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Enhancing student engagement and learning outcomes in social studies through Wordwall: A quasi-experimental study in a junior high school context

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Abstract

This study investigates the effect of Wordwall, an interactive digital learning medium, on student engagement and learning outcomes in junior high school social studies. Employing a quasi-experimental nonequivalent control group design, the research involved 58 seventh-grade students divided into experimental and control groups. The experimental group received instruction using Wordwall, while the control group followed conventional teacher-centered learning. Data were collected using observation sheets to measure learning activities and achievement tests to assess cognitive outcomes. Descriptive analysis indicated a consistent increase in student engagement in the experimental class across three meetings, with average activity scores rising from 89.52% to 92.56%. Inferential analysis using the Mann–Whitney U test revealed a statistically significant difference in learning outcomes between groups ($p < 0.001$). The findings suggest that Wordwall effectively promotes active participation and enhances academic achievement, supporting multimedia learning and constructivist perspectives in digital classroom environments.

Keywords

Digital learning media, learning outcomes, student engagement, Wordwall

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Introduction

The development of technology and information has had an unavoidable impact on various sectors, including education. The rapid expansion of digital innovation has transformed instructional practices, shifting paradigms from traditional teacher-centered models toward more collaborative, interactive, and student-centered approaches (Aspi & Syahrani, 2022). Technology is no longer merely a supporting tool but a system that can optimize learning processes and outcomes (Nurillahwaty, 2022). Through digital platforms, students can access information more efficiently, interact dynamically with learning materials, and collaborate with peers. Without meaningful learning activities, however, the instructional process becomes less effective, resulting in limited knowledge acquisition and reduced academic achievement (Nurmala et al., 2014).

In addition to technological advances, the growing demand for 21st-century skills has underscored the importance of innovative instructional strategies. People expect modern education to do more than just teach facts. It should also help students learn to think critically, work together, communicate with others, and use technology. Social studies, which focuses on civic understanding, cultural awareness, and social responsibility, plays a strategic role in developing students' analytical abilities and democratic values. However, traditional instructional approaches that rely heavily on teacher explanations often restrict student participation and limit opportunities for higher-order thinking. Research indicates that passive learning environments reduce motivation and hinder meaningful engagement (Bond et al., 2020; Järvelä & Renninger, 2021). Therefore, integrating interactive digital media into social studies instruction becomes increasingly relevant, particularly in contexts where engagement and academic performance remain challenges.

According to Nurmala et al. (2014), student learning activities can be observed through several indicators, including enthusiasm in participating in lessons, interaction with teachers, collaboration among peers, involvement in group work, and participation in summarizing learning materials. Active learning involves intellectual, emotional, and physical engagement. When students are actively involved in learning, they are more likely to develop critical thinking and problem-solving skills, which ultimately improve learning outcomes (Risnawati & Ellyawati, 2023). Learning outcomes are generally reflected in the cognitive, affective, and psychomotor domains, with the cognitive domain encompassing Bloom's taxonomy levels: knowledge, comprehension, application, analysis, synthesis, and evaluation (Yandi et al., 2023). Thus, student engagement and learning outcomes are interrelated components that significantly influence educational success.

Despite the availability of technological resources in many schools, challenges remain in effectively utilizing these tools to enhance learning quality. Some teachers have yet to fully master interactive digital media or strategically integrate it into their instructional design. As a result, classroom learning often remains teacher-dominated, limiting opportunities for discussion, questioning, and active exploration (Rokaliana, 2023). Low levels of classroom activity could hurt students' grades. This issue is particularly relevant in structured educational settings such as boarding schools, where students face demanding daily schedules. In the present research context, students engage in numerous religious and extracurricular activities,

including memorization sessions, collective prayers, and other structured routines. Such intensive schedules may reduce the time and energy available for independent academic study, potentially affecting learning outcomes. Therefore, instructional strategies that maximize engagement within limited classroom time are urgently needed.

