

The Effect of Interactive Wordwall Media on Improving Elementary School Students' Mathematical Numeracy Skills

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Abstract

This study aimed to analyze the effect of interactive Wordwall media on improving elementary school students' mathematical numeracy skills. The research employed a quantitative approach using a pre-experimental one-group pretest–posttest design. The participants were 20 third-grade students at SDN 02 Jatisari, consisting of 11 female students and 9 male students. Data were collected through a numeracy test consisting of five essay questions on multiplication material. The instrument was validated using the Product Moment correlation test and demonstrated acceptable reliability with a Cronbach's Alpha coefficient of 0.656. Data were analyzed using descriptive statistics, the Shapiro–Wilk normality test, N-Gain analysis, effect size analysis, and the Paired Sample t-test with the assistance of SPSS version 25. The results showed that students' mean numeracy score increased from 58.40 on the pretest to 83.15 on the posttest. The N-Gain score was 0.60, indicating a moderate level of improvement, while the effect size analysis yielded a Cohen's d value of 1.91, indicating a large effect. The Paired Sample t-test also revealed a statistically significant difference between pretest and posttest scores ($p < 0.05$). The findings demonstrate that interactive Wordwall media is effective in improving elementary school students' mathematical numeracy skills and can serve as an innovative digital learning tool to support engaging mathematics instruction.

Keywords: Wordwall, mathematical numeracy skills, gamification, mathematics learning, elementary school students

1. Introduction

Numeracy is one of the essential competencies that students need to develop in the twenty-first century. Numeracy not only involves performing mathematical calculations but also includes the ability to interpret, analyze, and apply mathematical concepts to solve real-life problems. According to the Organisation for Economic Co-operation and Development (OECD, 2023), mathematical numeracy refers to an individual's ability to formulate, employ, and interpret mathematics in various situations. Recent studies have emphasized that numeracy literacy significantly influences students' mathematical reasoning, critical thinking, and problem-solving abilities (Nuraida & Solihah, 2025). Therefore, strengthening numeracy skills from an early age is important to support students' academic achievement and everyday decision-making.

Despite its importance, Indonesian students' numeracy achievement remains relatively low. Results from the Programme for International Student Assessment (PISA) 2022 indicate that Indonesian students continue to perform below the OECD average in mathematics-related competencies. This condition suggests that many students still experience difficulties in understanding mathematical concepts and applying them to contextual problems. One factor contributing to this issue is the predominance of conventional learning approaches that limit students' active participation and engagement during mathematics learning.

To address these challenges, innovative learning media are needed to create more meaningful and engaging learning experiences. Interactive digital media can support students' understanding of

mathematical concepts through visualizations, immediate feedback, and active learning activities. Previous studies have shown that technology-based learning media can increase students' motivation, participation, and learning outcomes in mathematics learning (Indarti et al., 2025). Therefore, integrating technology into mathematics instruction has become an important strategy for supporting students' numeracy development.

One interactive digital platform that can be utilized in mathematics learning is Wordwall. Wordwall provides various educational game templates, quizzes, matching activities, and other interactive features that encourage students to participate actively in learning. The effectiveness of Wordwall can be explained through the concept of gamification, which refers to the application of game elements such as points, rewards, challenges, competition, and immediate feedback in educational settings. Gamification has been reported to increase students' motivation, engagement, and learning achievement by creating enjoyable and meaningful learning experiences.

Preliminary observations conducted at SDN 02 Jatisari revealed that many third-grade students experienced difficulties in understanding multiplication concepts and solving contextual numeracy problems. In addition, mathematics instruction was still predominantly teacher-centered, resulting in limited student participation and low learning motivation. These conditions indicate the need for innovative learning media that can actively engage students and support the development of mathematical numeracy skills.

