

The Effectiveness of Wordwall in Mathematics Teaching in Improving Pupils' Basic Numeracy Skills

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Abstract: This study examined changes in pupils' basic numeracy skills after implementing Wordwall in mathematics teaching. The research used a quantitative methodology with a pre-experimental one-group pre-test–post-test design. The study involved 12 Year 4 pupils at SD Inpres Mahambala, selected through purposive sampling. Data collection involved a straightforward numeracy skills assessment with 14 valid items, administered as both a pre-test and a post-test. The data were analysed using descriptive statistics and a paired-samples t-test with IBM SPSS. The results showed that pupils' mean basic numeracy score increased from 74.17 on the pre-test to 78.57 on the post-test, representing an improvement of approximately 4.41 points. However, the paired-samples t-test indicated that the difference was not statistically significant ($t = -1.974$, $p = .074$). The findings indicate that while pupils showed improved basic numeracy performance with Wordwall, there is not enough evidence to conclude that it significantly enhanced their skills. Wordwall can serve as an engaging practice tool but should be integrated into a structured teaching framework aligned with specific learning goals. Future research should focus on larger sample sizes, control groups, and longer interventions to better assess Wordwall's effectiveness in developing numeracy skills.

Keywords: Basic numeracy skills, digital learning resources, mathematics education, Wordwall



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A. Introduction

Digital tools have become increasingly important in mathematics education because they provide interactive learning environments that allow pupils to practise mathematical concepts, receive immediate feedback, and participate more actively in the learning process (Sihotang, 2025). This is particularly relevant to developing basic numeracy skills, which involve understanding numbers, performing basic arithmetic operations, recognising numerical relationships, and solving simple mathematical problems. These foundational skills are essential because difficulties in basic numeracy may hinder pupils' ability to engage with more complex mathematical concepts.

Interactive digital media can support numeracy learning by providing repeated practice, immediate responses, and engaging learning activities (Dewi, Berta Apriza, & Karsoni Berta Dinata, 2025). One platform that offers these features is Wordwall, which enables teachers to design interactive activities in various game-based formats. In mathematics learning, such activities may provide pupils with additional opportunities to practise foundational numerical skills in a more engaging environment (Sulaiman, Sumiyati, Arifin, & Nurjannah, 2025). Therefore, Wordwall can be considered a supplementary learning medium that supports teachers' instructional strategies rather than replacing structured mathematics instruction (Deng, Wu, Chen, & Peng, 2020).

Basic numerical skills for primary school pupils form a vital foundation for mathematics learning and must be taught from the outset (Purwati & Erawati, 2021). If pupils lack a solid grasp of basic numerical skills, they will struggle to learn more complex mathematical concepts at later levels (Devlin, Jordan, & Klein, 2022). In school mathematics teaching, many learning processes still take place in a conventional, teacher-centred manner, resulting in pupils being less actively and responsively engaged in the learning process (Nikolaos, Arifianto, & Triposa, 2024). This leads to low motivation to learn and results in suboptimal understanding of basic numeracy.

One alternative available to educators is to use digital learning resources that are interactive and engaging for learners (Fadilah et al., 2024). Game-based learning can create a more engaging learning environment and increase learner participation (Debrenti, 2024a). Wordwall is a digital learning platform that lets teachers create various educational games, such as quizzes, matching games, spinning wheels, and other interactive activities for classroom or online learning (Rezeki & Amelia, 2025).

Several studies on using Wordwall to improve pupils' numeracy skills indicate that digital learning tools, particularly Wordwall, can enhance pupils' engagement and motivation in mathematics lessons (Imanulhaq & Pratowo, 2022). Nadia and Desyandri (2022) showed that using Wordwall as an interactive learning tool can help pupils understand basic mathematical concepts through engaging educational games. Furthermore, pupils become more active in lessons because this medium provides a more enjoyable and less monotonous learning experience, as Afifah, Bahtiar, and Kriswati (2025) found improved mathematics learning outcomes after implementing Wordwall in classroom teaching.