Furthermore, the growing adoption of gamified learning environments has highlighted the advantages of integrating game elements into instructional practices. Gamification incorporates features such as scoring systems, competition, instant feedback, and interactive challenges to stimulate motivation and sustained participation (Sailer & Homner, 2020; Zainuddin et al., 2020). Interactive platforms like Wordwall transform conventional exercises into engaging activities that combine visual stimuli, rapid-response mechanisms, and formative assessment. When instructional time is limited, such as in boarding school contexts, interactive digital tools may optimize classroom efficiency by quickly capturing students' attention and maintaining focus throughout the lesson. Rather than functioning solely as presentation media, digital tools can serve as active learning environments that promote participation, collaboration, and cognitive reinforcement.

One digital platform that has gained attention for its practicality and accessibility is Wordwall. Wordwall offers interactive templates, including quizzes, matching activities, and randomized question formats, that can be adapted to different learning objectives. Wordwall can make learning more dynamic by incorporating multimedia and providing students with instant feedback. However, empirical evidence examining its effectiveness in social studies education, particularly within boarding school contexts, remains limited.

This study specifically investigates the use of Wordwall in teaching social and cultural diversity material to seventh-grade students. This topic is essential in fostering tolerance, empathy, and civic awareness from an early age. While previous research has explored digital media across various subjects, few studies have examined Wordwall's effectiveness in social studies within this educational setting using a quasi-experimental design. Therefore, this study aims to fill this gap by analyzing Wordwall's influence on student engagement and learning outcomes.

Given the importance of active participation and cognitive achievement in social studies learning, this research seeks to contribute to discussions on instructional innovation. By comparing Wordwall-based instruction with conventional teacher-centered approaches, the study aims to provide empirical evidence regarding the effectiveness of interactive digital media in enhancing student engagement and academic performance.

Literature Review

Cognitive theory of multimedia learning

The Cognitive Theory of Multimedia Learning (CTML), developed by Mayer (2021), provides a theoretical foundation for understanding how multimedia tools enhance learning. This theory posits that learners process information through dual channels—visual and auditory—each with limited capacity. Meaningful learning occurs when learners actively select, organize, and integrate information into coherent mental representations. Multimedia

environments that combine words and images effectively can improve comprehension compared to text-only instruction.

Recent empirical studies support the principles of CTML in digital learning contexts. For instance, Fiorella and Mayer (2022) demonstrated that multimedia presentations designed according to signaling and coherence principles significantly improve retention and transfer. Similarly, Schneider et al. (2022) found that well-designed multimedia materials reduce cognitive overload and enhance conceptual understanding in secondary education. These findings underscore the importance of instructional design in multimedia learning environments.

Wordwall, as an interactive multimedia platform, integrates text, visuals, and gamified elements, aligning with CTML principles. By presenting information through interactive quizzes and immediate feedback, Wordwall facilitates active cognitive processing. According to Moreno (2020), interactive multimedia environments promote generative processing, enabling learners to connect new information with prior knowledge. In addition, feedback mechanisms support metacognitive monitoring, which strengthens retention and comprehension.

However, multimedia tools must avoid excessive cognitive load. Sweller et al. (2019) emphasized that poorly designed multimedia may overwhelm learners' working memory, reducing learning effectiveness. Therefore, multimedia applications should apply principles such as redundancy avoidance, segmentation, and signaling. When Wordwall activities are structured clearly and aligned with learning objectives, they can enhance both engagement and cognitive achievement.

In social studies learning, which involves conceptual understanding and value formation, multimedia tools support the visualization of abstract content. Interactive quizzes can help students reinforce key concepts and practice analytical thinking. Thus, CTML provides a strong theoretical justification for investigating Wordwall's impact on learning outcomes in social studies classrooms.

Constructivism and technology-supported learning

Constructivist theory emphasizes that learners actively construct knowledge through interaction, reflection, and social engagement. Contemporary interpretations highlight collaborative digital environments as spaces where learners negotiate meaning and build understanding collectively (Schunk, 2020). Technology-supported learning aligns with constructivist principles when students engage in problem-solving, discussion, and self-directed exploration.

Recent research confirms that digital interactive tools support constructivist learning environments. According to Kirschner and Hendrick (2020), structured interactive technologies facilitate guided discovery learning when appropriately scaffolded. In addition, Järvelä and Renninger (2021) argue that digital tools enhance situational interest, leading to sustained cognitive engagement. These tools enable learners to test ideas, receive feedback, and collaboratively refine their understanding.