Previous studies have reported that Wordwall improves students' learning motivation, engagement, critical thinking, and mathematics achievement (Hidayah & Andriani, 2023; Oktaviasari et al., 2024; Mirna Dewi & Dinata, 2025). However, most studies focused on learning motivation, engagement, critical thinking, and general mathematics achievement rather than specifically examining mathematical numeracy skills. In addition, previous studies rarely investigated students' ability to apply mathematical concepts in solving contextual numeracy problems, which represent an essential component of numeracy competence. Empirical evidence regarding the effectiveness of gamification-based Wordwall activities in supporting elementary school students' numeracy development also remains limited. Considering the importance of numeracy skills for students' academic success and everyday problem-solving, further investigation is needed to provide empirical evidence regarding the contribution of interactive Wordwall media to numeracy development. Therefore, this study aims to analyze the effect of interactive Wordwall media on improving elementary school students' mathematical numeracy skills. The findings are expected to enrich the literature on technology-enhanced mathematics learning and provide practical recommendations for teachers in implementing innovative digital learning media to support numeracy development in elementary schools.

2. Method

The research applied a quantitative pre-experimental design involving one experimental class. The research design used is a pre-experimental design with a *one-group pretest-posttest design*, which is a study involving one class without a control group. The research subjects were not randomly selected and all students in one class were used as treatment groups.

In its implementation, students are given an initial test (*pretest*) to find out numeracy skills before treatment is given. Furthermore, students were given treatment in the form of the use of interactive *wordwall* media in the learning process, then ended with the administration of a final test (*posttest*). Comparison of *pretest* and *posttest results* was used to determine the effect of the use of interactive Wordwall media on Improving the mathematical numeracy skills of elementary school students.

1. Research Design

Groups	Pre-test	Treatment	Post-test
Experiment	O ₁	X	O ₂

(Source : Sugiyono, 2022)

Description:

O₁ = *Pretest* before treatment is given

O₂ = *Posttest* after treatment

X = Treatment in the experimental class, namely the use of interactive *Wordwall* media

Although the one-group pretest-posttest design allows researchers to examine changes in students' numeracy skills before and after the treatment, this design has limitations because it does not involve a control group. Consequently, external factors that may influence students' performance cannot be fully controlled. Therefore, the findings should be interpreted cautiously when drawing causal conclusions regarding the effectiveness of the intervention. The research was carried out at SDN 02 Jatisari. The time for this research was carried out in the even semester of the 2025/2026 school year. The research subjects were all grade III students totaling 20 people with 11 females and 9 males. The sampling technique used is saturated sampling, where the entire population is used as a research sample because the number is relatively small.

The variables in this study consist of independent variables and dependent variables. The independent variable (X) is the use of interactive *Wordwall* media in mathematics learning, while the dependent variable (Y) is the mathematical numeracy ability of elementary school students.

The research procedure is carried out in three stages, namely the initial stage, the implementation stage, and the final stage. In the early stages, students are given a *pretest* to find out their mathematical numeracy skills before being given treatment. In the implementation stage, students take part in mathematics learning multiplication materials using interactive *Wordwall* media. Furthermore, in the final stage, students are given a final test (*posttest*) to find out their mathematical numeracy skills after the treatment is given.

The data were analyzed quantitatively using descriptive statistics, the Shapiro–Wilk normality test, N-Gain analysis, effect size analysis, and the Paired Sample t-test to determine the effect of interactive *Wordwall* media on students' mathematical numeracy skills.

3. Results and Discussion

Results

1. Research Preparation Stage

Before the implementation of research in the field, researchers first carried out several stages of preparation. These stages include the creation of *Wordwall* media, the preparation of test instruments, and instrument trials for grade III students. The explanation of each stage is presented as follows:

Interactive *Wordwall* media was developed using multiplication materials and integrated game-based learning activities such as quizzes and educational games. The media was designed to facilitate students' active participation, provide immediate feedback, and create an engaging learning environment. Students accessed the activities through a link or QR code and completed the tasks during the learning process. The implementation of *Wordwall* aimed to support the development of students' mathematical numeracy skills through interactive and enjoyable learning experiences.

a. Stage of Preparation of Numeracy Ability Test Instruments

The instrument used in this study is in the form of a test to measure the mathematical numeracy ability of grade III students on multiplication material. The test was carried out in two stages, namely *pretest* and *posttest*, with the aim of finding out the difference in students' numeracy skills before and after the implementation of the use of *interactive Wordwall* media in grade III of SDN 02 Jatisari.