Another study by Adiansha (2025) found that using Wordwall in mathematics teaching positively impacts pupils' numerical skills. Putra et al. (2024) explain that the Wordwall platform helps pupils understand basic arithmetic operations such as addition, subtraction, multiplication, and division more effectively through game-based exercises. Meanwhile, Putri et al. (2024) demonstrated a significant improvement in pupils' numerical abilities after using the Wordwall medium compared to conventional teaching. Consequently, Wordwall can serve as an innovative alternative learning medium to enhance pupils' understanding of basic mathematical concepts.

Although previous studies have reported positive effects of Wordwall on pupils' motivation, engagement, mathematics learning outcomes, and numeracy-related skills, empirical evidence focusing specifically on measurable changes in basic numeracy skills among primary school pupils remains limited. In particular, previous studies have tended to examine broader learning outcomes or engagement rather than foundational numeracy competencies. Therefore, further investigation is needed to determine whether using Wordwall is associated with changes in pupils' basic numeracy performance. Accordingly, this study aimed to examine Wordwall's effectiveness in mathematics teaching by comparing pupils' basic numeracy skills before and after its implementation.

B. Method

This study employed a quantitative approach with a pre-experimental One-Group Pretest-Posttest Design to examine changes in pupils' basic numeracy skills after implementing Wordwall. The study was conducted at SD Inpres Mahambala and involved 12 Year 4 pupils selected through purposive sampling. Data were collected using a basic numeracy skills test consisting of 14 valid items administered as both the pre-test and post-test. Item validity testing showed that the 14 items met the validity criterion of $r\text{-count} > r\text{-table}$ ($0.576, \alpha = .05$). Reliability analysis yielded a Cronbach's alpha of 0.81, indicating good internal consistency.

The data were analysed using IBM SPSS through descriptive and inferential statistical procedures. Descriptive statistics were used to obtain the mean, standard deviation, minimum, and maximum scores of the pre-test and post-test (Mishra et al., 2019). Before hypothesis testing, the One-Sample Kolmogorov–Smirnov test assessed data normality. A significance value greater than .05 indicated that the normality assumption was satisfied (Pramusinta & Dewi, 2026). A paired-samples t-test was then used to determine whether pupils' pre-test and post-test basic numeracy scores differed significantly. Statistical significance was determined at $\alpha = .05$ (Annisa, Rizal, & Syabrina, 2025; Viyanti, Moh Faiz Shofi, & Evi Wiyanti, 2025).

C. Results and Discussion

Results

Based on the data collected before and after implementing Wordwall in mathematics instruction, each pupil's score was calculated by taking the mean score and multiplying it by 100 to convert the results to a 0–100 scale. The data were then analysed using descriptive statistics in IBM SPSS to provide an overview of pupils' basic numeracy skills at the pre-test and post-test stages. The descriptive analysis included the minimum, maximum, mean, and standard deviation, providing an initial indication of changes in pupils' basic numeracy skills before and after the implementation of Wordwall. The results of the descriptive statistical analysis are presented in Table 1.

Table 1 presents descriptive statistics of pupils' basic numeracy skills before and after implementing Wordwall in mathematics instruction. The analysis involved 12 pupils

in both the pre-test and post-test. Pre-test scores ranged from 40.00 to 95.00 (range = 55.00), with a mean of 74.1667 and a standard deviation of 13.87171. The variance of the pre-test scores was 192.424, indicating a relatively considerable variation in pupils' initial basic numeracy skills. Post-test scores ranged from 51.43 to 97.14 (range = 45.71), with a mean of 78.5717 and a standard deviation of 10.86104. The post-test variance decreased to 117.962, indicating that pupils' scores became less dispersed after implementing Wordwall. Descriptively, the increase in the mean score from 74.1667 to 78.5717 indicates an improvement of approximately 4.41 points in pupils' basic numeracy skills following the intervention.