In the classroom, interactive platforms like Wordwall allow students to be active participants rather than passive recipients. Students respond to questions, collaborate in teams,

and reflect on answers. Such processes reflect Vygotskian principles of social interaction and scaffolding, where learning occurs within the zone of proximal development (Schunk, 2020). Immediate feedback from digital platforms also supports formative assessment, a key component of constructivist pedagogy.

Moreover, constructivist learning emphasizes authentic problem contexts. According to Holmes et al. (2019), digital tools that simulate real-world challenges enhance critical thinking and conceptual understanding. In social studies education, interactive quizzes and scenario-based questions can stimulate discussion and perspective-taking, which are essential for civic competence.

However, constructivist learning with technology requires active teacher facilitation. Teachers must guide reflection, encourage dialogue, and connect digital activities to conceptual objectives. Without pedagogical integration, digital tools risk becoming superficial engagement mechanisms. Therefore, investigating Wordwall within a constructivist framework helps clarify how interactive media influence both student activity and learning outcomes.

Self-determination theory and gamified learning

Self-Determination Theory (SDT), developed by Deci and Ryan (2020), provides an important motivational framework for understanding how interactive digital tools such as Wordwall affect student engagement and learning outcomes. SDT posits that human motivation is driven by the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. When these needs are satisfied, learners are more likely to experience intrinsic motivation, sustained engagement, and deeper cognitive processing.

Autonomy refers to the perception of having control over one's learning activities. In technology-supported environments, autonomy can be fostered when students actively interact with content, make choices, and receive immediate feedback. Wordwall allows students to respond to quizzes independently, track their progress, and participate at their pace. According to Ryan and Deci (2020), learning environments that support autonomy increase intrinsic motivation, which in turn enhances persistence and academic performance. Interactive digital platforms reduce passive information consumption and promote active decision-making, aligning with autonomy-supportive pedagogy.

Competence involves feeling capable and effective in one's learning tasks. Gamified learning platforms contribute to competence development by providing structured challenges and instant feedback. Sailer and Homner (2020) found that gamification elements such as points, progress indicators, and immediate feedback significantly improve perceived competence and academic achievement. Wordwall integrates such features through scoring systems, time-based challenges, and corrective responses. When students receive immediate confirmation of correct answers or constructive feedback on mistakes, they are more likely to refine their understanding and experience mastery. This sense of competence strengthens motivation and reinforces cognitive engagement.

Relatedness refers to the need for social connection and interaction. Digital learning tools can enhance relatedness when they encourage collaboration, competition, or shared experiences. Wordwall activities can be implemented in group formats or displayed collectively in classrooms, fostering shared participation. According to Dichev and Dicheva (2017),

gamified learning environments that incorporate collaborative elements foster peer interaction and increase emotional engagement. Social interaction is particularly important in middle school contexts, where peer dynamics strongly influence motivation and classroom participation.

Recent empirical research supports the application of SDT in digital and gamified learning environments. Hanus and Fox (2015) found that well-designed gamification improves engagement when it supports intrinsic motivation rather than relying solely on external rewards. Similarly, Howard et al. (2021) demonstrated that autonomy-supportive digital tools positively predict academic persistence and conceptual understanding in secondary education. These findings suggest that the effectiveness of interactive platforms depends not only on their technological features but also on their alignment with motivational principles.

In addition, SDT helps explain the relationship between engagement and learning outcomes. When students feel autonomous, competent, and socially connected, they are more likely to invest cognitive effort in processing information. Increased effort enhances memory consolidation and conceptual understanding (Ryan & Deci, 2020). Therefore, improvements in learning outcomes observed in gamified environments may be mediated by motivational enhancement rather than by technology alone. This perspective complements the cognitive theory of multimedia learning by emphasizing the affective and motivational mechanisms underlying cognitive processing.

However, SDT also cautions against excessive reliance on extrinsic rewards. If gamification focuses solely on competition or points accumulation without meaningful alignment with learning, intrinsic motivation may decline (Hanus & Fox, 2015). Therefore, digital platforms like Wordwall must be integrated thoughtfully within pedagogical objectives to ensure that motivational elements support rather than replace conceptual understanding.