Each test instrument contains question items that are arranged based on material that has been adjusted by the researcher, with a total of five questions. These questions are answered/completed by students to measure the level of numeracy skills they have. The grid of numeracy ability test instruments is presented as follows.

Table 2. Test Specification

No	Numeracy Indicators	Competency Indicators	Question Form	Questions Number
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1	Able to use basic numbers and calculation operations in solving everyday problems	Determining the results of simple multiplication in the context of everyday life (C2)	Word Problems	1
2	Able to use numbers and calculation operations in solving everyday problems	Determining the result of simple multiplication based on the arrangement of objects (C2)	Word Problems	2
3	Able to understand and apply the concept of multiplication in a variety of situations	Solving multiplication problems based on contextual information (C3)	Word Problems	3
4	Able to solve numeracy problems in various life contexts	Analyzing and determining the multiplication results of a problem (C3)	Word Problems	4
5	Able to interpret and use numeracy information for decision-making	Analyze contextual problems and determine the right solution using multiplication operations (C4)	Word Problems	5

An example of a numeracy test item is as follows: “A teacher prepares 6 boxes of pencils. Each box contains 4 pencils. How many pencils are there in total?” This item was designed to measure students’ ability to apply multiplication concepts in a contextual situation.

The numeracy test consisted of five essay questions on multiplication material. Each item was scored using an analytic scoring rubric with a maximum score of 20 points, resulting in a total maximum score of 100 points. The scoring rubric was used to assess students’ conceptual understanding, problem-solving procedures, calculation accuracy, and final answers.

Table 3. Scoring Rubric

Score	Criteria
20	Correct procedure and correct answer
15	Correct procedure with minor calculation errors
10	Partially correct procedure
5	Attempted answer but incorrect procedure
0	No answer or irrelevant answer

c. Instrument Trial Stage to Class III

The instrument that had been prepared was then tested on 20 third-grade students to determine its validity and reliability. The analysis was carried out using SPSS version 25 with the Product Moment correlation test. Each item was considered valid if the calculated r-value exceeded the r-table value of 0.468 at the 5% significance level. The results showed that all question items (P01–P05) had calculated r-values greater than the r-table value (0.468), indicating that all items were valid. The r-values obtained were P01 = 0.512, P02 = 0.601, P03 = 0.575, P04 = 0.689, and P05 = 0.721.

Furthermore, the reliability test using Cronbach’s Alpha produced a coefficient of 0.656. According to commonly accepted reliability criteria, a value between 0.60 and 0.70 indicates an acceptable or sufficient level of reliability. Therefore, the instrument was considered sufficiently reliable and suitable for use in this study. However, the coefficient also suggests that further refinement may improve the instrument’s internal consistency. Thus, the numeracy test instrument was considered feasible for data collection.

2. Research Implementation

After the instrument is declared valid and reliable, the next stage is the implementation of field research to collect data. This activity includes the process of implementing learning and collecting data on student learning outcomes.

a. Data Collection Techniques

This study uses a pre-experimental design with a *one-group pretest-posttest* design that only involves one group without a control group. The research subjects consisted of 20 students in one class who were used as a treatment group.

The data collection technique is carried out using tests and documentation. The numeracy test consisted of five essay questions related to multiplication material. The instrument was developed based on numeracy indicators, including the ability to use numbers and mathematical operations, understand multiplication concepts, solve contextual problems, and apply mathematical reasoning in everyday situations. The same indicators were used in both the pretest and posttest, with different question contexts to minimize testing effects. Tests are given in the form of *pretest* and *posttest* to find out students' mathematical numeracy skills before and after being given treatment. The pretest is carried out before learning using interactive *Wordwall* media to find out students' initial abilities. Furthermore, students were given treatment in the form of learning using interactive *Wordwall* media, then ended with a *posttest* to find out the improvement of students' mathematical numeracy skills after the treatment was given.

