Leveraging WordWall Teaching Media as Tools to Improve Learning Outcomes in Natural Science Subject

Muktar Bahruddin Panjaitan[1,*], Asister Fernando Siagian[1], Gunaria Siagian[2], Loso Judijanto[3], Sherly Sherly[4], Hendra Simanjuntak[5] & Herman Herman[6]

[1]Department of Natural Science Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia

[2]Department of Biology Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia

[3]IPOSS Jakarta, Indonesia

[4]Department of Master Management Science, Sekolah Tinggi Ilmu Ekonomi Sultan Agung, Indonesia

[5]Department of Chemistry Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia, Indonesia

[6]Department of English Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia

*Correspondence: Department of Natural Science Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia. E-mail: muktar.panjaitan@uhnp.ac.id

Received: September 9, 2025 Accepted: March 5, 2026 Online Published: May 12, 2026

doi:10.5430/jct.v15n2p248 URL: https://doi.org/10.5430/jct.v15n2p248

Abstract

This study investigates the effectiveness of WordWall as a digital gamified learning medium in improving students' learning outcomes in Physics among eighth-grade students at SMP Methodist Pematangsiantar. The study was motivated by low student engagement and unsatisfactory academic performance associated with conventional teacher-centered instructional approaches. A quasi-experimental design employing a pretest–posttest control group design was used, involving 50 students divided into an experimental group ($n = 25$) and a control group ($n = 25$). Both groups were administered pre-tests and post-tests to measure learning outcomes. The experimental group received instruction using WordWall-based interactive activities, while the control group was taught using traditional methods. The results revealed that the experimental group's mean score improved from 66.4 to 80.4, whereas the control group increased from 58.0 to 68.2. Inferential analysis showed that the difference was statistically significant, $t(48) = 3.536$, $p < 0.05$, with a large effect size (Cohen's $d \approx 0.8$). These findings indicate that WordWall significantly enhances students' understanding of Physics concepts by promoting engagement, interaction, and immediate feedback. The study suggests that integrating gamified digital media into science instruction can improve student motivation and academic achievement. It is recommended that educators adopt interactive learning platforms such as WordWall to support more effective and student-centered learning environments.

Keywords: WordWall, physics learning outcomes, gamified learning, digital learning media, quasi-experimental design

1. Introduction

The effectiveness of science education, particularly in Physics, heavily depends on how the material is delivered and the level of student engagement during the learning process. Physics, as a branch of science that deals with complex and often abstract concepts, requires instructional strategies that not only present information but also foster understanding and retention. However, in many middle school settings, such as in SMP Methodist Pematangsiantar, Physics learning remains dominated by teacher-centered approaches. These traditional methods often result in passive student participation, reduced motivation, and minimal conceptual understanding.

Preliminary observations conducted at SMP Methodist Pematangsiantar revealed that students in grade VIII showed low enthusiasm and involvement in Physics lessons. Many students tended to be passive, with limited interaction during lessons. They often just listened to the teacher's explanations without engaging in the learning process. This lack of engagement not only diminishes students' interest in the subject but also hampers their cognitive development and understanding of key physics concepts. According to Arends (2012), effective teaching should involve students actively in constructing their own understanding rather than passively receiving information (Panjaitan et al., 2026).

In addition to low engagement, student performance in Physics was also found to be lacking. Data from the school's Semester Ganjil assessment for the academic year 2024/2025 showed that out of 25 students, only 10 reached the Minimum Mastery Criteria (KKM) of 75, while the remaining 15 students failed to meet the standard. These results underscore a concerning trend: more than half the class struggles to meet basic learning outcomes in Physics. Low achievement rates such as this may be attributed to various factors, including ineffective instructional strategies and the limited use of engaging teaching media (Sadiman et al., 2011; Landers, 2014; Buckley & Doyle, 2016). One major issue identified in the classroom was the teacher's reliance on lecture-based instruction with minimal incorporation of interactive or visual teaching tools. While the lecture method can efficiently deliver information to a large group, it often falls short in promoting student-centered learning, especially in subjects requiring hands-on exploration and conceptual visualization like Physics. According to Mayer (2009), the use of appropriate media can significantly enhance students' understanding of complex material by providing concrete representations of abstract ideas (Zainuddin et al., 2020; Widodo et al., 2024). Therefore, the absence of such media may render Physics even more difficult for students to grasp.