In the context of social studies education, where discussion, reflection, and value formation are essential, satisfying students' psychological needs can enhance both participation and comprehension. Wordwall's interactive quizzes, collaborative opportunities, and immediate feedback mechanisms may foster autonomy, competence, and relatedness simultaneously. Consequently, Self-Determination Theory provides a complementary theoretical foundation for examining how interactive digital media influence student engagement and learning outcomes.

Methodology

Research design, site, and participants

This study employed a quantitative experimental approach to examine the effect of Wordwall as a learning medium on students' engagement and learning outcomes in social studies at SMP Negeri Tahfidz Madani Pasir Pengaraian, Rokan Hulu Regency, Riau Province. The research utilized a nonequivalent control group design, a type of quasi-experimental design in which two groups are administered both pretests and posttests. However, only the experimental group received instruction using Wordwall, while the control group was taught using conventional teacher-centered methods without Wordwall integration (Abraham & Supriyati, 2022). This design was selected because it is widely used in educational research to

evaluate the effectiveness of instructional interventions by comparing outcomes between treatment and comparison groups in natural classroom settings.

The participants consisted of all seventh-grade students at SMP Negeri Tahfidz Madani Pasir Pengaraian. From a total population of 175 students distributed across six classes, two classes were selected through cluster random sampling. Class VII.A was assigned as the control group, and Class VII.B was designated as the experimental group. The study involved 58 participants, 29 in each group. This sampling technique was chosen to maintain the natural classroom structure while ensuring comparability between groups.

Data collection

The research instruments consisted of a learning achievement test and an observation sheet designed to measure student engagement during social studies instruction. The learning achievement test was developed in line with the curriculum objectives and covered the cognitive aspects of the social and cultural diversity material. Meanwhile, the observation sheet was structured to assess various dimensions of student activity, including visual, oral, listening, writing, mental, and emotional engagement throughout the learning process.

Data were collected through two primary techniques: (1) tests to measure students' learning outcomes and (2) classroom observations to assess student engagement during instructional sessions. The achievement test was administered twice: a pretest before the intervention and a posttest after the instructional treatment. This procedure allowed the researcher to measure learning gains and compare improvements between the experimental and control groups.

Before implementation, the test instrument underwent validity and reliability testing to ensure it was appropriate for measuring students' cognitive achievement. Content validity was established through expert judgment by subject-matter specialists, ensuring alignment with learning objectives and curriculum standards. Reliability was assessed using internal consistency measures to confirm the instrument's stability. Only valid and reliable items were included in the final test used for data collection.

Classroom observations were conducted during each meeting to monitor students' learning activities. The observation sheet used a structured rating format to record students' behaviors and participation levels systematically. Observations were carried out consistently across three instructional meetings for both groups to ensure comparability. The collected data were then tabulated and converted into percentage scores to facilitate descriptive and inferential statistical analysis.

Data analysis

The data were analyzed using both descriptive and inferential statistical techniques. Descriptive analysis was used to summarize student engagement levels and learning outcomes in both the experimental and control groups. Student activity data from observation sheets were converted to percentage scores and categorized to illustrate participation levels across instructional meetings. Similarly, mean scores, standard deviations, and N-Gain scores were

calculated to provide an overview of students' cognitive improvement before and after the intervention.

Inferential analysis was conducted to test the research hypotheses and assess statistically significant differences between the two groups. The improvement in learning outcomes was measured using the normalized gain (N-Gain) formula, which evaluates the magnitude of learning progress from pretest to posttest. Before hypothesis testing, assumption tests were performed, including normality testing using the Kolmogorov–Smirnov test and homogeneity testing using Levene's test. Because the homogeneity assumption was not met, a non-parametric statistical test was selected. Consequently, differences in learning outcomes between the experimental and control groups were analyzed using the Mann–Whitney U test, which is appropriate for comparing two independent groups when data do not meet parametric assumptions.

In addition to statistical significance testing, effect size analysis was conducted to assess the intervention's practical significance. The effect size (r) was calculated based on the standardized test statistic obtained from the Mann–Whitney analysis. Reporting the effect size provides a clearer understanding of the magnitude of the instructional impact beyond the p-value. This step is important because statistically significant results may not always reflect meaningful educational differences. By including effect size analysis, the study offers a more comprehensive interpretation of Wordwall's influence on student learning outcomes.