Table 1. Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Kurtosis	Std. Error
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Pre_Test	12	55.00	40.00	95.00	74.1667	13.87171	192.424	2.901	1.232
Post_Test	12	45.71	51.43	97.14	78.5717	10.86104	117.962	3.558	1.232
Valid N (listwise)	12								

Table 2. The Results of the Normality Test
One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		12
Normal Parameters ^{a,b}	Mean	.0000000
	Std. Deviation	6.02896741
Most Extreme Differences	Absolute	.153
	Positive	.153
	Negative	-.116
Test Statistic		.153
Asymp. Sig. (2-tailed)		.200 ^{c,d}

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

The data were analysed using IBM SPSS through descriptive and inferential statistical procedures. Descriptive statistics, including the mean, standard deviation, minimum, and maximum scores, described pupils' pre-test and post-test performance (Mishra et al., 2019). Prior to hypothesis testing, the normality assumption was examined using the One-Sample Kolmogorov–Smirnov test. A significance value greater than .05 was interpreted as indicating no statistically significant deviation from normality. Because the normality assumption was met, a paired-samples t-test was conducted to determine whether pupils' pre-test and post-test basic numeracy scores differed significantly (Kim, 2015). Statistical significance was determined at $\alpha = .05$. The results

of the normality test are presented in Table 2. Table 2 presents the results of the One-Sample Kolmogorov–Smirnov normality test. The significance value was .200, which was greater than .05, indicating that the data were normally distributed. Therefore, the normality assumption was satisfied, and the analysis proceeded using the paired-samples t-test.

The normality test indicates that the unstandardized residuals were normally distributed because the significance value of 0.200 exceeded the 0.05 significance level. Therefore, we did not reject the null hypothesis that the data follow a normal distribution. This result indicates that the normality assumption was satisfied and that the data were appropriate for subsequent parametric statistical analysis. Accordingly, the analysis proceeded to the hypothesis-testing stage using an appropriate parametric procedure to examine differences in pupils' basic numeracy skills before and after the implementation of Wordwall. The results of the paired-sample t-test are shown in Table 3.

Table 3. Paired Samples Test

Table 1: Paired Samples Test									
		Paired Differences							
			Std.	Std. Error	95% Confidence Interval of the Difference				Sig. (2-
		Mean	Deviation	Mean	Lower	Upper	t	df	tailed)
Pair 1	Pre_Test - Post Test	- 4.40500	7.72991	2.23143	-9.31635	.50635	- 1.974	11	.074

The results of the paired-samples t-test are presented in Table 3. The analysis compared pupils' basic numeracy scores before and after implementing Wordwall in mathematics teaching. The mean difference between the pre-test and post-test scores was -4.40500, indicating that the post-test scores were, on average, 4.405 points higher than the pre-test scores. The standard deviation of the paired differences was 7.72991, and the standard error of the mean was 2.23143. The 95% confidence interval for the mean difference ranged from -9.31635 to 0.50635. The obtained t-value was -1.974 with 11 degrees of freedom, and the significance value was 0.074.

The paired-samples t-test results indicate that the increase in pupils' basic numeracy scores following the implementation of Wordwall was not statistically significant at the 0.05 significance level, because the p-value of 0.074 was greater than 0.05. Therefore, the null hypothesis was not rejected, indicating that the observed improvement in mean scores from 74.1667 in the pre-test to 78.5717 in the post-test was not sufficient to demonstrate a statistically significant difference. Although the descriptive results suggest a positive change in pupils' basic numeracy performance after learning mathematics through Wordwall, the statistical evidence does not support a significant improvement in the study sample. Thus, under the conditions of this pre-experimental study, Wordwall showed a positive descriptive contribution to pupils' basic numeracy skills, but its effect was not statistically significant.

Discussion

The findings indicate that implementing Wordwall was associated with a positive descriptive improvement in pupils' basic numeracy performance, although the improvement did not reach statistical significance. This suggests that Wordwall provided learning opportunities that may have supported pupils' numeracy performance, but the improvement was not sufficiently consistent across participants to provide strong evidence of effectiveness. Therefore, the findings should be interpreted as indicating a positive learning tendency rather than conclusive evidence that Wordwall significantly improved pupils' basic numeracy skills.

The non-significant result can be understood by considering the characteristics of both the data and the learning process. The study involved only 12 pupils, which limited the information available to estimate the intervention effect and may have reduced the statistical test's ability to detect differences between the two measurements (Lakens, 2022). In addition, the mean improvement was not equally reflected across all pupils. Although the minimum score increased substantially and the post-test scores became less dispersed, the overall mean difference remained relatively modest. This pattern suggests that Wordwall may have provided useful learning opportunities for some pupils, particularly those who initially scored lower. However, the improvement was not consistent enough across the whole group to produce a statistically significant difference.