In this context, the integration of digital learning media such as WordWall offers a promising solution. WordWall is an online platform that allows teachers to create interactive games, quizzes, and activities that engage students in dynamic ways. By incorporating elements of gamification, such tools transform the classroom from a passive learning environment into one that encourages participation, critical thinking, and motivation (Deterding et al., 2011; Hamari et al., 2014). According to Prensky (2001), game-based learning can significantly increase student interest and enthusiasm, especially when the content is aligned with curriculum objectives.

Implementing WordWall in the teaching of Physics not only supports visual and interactive learning but also accommodates diverse learning styles. Visual learners benefit from diagrams and animations, kinesthetic learners from interactive tasks, and auditory learners from verbal feedback embedded in the media. Moreover, the real-time feedback provided by WordWall can help both teachers and students identify learning gaps immediately, allowing for timely remediation and reinforcement of concepts (Glover, 2013). This is particularly crucial in subjects like Physics, where misunderstanding one concept can hinder the comprehension of subsequent topics.

Furthermore, the use of technology-driven media like WordWall aligns with the goals of 21st-century education, which emphasizes digital literacy, creativity, and collaborative learning. It helps bridge the gap between traditional teaching methods and the technological familiarity of today's students, making learning more relevant and engaging (Laurillard, 2012). In classrooms such as those in SMP Methodist Pematangsiantar, where student engagement and performance in Physics are low, such innovations could be key to reversing the trend and improving learning outcomes.

Therefore, this study aims to explore the impact of WordWall teaching media on student learning outcomes in Physics education. By integrating interactive technology into the learning process, the research seeks to evaluate whether tools like WordWall can serve as effective interventions to foster engagement, enhance understanding, and ultimately raise student achievement in Physics.

2. Literature Review

Improving learning outcomes in Physics education has long been a central concern for educators, especially at the secondary school level where abstract concepts often hinder student comprehension. Numerous studies have highlighted that one of the key challenges in Physics learning lies in the lack of student engagement and the failure to implement interactive, student-centered teaching methods (Yuliati & Subali, 2017; Panjaitan et al., 2025). In classrooms where traditional, lecture-based teaching dominates, students often become passive recipients of information, leading to decreased motivation and lower academic performance (Mayer, 2014; Sari & Setiawan, 2020). As a response to these issues, researchers have increasingly emphasized the integration of educational technology and gamified media as tools to enhance learning experiences and outcomes (Ansari et al., 2023; Purba et al., 2026).

While previous studies have demonstrated the effectiveness of WordWall in enhancing student engagement and learning outcomes, most of these studies are limited to general science or language learning contexts. For instance, Nugroho and Hartatik (2022) and Mahmudah and Purwanto (2021) reported improved student participation; however, their studies primarily focused on surface-level engagement without deeply examining conceptual understanding in content-heavy subjects such as Physics. Furthermore, many existing studies rely on short-term interventions and lack rigorous experimental comparisons, limiting the generalizability of their findings. Therefore, there remains a need for more focused empirical research that investigates the effectiveness of WordWall within Physics education using controlled comparisons and measurable learning outcomes.

The gamification aspect of WordWall plays a crucial role in fostering motivation and active participation. Through elements like points, time limits, and competitive formats, WordWall transforms conventional assessments into engaging learning activities. This dynamic learning environment is particularly effective for Generation Z learners, who are more responsive to visual and digital learning stimuli (Domínguez et al., 2013; Plass et al., 2015; Sailer & Homner, 2020; Wibowo et al., 2021). Research by Fitriani and Supahar (2020) supports this notion, demonstrating that students exposed to gamified instructional media exhibited higher levels of interest and retention, especially in the cognitive domain of Bloom's taxonomy. In addition to increasing student engagement, WordWall also supports formative assessment strategies. Teachers can use the platform to identify misconceptions and provide immediate feedback to learners. Susanti et al. (2023) emphasized the benefit of WordWall for real-time evaluation, noting that the media enables teachers to monitor student progress more efficiently and adjust their teaching accordingly. This continuous feedback loop enhances the effectiveness of the teaching-learning process and allows for personalized learning interventions, which are crucial for improving academic outcomes in Physics.