All statistical analyses were performed using statistical software to ensure the accuracy and reliability of calculations. The level of significance was set at 0.05 for all hypothesis testing. Results were interpreted by considering both statistical significance and practical relevance, enabling balanced conclusions about Wordwall's effectiveness in enhancing student engagement and cognitive achievement.

Findings

Analysis of the influence of Wordwall media on student learning activities

Table 1. *Analysis of the learning activities of students in the experimental class*

Student Activities	Average Score (%) of Experimental Class			Average Score (%) of Control Class		
	1st meeting	2nd meeting	3rd meeting	1st meeting	2nd meeting	3rd meeting
Visual Activities	93.7	93.75	100	50	87.5	68.75
Oral Activities	91.66	100	100	66.66	70.83	66.66
Listening Activities	87.5	93.75	87.5	62.5	68.75	62.5
Writing Activities	100	100	100	87.5	81.25	81.25
Mental Activities	75	75	75	66.66	66.6	50
Emotional Activities	89.28	89.28	92.85	57.14	78.57	57.14
Average activity	89.52	91.96	92.56	65.08	75.58	64.38

Based on Table 1, the results show a consistent increase in student activity in the experimental class. The average activity score improved from 89.52% at the first meeting to 91.96% at the second, then to 92.56% at the third. Writing activities showed consistently high results (100%) in each meeting, indicating strong student participation in completing interactive tasks. Oral and visual activities also reached optimal levels by the third meeting. Meanwhile, mental activities remained constant at 75% across the three meetings, indicating that higher-order cognitive engagement still requires reinforcement. This pattern indicates that Wordwall significantly improves behavioral and emotional engagement, including visual, oral, writing, and emotional activities. At the same time, deeper analytical or reflective thinking skills may require complementary instructional strategies such as problem-based tasks or extended discussion sessions.

In contrast, the control class demonstrated fluctuating results. The average activity increased from 65.08% in the first meeting to 75.58% in the second, then decreased again to 64.38% in the third. This instability indicates that teacher-centered instruction was less effective in sustaining student engagement over time.

Figure 1 shows even more clearly how different the two groups are. The experimental class shows a stable upward trend, whereas the control class demonstrates variability and decline. This visual comparison strengthens the interpretation that Wordwall contributed significantly to maintaining consistent classroom participation.

Figure 1. *Average student activity score*

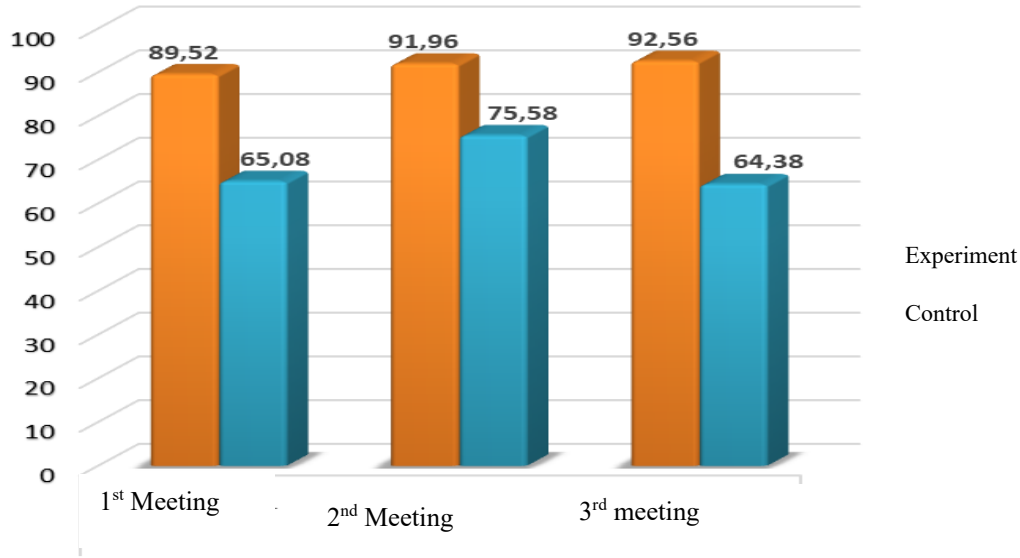

Table 2. *Normality test result*s

Tests of Normality			
Group	Kolmogorov-Smirnova		
	Statistic	df	Sig.
Experimental	.151	29	.090
Control	.130	29	.200*
*. This is a lower bound of true significance.			
a. Lilliefors Significance Correction			