In addition, documentation is used as supporting data during the research process, such as photos of learning activities and student data.



Gender	Number of Students
female	11 Students
Male	9 Students
Total	20 Students

Figure 10. Documentation of Learning Activities **Table 4.** Respondents by Gender

b. Research Results

Based on the data from the research results that have been obtained, a descriptive analysis of students' *pretest* and *posttest* scores was carried out after the use of interactive *Wordwall* media. The average *pretest* and *posttest* scores showed an increase in both classes after the learning process took place.

To clarify the comparison, the following table and diagram images are presented

Table 5. Descriptive Analysis

Data	N	Minimum Score	Maximum Value	Mean
<i>Pretest</i>	20	45	75	58,40
<i>Posttest</i>	20	70	95	83,15

Based on the table and diagram above, the average student pretest score is 58.40 while the average posttest score is 83.15. This shows that students' mathematical numeracy skills have improved after using *Wordwall* media in the learning process.

After the implementation of the research, the next stage is to analyze the data obtained. This analysis is carried out through two stages, namely a Prerequisite Test and a hypothesis test. The description of each stage is as follows.

Table 6. N-Gain Analysis

Mean Pretest	Mean Posttest	N-Gain	Category
58.40	83.15	0.60	Medium

To further examine the improvement in students' numeracy skills, an N-Gain analysis was conducted. The result showed an N-Gain score of 0.60, which falls into the medium category. This finding indicates that the use of interactive Wordwall media contributed to a moderate improvement in students' mathematical numeracy skills.

1) Prerequisite Test

After the instrument is declared suitable for use, the next test is applied to measure the numeracy ability of grade III students. The data obtained were then analyzed using a normality test as a condition before hypothesis testing. The normality test was carried out using *the Shapiro-wilk method* with the help of the SPSS version 25 application.

Normality tests are carried out to find out whether the data from the research results are distributed normally or not. In this study, a normality test was carried out on *the pretest* and *posttest* data of students' mathematical numeracy ability using *the Shapiro-wilk* test with the help of SPSS 25.

Table 7. Results of data normality test

No	Data	Statistics <i>Shapiro-Wilk</i>	Sig.	Remarks
1	<i>Pretest</i>	0,957	0,200	Normally Distributed
2	<i>Posttest</i>	0,936	0,137	Normally Distributed

The results of the normality test showed that the significance value (Sig.) in the *pretest* data was 0.200 and *the posttest data* was 0.137. Based on the test criteria, the data is declared to be normally distributed if the significance value is greater than 0.05. Because the significance value of *the pretest* and *posttest* is greater than 0.05, it can be concluded that the research data is normally distributed. Thus, data analysis can be continued using a parametric test, namely *the Paired Sample t-test* to determine the effect of the use of interactive Wordwall media on Improving students' mathematical numeracy skills.

2. Hypothesis Testing

Hypothesis testing in this study was carried out using *the Paired Sample t-test* with the help of SPSS 25. This test was used to find out whether there was an effect of the use of interactive Wordwall media on the mathematical numeracy ability of grade III students of SDN 02 Jatisari on multiplication material. The test was carried out by comparing the *pretest* and *posttest* scores of 20 students after being given treatment using Interactive Wordwall media.

Table.8 Results of the Paired Sample Hypothesis *t-test*

	Mean	t count	Sig. (2-tailed)	Remarks
<i>Pretest – Posttest</i>	-18,450	8,542	0,000	H ₀ rejected, H ₁ accepted

Testing Criteria

- If the value of Sig. < 0.05 then H₀ is rejected and H₁ is accepted.
- If the value of Sig. > 0.05 then H₀ is accepted and H₁ is rejected.