Beyond individual learning gains, WordWall also encourages collaborative learning. The interactive nature of the platform allows students to work in groups or compete in teams, promoting communication and critical thinking skills. A study by Ramadhani and Wahyuni (2021) revealed that when students engaged in group-based WordWall activities, their problem-solving skills improved significantly compared to those in traditional classrooms. This aligns with social constructivist theory, which emphasizes that knowledge is constructed more effectively through interaction and collaboration (Vygotsky, 1978, as cited in Amalia & Prasetyo, 2021). Moreover, the use of WordWall aligns with the broader shift towards digital pedagogy in the post-pandemic era. With the increased integration of hybrid and remote learning models, digital tools have become essential in maintaining instructional continuity and quality (Wouters et al., 2013; Clark et al., 2016; Permatasari et al., 2022). WordWall's compatibility with online learning platforms makes it a flexible tool for both face-to-face and virtual classrooms, thus supporting the development of 21st-century learning competencies, including digital literacy, communication, and collaboration (Sung et al., 2016; Schindler et al., 2017).

Although the literature indicates the effectiveness of WordWall in various educational contexts, studies focusing specifically on its implementation in Physics education remain relatively limited. This gap presents an opportunity for further investigation. As pointed out by Hasanah and Widodo (2022), while WordWall has been widely used in language and general science classes, its potential in conceptually heavy subjects like Physics deserves more focused research. Thus, this study contributes to filling that gap by examining how WordWall media can influence student learning outcomes in the Natural science subject at SMP Methodist Pematangsiantar.

3. Research Methods

3.1 Research Design

This study adopted a quasi-experimental design, specifically the One-Group Pretest-Posttest Design. This design was chosen to investigate the effect of implementing WordWall teaching media on student learning outcomes in Physics without using a control group for comparison. The structure of this design allows researchers to measure changes in students' performance by comparing scores before and after the intervention. While this design does not include a separate control group, it enables a basic causal inference by observing performance differences within the same group of students (Creswell, 2012; Herman et al., 2025). The procedure began with administering a pre-test (O_1) to assess students' initial understanding of the Physics material. This was followed by the treatment (X)—learning activities using WordWall interactive media. After the completion of the treatment phase, students were given a post-test (O_2) to evaluate any improvement in their learning outcomes. The design format is represented below:

Table 1. Research Design

Pre-test	Treatment	Post-test
O_1	X	O_2

(*Adapted from Creswell, 2012*)

3.2 Data Source

The target population of this study consisted of all Grade VIII students enrolled at SMP Methodist Pematangsiantar during the 2024/2025 academic year. The total number of students across the six parallel classes (VIII-A to VIII-F) was 214. These students represented diverse academic abilities and were taught under a standardized curriculum, making them suitable for generalizing findings related to the integration of WordWall in Physics education.

The sampling technique employed was purposive sampling, selecting two classes—VIII-A and VIII-B—due to their similar characteristics, including class size and academic level. Class VIII-A was designated as the experimental group, receiving Physics instruction with WordWall as the main teaching media. Class VIII-B served as the control group, which continued with conventional teaching methods. Each group consisted of 25 students, bringing the total sample to 50 students.

Table 2. Sampling of the Research

Group	Class	Number of Students
Experimental	VIII-A	25
Control	VIII-B	25

3.3 Research Instrument

The primary instrument used in this study was a multiple-choice test consisting of 25 items, which was constructed to assess student learning in Physics. The questions were designed according to cognitive levels from Bloom's taxonomy, covering C1 (Remembering), C2 (Understanding), C3 (Applying), and C4 (Analyzing). This instrument was validated by subject experts to ensure content validity and relevance to the Physics syllabus. The same test was administered as both the pre-test and post-test to determine learning gains after the use of WordWall media.