The normality test in the table used the Kolmogorov–Smirnov test with the Lilliefors significance correction to determine whether the N-Gain scores of the experimental and control groups were normally distributed. The Kolmogorov–Smirnov test is commonly used to assess normality, particularly when the sample size in each group exceeds 30 participants. In this study, each group consisted of 29 students, which is considered sufficient for applying this test in educational research contexts.

In interpreting the results, a significance value (Sig.) greater than 0.05 indicates that the data do not deviate significantly from normality, so the assumption of normality is met. Conversely, a significance value less than 0.05 indicates that the data deviate significantly from normality and are therefore not normally distributed. Based on the results presented in Table 2, the significance value for the experimental group is 0.090, while that for the control group is 0.200. Both values exceed the 0.05 significance level, indicating that the N-Gain scores in both groups are normally distributed. The asterisk (*) next to the 0.200 value signifies that it represents the lower bound of the true significance level, as generated by the statistical software. The Lilliefors Significance Correction was applied because the population parameters (mean and standard deviation) were estimated from the sample rather than known a priori.

Therefore, it can be concluded that the data from both the experimental and control groups satisfy the assumption of normality. However, before selecting an appropriate statistical test, the assumption of homogeneity of variance must also be examined to ensure the data meet the necessary requirements for parametric analysis.

Table 3. *Homogeneity test results*

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
N-Gain	Based on the Mean	6.716	1	56	.012
	Based on the Median	5.195	1	56	.026
	Based on the Median and with adjusted df	5.195	1	46.091	.027
	Based on the trimmed mean	6.336	1	56	.015

Based on Table 3, the homogeneity of variance was tested using Levene's test to determine whether the variance of N-Gain scores between the experimental and control groups was equal. Homogeneity of variance is an important assumption for parametric tests, such as the independent samples t-test. If the significance value (Sig.) is greater than 0.05, the variances are considered equal (homogeneous). Conversely, if the significance value is less than 0.05, the variances are considered unequal (not homogeneous).

The results in Table 3 show that the significance value based on the mean is 0.012, which is smaller than 0.05. Similarly, the significance values based on the median (0.026), adjusted median (0.027), and trimmed mean (0.015) are also below 0.05. Because all significance values are less than the 0.05 threshold, it can be concluded that the assumption of homogeneity of variance is violated. In other words, the experimental and control groups do not have equal variances in their N-Gain scores.

Violating the homogeneity assumption indicates heteroscedasticity, meaning the variability of learning gains differs across groups. When this assumption is not met, the use of parametric tests such as the independent samples t-test may produce biased or unreliable results. Therefore, a nonparametric alternative that does not require equal variances was selected.

Consequently, the Mann–Whitney U test was used to compare learning outcomes between the experimental and control groups. The Mann–Whitney U test is appropriate for comparing two independent groups when assumptions of homogeneity are not satisfied. By selecting this test, the analysis ensures statistical robustness and enhances the validity of the study's conclusions regarding Wordwall's effectiveness in improving student learning outcomes.

Table 4. *Hypothesis test results*

Test Statistics[a]	
	N-Gain
Mann-Whitney U	118.500
Wilcoxon W	553.500
Z	-4.702
Asymp. Sig. (2-tailed)	.000

The hypothesis testing presented in Table 4 used the Mann–Whitney U test to determine whether there was a statistically significant difference in N-Gain scores between the experimental and control groups. The Mann–Whitney U test was selected because the assumption of homogeneity of variance was not met, as indicated by the results of Levene's test. When the homogeneity assumption is violated, nonparametric tests such as the Mann–Whitney U test provide a more appropriate and robust alternative to the independent samples t-test.