Based on the results of the analysis in Table 6, the mean *difference* value of -18,450 was obtained. The negative score shows that the *posttest* score is higher than the *pretest* score, so it can be seen that there is an increase in students' mathematical numeracy skills after using interactive *Wordwall* media. In addition, a calculated t-value of 8.542 was obtained with a significance value (Sig. 2-tailed) of 0.000. The significance value is smaller than the significance level of 0.05 (0.000 < 0.05), so H₀ is rejected and H₁ is accepted.

Table 9. Effect Size Analysis

Effect Size (Cohen's d)	Category
1.91	Large

The effect size analysis produced a Cohen's d value of 1.91, indicating a large effect. This result demonstrates that interactive Wordwall media had a substantial impact on improving students' mathematical numeracy skills. Therefore, the improvement observed was not only statistically significant but also educationally meaningful.

Discussion

The findings of this study indicate that the use of interactive Wordwall media significantly improved students' mathematical numeracy skills. The improvement can be explained through the principles of gamification embedded in Wordwall. Gamification incorporates game elements such as points, rewards, challenges, competition, and immediate feedback into learning activities. These features create a more engaging learning environment that encourages students to actively participate in solving mathematical problems. According to gamification theory, active participation and continuous interaction with learning content can enhance students' motivation and conceptual understanding, which ultimately contribute to improved learning outcomes.

Another factor contributing to the improvement in numeracy skills is the immediate feedback provided by Wordwall. Through interactive quizzes and educational games, students receive direct information about the correctness of their answers. Immediate feedback enables students to identify mistakes, correct misconceptions, and strengthen their understanding of multiplication concepts. This process supports the development of mathematical reasoning and helps students apply mathematical concepts more effectively when solving contextual numeracy problems.

Furthermore, the use of Wordwall increased students' learning motivation and engagement during mathematics instruction. Compared to conventional teacher-centered learning, Wordwall provides a more interactive and enjoyable learning experience. Students were actively involved in completing challenges, answering questions, and participating in learning activities. Higher levels of engagement allow students to spend more time interacting with mathematical concepts, thereby supporting the development of numeracy skills.

The findings of this study are consistent with previous studies reporting the positive effects of Wordwall on mathematics learning. Hidayah and Andriani (2023) found that Wordwall increased students' interest and engagement in learning, while Oktaviasari et al. (2024) reported that Wordwall improved students' understanding of basic mathematical concepts. Similarly, Nisa and Susanto (2022) found that game-based Wordwall activities enhanced students' learning motivation. The consistency between the present study and previous studies suggests that Wordwall is an effective digital learning medium for supporting mathematics learning.

However, this study also differs from previous research in several aspects. Most previous studies focused on learning motivation, engagement, and general mathematics achievement, whereas the present study specifically examined students' mathematical numeracy skills. In addition, this study focused on multiplication material for third-grade elementary school students and employed a one-group pretest-posttest design. Therefore, the findings contribute additional empirical evidence regarding the effectiveness of Wordwall in supporting numeracy development at the elementary school level.

Despite the positive findings, this study has several limitations. The research employed a one-group pretest-posttest design without a control group, which limits the ability to fully attribute the observed improvements solely to the intervention. In addition, the study involved a relatively small sample from a single elementary school. Future studies are recommended to involve larger samples and apply quasi-experimental or true experimental designs to obtain more comprehensive evidence regarding the effectiveness of interactive Wordwall media in improving students' mathematical numeracy skills.

4. Conclusion

The findings of this study indicate that interactive Wordwall media is effective in supporting the improvement of elementary school students' mathematical numeracy skills. The integration of gamification elements and interactive learning activities encourages students' engagement and

motivation, thereby facilitating a better understanding and application of mathematical concepts in contextual situations.

The results imply that teachers can utilize Wordwall as an innovative digital learning medium to create more engaging and student-centered mathematics instruction. The integration of interactive features and educational games can help students participate more actively in the learning process and support the development of numeracy skills.

Future studies are recommended to involve larger samples and employ quasi-experimental or true experimental designs with control groups to provide stronger evidence regarding the effectiveness of Wordwall in improving students' mathematical numeracy skills.

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