From an instructional perspective, this finding also suggests that interactive digital media should not be assumed to improve basic numeracy merely because they provide attractive game-based activities. Basic numeracy involves understanding numbers, numerical relationships, arithmetic operations, and simple problem solving (Aprilliani & Santi, 2025; Aunio & Räsänen, 2016). These competencies require not only opportunities for practice but also structured explanation, repeated exercises, feedback, and instructional activities that are closely aligned with the targeted mathematical concepts. Game-based learning can enhance participation and create a more engaging learning environment, but its educational value depends on how the game is integrated with instructional objectives and pedagogical strategies (Debreñti, 2024b; Tokac, Novak, & Thompson, 2019). Therefore, Wordwall may be better understood as a supplementary medium that facilitates practice and engagement rather than a stand-alone intervention for developing foundational numeracy competencies.

This interpretation helps explain why the present findings differ from several previous studies. Adiansha et al. (Adiansha, 2025), for example, reported positive outcomes when Wordwall was integrated into student-centred learning to develop elementary pupils' numeracy problem-solving skills. Dewi et al. (2025) also reported generally positive outcomes for Wordwall in elementary mathematics learning. These findings suggest that Wordwall's effectiveness may depend not only on the platform itself but also on the instructional context in which it is used. When Wordwall is combined with an appropriate pedagogical approach, clearly defined learning objectives, and activities that correspond directly to the intended mathematical competencies, its contribution may

be stronger than when it is treated primarily as an interactive medium (Dewi et al., 2025; Halawa, Telaumbanua, Mendrofa, & Lase, 2025).

The results are also relevant when compared with studies focusing on pupils' responses to Wordwall. Alessiya and Utoyo (2024) reported positive effects of Wordwall on children's counting ability, while Juraidah et al. (2025) found that Wordwall-based interactive learning increased pupils' motivation in mathematics learning. Marlita et al. (2024) similarly described Wordwall as an interactive medium that can create more engaging mathematics learning activities. These studies demonstrate that Wordwall has considerable potential to support engagement, motivation, and mathematical practice (Juniarti, Syarifudin, & Nurrahmah, 2024; Yuniastuti, Murtafiah, & Pradana, 2025). Nevertheless, increased engagement does not necessarily translate directly into statistically significant improvement in a specific cognitive competency such as basic numeracy. The present study therefore adds an important qualification to the existing literature: positive learning experiences and descriptive score improvement should be distinguished from statistically demonstrated improvement in numeracy performance.

Overall, the findings suggest that Wordwall's contribution to basic numeracy learning depends on context. In the present study, pupils demonstrated a positive descriptive improvement after using Wordwall, but the statistical evidence was insufficient to conclude that the medium significantly improved their basic numeracy skills. This finding does not necessarily indicate that Wordwall has no educational value; rather, it suggests it may be more effective when embedded in structured mathematics instruction, supported by repeated, targeted numeracy practice, and aligned with specific learning objectives. Future studies should therefore examine Wordwall within more clearly defined instructional strategies, involve larger groups of pupils and comparison groups, and use longer intervention periods to determine when Wordwall can produce more consistent improvements in basic numeracy skills.

D. Conclusion

This study found that pupils' mean basic numeracy score increased from 74.17 on the pre-test to 78.57 on the post-test after implementing Wordwall. However, the paired-samples t-test showed that the difference was not statistically significant ($t = -1.974$, $p = .074$). Therefore, although Wordwall was associated with a positive descriptive improvement in pupils' basic numeracy performance, the findings do not provide sufficient statistical evidence to conclude that Wordwall significantly improved pupils' basic numeracy skills. Wordwall may therefore serve as a supplementary interactive learning medium that provides additional opportunities for practice and engagement. However, its implementation should be integrated with structured mathematics instruction and aligned with specific numeracy objectives.

The study is limited by its small sample size, one-group pre-test–post-test design without a control group, and limited intervention context, which restrict the generalisability of the findings and limit causal interpretation. Future studies should use larger, more diverse samples, controlled or quasi-experimental designs, and longer

intervention periods. Further research should also examine integrating Wordwall with structured pedagogical approaches and assess whether its effects on basic numeracy skills are sustained over time.

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