The Mann–Whitney U value obtained was 118.500, with a corresponding Wilcoxon W value of 553.500 and a Z value of –4.702. The standardized Z score reflects the magnitude and direction of the difference between the two groups. The negative sign indicates that the distribution of N-Gain scores in the experimental group was higher than that of the control group. Most importantly, the asymptotic significance (2-tailed) value is 0.000, which is reported

as $p < 0.001$. Since this value is significantly lower than the predetermined alpha level of 0.05, the null hypothesis (H_0) is rejected.

Rejecting the null hypothesis means that there is a statistically significant difference in learning gains between students taught with Wordwall, an interactive learning tool, and those taught with conventional instruction. This result indicates that using Wordwall had a meaningful effect on students' cognitive development in social studies. In other words, the observed difference in N-Gain scores is unlikely to have occurred by chance. Furthermore, the substantial Z value suggests a strong separation between the two groups' score distributions. When combined with the previously calculated effect size (r = 0.62), the findings indicate not only statistical significance but also practical significance. Therefore, the results of the Mann–Whitney U test provide strong empirical evidence that integrating Wordwall significantly enhanced student learning outcomes compared to traditional teacher-centered methods.

Effect size calculation

$$r = \frac{Z}{\sqrt{N}} = \frac{-4.702}{\sqrt{58}} = \frac{-4.702}{7.62} \approx -0.62$$

The absolute value (r = 0.62) indicates a large effect size, demonstrating that Wordwall had a strong practical impact on student learning outcomes. According to Cohen's criteria, an effect size of 0.10 is considered small, 0.30 is moderate, and 0.50 or above is large. Therefore, an r value of 0.62 reflects a substantial difference in learning gains between the experimental and control groups. This means that the improvement observed in the experimental class was not only statistically significant but also educationally meaningful.

In practical terms, a large effect size suggests that Wordwall use, which is a digital learning tool designed to create interactive educational activities, contributed substantially to students' cognitive development, particularly in mastering social studies content. The magnitude of this effect indicates that the difference between the two groups is not trivial or marginal; rather, it represents a strong instructional impact. This finding strengthens the conclusion that interactive digital media, when implemented appropriately, can significantly enhance learning performance. Moreover, the large effect size supports the argument that increased engagement through interactive activities may have facilitated deeper information processing, retention, and understanding, ultimately leading to higher academic achievement.

Discussion

The effect of Wordwall on student engagement

The findings demonstrate that Wordwall use significantly increased student engagement in the experimental class compared to the control class. The consistent rise in activity scores across three meetings indicates that interactive digital media can sustain behavioral and emotional engagement. This finding is consistent with engagement theory, which defines engagement as behavioral, emotional, and cognitive participation in the learning process

(Fredricks et al., 2019). In this study, high scores in writing, oral, visual, and emotional activities suggest that Wordwall successfully stimulated active participation.

The interactive and gamified features of Wordwall—such as instant feedback, competitive quizzes, and visually appealing interfaces—likely contributed to sustained motivation. Research by Wang and Tahir (2020) and Zainuddin et al. (2020) supports the idea that gamification enhances student attention and participation. The visual trend presented in Figure 1 further confirms that engagement in the experimental class remained stable and progressive, unlike the fluctuating pattern in the control class. The mental activity indicator, on the other hand, stayed the same. This suggests that Wordwall may improve observable participation, but deeper cognitive engagement may need more instructional support (Kirschner & Hendrick, 2020).

Moreover, the structured repetition embedded within Wordwall activities may have contributed to sustained concentration and task persistence. When students repeatedly interact with quiz-based questions and receive immediate corrective feedback, they remain cognitively alert and behaviorally active. This structured interactivity may reduce the tendency toward passive learning that is common in teacher-centered instruction. Additionally, the competitive yet collaborative atmosphere created by digital quizzes likely fostered peer interaction, increasing classroom dynamism. Therefore, Wordwall appears not only to increase participation frequency but also to create a more stimulating, student-centered learning environment.

The impact of Wordwall on learning outcomes

The statistical analysis revealed a significant difference in learning outcomes between the experimental and control groups ($p < .001$), with a large effect size ($r = 0.62$). This indicates that Wordwall produced not only statistically significant improvements but also a substantial practical impact. According to Cohen's criteria, an effect size above 0.50 represents a strong educational effect, confirming that the improvement was meaningful.

