60	Currently
15.	S-15	63	91	0,76	Tall

16.	S-16	59	81	0,54	Curr ently	36	S-36	60	73	0,33	Curr ently
17.	S-17	62	85	0,61	Curr ently	37	S-37	61	75	0,36	Curr ently
18.	S-18	60	79	0,48	Curr ently	38	S-38	63	92	0,78	Tall
19.	S-19	61	87	0,67	Curr ently	39	S-39	58	70	0,29	Low
20.	S-20	64	93	0,81	Tall	40	S-40	60	71	0,28	Low
21	S-21	58	76	0,43	Curr ently	41	S-41	62	74	0,32	Curr ently
22	S-22	60	83	0,58	Curr ently	42	S-42	59	72	0,32	Curr ently
23	S-23	62	80	0,47	Curr ently	44	S-44	64	76	0,33	Curr ently
24	S-24	59	77	0,44	Curr ently	45	S-45	60	69	0,23	Low
25	S-25	61	84	0,59	Curr ently	46	S-46	58	68	0,24	Low
26	S-26	63	89	0,70	Tall	47	S-47	62	70	0,21	Low
27	S-27	60	75	0,38	Curr ently	48	S-48	59	67	0,20	Low
28	S-28	64	87	0,64	Curr ently	49	S-49	61	72	0,28	Low
29	S-29	62	86	0,63	Curr ently	50	S-50	63	71	0,22	Low
30	S-30	58	72	0,33	Curr ently	51	S-51	60	82	0,55	Curr ently
31	S-31	60	78	0,45	Curr ently	52	S-52	62	84	0,58	Curr ently
32	S-32	61	79	0,46	Curr ently	53	S-53	58	80	0,52	Curr ently
33	S-33	59	74	0,37	Curr ently	54	S-54	64	88	0,67	Curr ently
34	S-34	62	88	0,68	Curr ently	55	S-55	61	83	0,56	Curr ently
35	S-35	64	90	0,72	Tall	56	S-56	63	85	0,59	Curr ently
						57	S-57	60	81	0,53	Curr ently
						58	S-58	62	86	0,63	Curr ently
						59	S-59	59	79	0,49	Curr ently

60	S-60	64	91	0,75	Curr ently
44	S-44	64	76	0,33	Curr ently

The results shown in the table provide information regarding the distribution of students' numeracy abilities after treatment as well as the average N-Gain achieved. The following is a detailed explanation of the results:

- a. Height: 15 students
- b. Medium: 38 students
- c. Low: 7 students
- d. Average N-Gain: ± 0.53 (medium category)

These results indicate that the Android-based learning game application significantly impacts students' numeracy mastery, but further evaluation is needed for students in the lower categories. Interactive learning using technology is considered effective, but it would be even better if combined with approaches tailored to students of all ability levels to ensure that all students can develop optimally..

Table 2. Descriptive Statistics of Students' Numeracy Ability (Overall)

Varia bles	N	Minim um	Maxi mum	Flat "Value	Categ ory Value

Prete st	6 0	58	64	62, 10	Curre ntly
Postt est	6 0	67	93	82, 05	Tall
N- Gain	6 0	0,20	0,81	0,5 3	Curre ntly

Overall, this statistical table shows that the Android-based learning game application has a significant positive impact on students' numeracy skills. The increase in scores from pretest to posttest, as indicated by the good average score and N-Gain, demonstrates the effectiveness of this learning method. Therefore, it is important for educators to consider the use of interactive learning media to improve learning outcomes in the classroom.

Table 3. Descriptive Statistics of Numeracy Ability Based on Grade Level

Class	N	Prete st Avera ge	Avera ge Postte st	Avera ge N- Gain	Categ ory
IV	2 0	61,25	80,40	0,50	Curre ntly
V	2 0	62,10	82,15	0,53	Curre ntly
VI	2 0	63,00	83,60	0,56	Curre ntly
Total	6 0	62,10	82,05	0,53	Curre ntly

Overall, the results in this table indicate that the implemented learning resulted in positive improvements in

students' numeracy skills at all grade levels. The intervention successfully engaged students effectively, resulting in measurable improvements in numeracy skills. The use of N-Gain as an indicator of improvement also supports the conclusion that the adopted method is not only successful but also relevant for application in elementary education contexts.