These findings are consistent with the cognitive theory of multimedia learning (Mayer, 2021), which posits that meaningful learning occurs when learners actively process information through dual channels. Wordwall integrates visual and textual elements, encouraging active response and the processing of feedback. Fiorella and Mayer (2022) argue that generative learning activities, such as interactive quizzes, promote deeper comprehension and retention. The observed increase in N-Gain scores supports this theoretical framework and indicates that interactive digital media can significantly enhance academic achievement in social studies.

Furthermore, the large effect size suggests that the instructional intervention had a transformative rather than incremental influence on student understanding. Repetitive exposure to key concepts across varied quiz formats may have strengthened encoding and retrieval processes. Interactive assessment also enables immediate correction of misconceptions, reducing the persistence of inaccurate knowledge structures. As a result, students in the experimental class likely experienced deeper conceptual consolidation compared to those in conventional instruction. This supports the idea that interactive multimedia tools can help people get more involved and improve their cognitive skills.

The relationship between engagement and achievement

The parallel increase in engagement and learning outcomes suggests a positive relationship between active participation and cognitive achievement. Engaged students are more likely to invest effort and persist in tasks, leading to stronger academic performance (Fredricks et al., 2019). In this study, consistent increases in activity levels in the experimental class were associated with significantly higher learning gains, suggesting that engagement may mediate these effects.

The gamified structure of Wordwall likely facilitated sustained attention and repeated practice, which are essential for memory consolidation. Schneider et al. (2022) assert that well-designed multimedia learning environments improve retention by reducing extraneous cognitive load and fostering active processing. The results indicate that Wordwall enhances learning by fostering greater engagement and facilitating effective cognitive reinforcement.

Additionally, the alignment between high engagement indicators and large N-Gain scores strengthens the theoretical assumption that behavioral involvement precedes cognitive mastery. Students who write, speak, and engage with information in meaningful ways are more likely to remember it. Emotional engagement also plays a crucial role, as positive learning experiences increase motivation and persistence. Therefore, the relationship observed in this study supports the view that engagement is not merely a surface-level indicator but a critical driver of academic success in technology-supported learning environments.

Pedagogical and contextual implications

The results have important implications for social studies instruction, particularly in structured educational environments such as boarding schools. Given students' demanding schedules, interactive media may optimize classroom time by maximizing active engagement during instruction. Holmes et al. (2019) argue that digital tools can improve instructional efficiency when aligned with pedagogical goals.

However, technology integration must be accompanied by thoughtful instructional design. Bond et al. (2020) stress that technology by itself does not guarantee better results, teachers still need to be involved. Therefore, Wordwall should be strategically integrated into lesson planning to maximize cognitive engagement. Future research may explore long-term implementation and investigate additional scaffolding strategies to enhance higher-order thinking skills.

Furthermore, educators should consider integrating Wordwall with discussion-oriented or inquiry-driven activities to enhance cognitive and analytical engagement. While digital quizzes are effective for reinforcement and recall, deeper conceptual reasoning may require collaborative problem-solving tasks. The findings of this study suggest that interactive digital tools are most effective when embedded within comprehensive pedagogical frameworks. Consequently, Wordwall can serve as a valuable complement to traditional instruction, promoting balanced development of engagement, understanding, and critical thinking in social studies education.

Conclusion and Recommendations

Research shows that Wordwall can improve student learning outcomes. In classes that use Wordwall, students achieve higher results than when learning without it. This can be seen in the hypothesis test, where the significance value (p-value) is <0.001, much smaller than 0.05, indicating statistical significance.

The results of this study imply that the use of interactive learning media, such as Wordwall, can improve student engagement and learning outcomes, so teachers should use it to create more engaging, active, and participatory learning experiences. These findings can also encourage schools to integrate similar digital media across other subjects to improve learning quality. For subsequent research, it is advisable to incorporate a larger sample or a more diverse set of schools to achieve more representative results, investigate the use of Wordwall across various grade levels and subjects, and incorporate variables such as learning motivation and critical thinking skills to achieve a more holistic understanding. Additionally, a more rigorous experimental design, such as a randomized controlled trial, could strengthen the validity of the research findings.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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