Table 4. Distribution of Numeracy Ability Improvement Categories (N-Gain)

Categor	Value	Number	Presentatio
y	Rang	of	n
	e	Student	s
Tall	$\geq 0,70$	15	25%
Currentl	0,30 –	38	63%
y	$< 0,70$		
Low	$< 0,30$	7	12%
Total		60	100%

The results from this table provide important insights into the impact of game-based learning interventions on students' numeracy development. While the percentage of students in the high category indicates success, the percentage of students in the low category highlights areas where additional strategies may be needed to ensure that all students benefit optimally from the learning method.

Table 5. Descriptive Summary of Research Results

Aspect	Description
Students of State	Students of State
Research Subjects	Elementary School
	74 Ambon
Grade Level	IV, V, dan VI
Number of Students	60
Pretest Average	62,10
Posttest Average	82,05
Average N-Gain	0,53 (Currently)
Key Results	There was an increase in numeracy skills after using Android-based game applications.

Overall, this table illustrates promising research results regarding the application of Android-based game applications in the context of numeracy learning among elementary school students. The results of the increase from pretest to posttest and the average N-Gain which is in the medium category indicate that this method can be further optimized to achieve better results in the future.

Discussion

The results of the study show that the use of an Android-based number recognition learning game application has proven effective in improving the numeracy skills of students in grades IV, V, and VI at SD Negeri 74 Ambon. This effectiveness is demonstrated by the increase in

students' average score from 62.10 in the pretest to 82.05 in the posttest, with an N-Gain value of 0.53, which is included in the moderate category. These findings confirm that digital game-based learning can have a positive influence on the mastery of numeracy concepts in elementary school students (Hasanah & Rondli, 2023).

Improved numeracy skills are influenced by the application's characteristics, which present number recognition and basic arithmetic operations through visual displays, audio, and direct interaction. This approach aligns with the cognitive developmental stage of elementary school students, who are in the concrete operational phase, making it easier for students to understand numeracy concepts through engaging and meaningful learning experiences. Furthermore, the application of game elements such as scoring, levels, and instant feedback can increase student motivation and engagement in the learning process (Sirjon et al., 2023).

Based on descriptive analysis at each grade level, all classes showed moderate improvement in numeracy skills. Sixth-grade students achieved the highest N-Gain scores compared

to fourth- and fifth-grade students, indicating that cognitive maturity influences students' ability to optimally utilize the application's features. Nevertheless, the results for fourth- and fifth-grade students still demonstrate that the learning game application is effective when implemented across elementary school grade levels (Hutomo et al., 2023).

The distribution of N-Gain values shows that the majority of students are in the medium to high category, indicating a significant contribution of using Android-based learning game applications to improving numeracy skills. Students in the low category are suspected to be influenced by variations in initial abilities, adaptation to technology, and learning environment conditions. Therefore, the role of teachers as facilitators in the use of applications is crucial to ensuring that the learning benefits are felt evenly (Tesa Laela et al., 2025).

The findings of this study are consistent with previous research, which found that technology-based learning media and educational games can improve elementary school students' mathematics and numeracy learning outcomes.

Educational games serve not only as a means of entertainment but also as a learning medium that encourages active engagement, improves concentration, and gradually strengthens conceptual understanding. Therefore, Android-based learning game applications can be used as an alternative, innovative learning medium that aligns with the characteristics of students in the digital era (Musyafak et al., 2024).

D. Conclusion

Based on the research results, it can be concluded that the use of Android-based number learning game applications is effective in improving elementary school students' numeracy skills. The integration of game elements and digital technology can create a more interesting, interactive and meaningful learning experience. Therefore, Android-based learning game applications are worthy of being used as innovative learning media to support strengthening numeracy literacy in elementary schools in accordance with the demands of education in the digital era.

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