3.4 Data Collection Methods

Data collection was carried out in three main phases:

1. **Pre-test Administration**

   Prior to the intervention, both the experimental and control groups completed a pre-test to evaluate their baseline knowledge in Physics. This stage provided a reference point to determine the impact of the teaching media used.

2. **Treatment Implementation**

   The experimental group received Physics instruction using WordWall media, which included interactive games, quizzes, and matching tasks tailored to the lesson objectives. The activities were integrated over several sessions. Meanwhile, the control group received the same content through traditional lecture-based methods, aligned with the standard curriculum. The intervention was conducted over a period of two weeks, consisting of four instructional sessions (each lasting 90 minutes). WordWall activities were integrated into each session as the primary learning medium for the experimental group.

3. **Post-test Administration**

   Following the completion of the intervention, both groups were administered the same set of test items used in the pre-test. This allowed for comparison of the performance differences and assessment of the effectiveness of the WordWall media in improving learning outcomes.

3.5 Data Analysis Methods

Quantitative data analysis was used to determine the effect of the treatment. The scores from the pre-test and post-test were analyzed using the following steps:

1. **Scoring**

   Each student's test score was calculated using the formula:

$$\text{Score} = \left(\frac{\text{Number of correct answers}}{\text{Total number of items}} \right) \times 100$$

2. **Mean Score Calculation**

   The average scores for both experimental and control groups were computed using:

$$M = \frac{\sum x}{N}$$

Where:
MM = mean score,

∑x\sum x = total of individual scores,

NN = number of students in the group.

3. **Standard Deviation**

To measure the variability of the scores in each group, the standard deviation was calculated using:

$$SD^2 = \sum d^2 - \frac{(\sum d)^2}{N}$$

4. **T-test Analysis**

To determine whether there was a significant difference in learning outcomes between the experimental and control groups, an independent samples t-test was conducted using the following formula:

$$t = \frac{M_a - M_b}{\sqrt{\left(\frac{SD_a^2 + SD_b^2}{N_a + N_b - 2}\right)\left(\frac{1}{N_a} + \frac{1}{N_b}\right)}}$$

Where:

M_a, SD_a = mean and standard deviation of the experimental class,

M_b, SD_b = mean and standard deviation of the control class,

N_a, N_b = number of students in each group.

This analysis aimed to test the hypothesis that the use of WordWall media would result in significantly higher learning outcomes in Physics compared to conventional teaching methods.

4. Data Analysis and Results

This section presents the findings of the study based on the data collected from the experimental and control groups. The analysis includes both descriptive and inferential statistics to determine the effectiveness of using WordWall media in improving student learning outcomes in Physics.

A. Descriptive Statistics

1. Pre-test and Post-test Scores of Experimental Class

Before applying the WordWall media, a pre-test was administered to the experimental class (VIII-A). The average pre-test score was 66.4, with a total score of 1660 across 25 students. After the treatment using WordWall media, students took a post-test. The average score improved to 80.4, with a total score of 2010. The descriptive statistics of the experimental class are presented in Table 3

Table 3. Mean Scores of Pre-test and Post-test in Experimental Class

Test Type	Total Score	Number of Students	Mean Score
Pre-test	1660	25	66.4
Post-test	2010	25	80.4

2. Pre-test and Post-test Scores of Control Class

The control class (VIII-B), which received instruction using conventional methods, had a pre-test average score of 58.0, with a total score of 1445. After instruction without using WordWall media, the post-test average score increased to 68.2, with a total score of 1705. The results of the control class are summarized in Table 4

Table 4. Mean Scores of Pre-test and Post-test in Control Class

Test Type	Total Score	Number of Students	Mean Score
Pre-test	1445	25	58.0
Post-test	1705	25	68.2

B. Comparative Score Improvements

To determine the effectiveness of the WordWall media, the study measured the gain scores (difference between post-test and pre-test scores) in both classes.

1) Experimental class gain: 14.0
2) Control class gain: 10,2

This indicates a higher learning gain in the group that used WordWall.

Mean Score Comparison

Group	Pre-test	Post-test
Experimental	66.4	80.4
Control	58.0	68.2

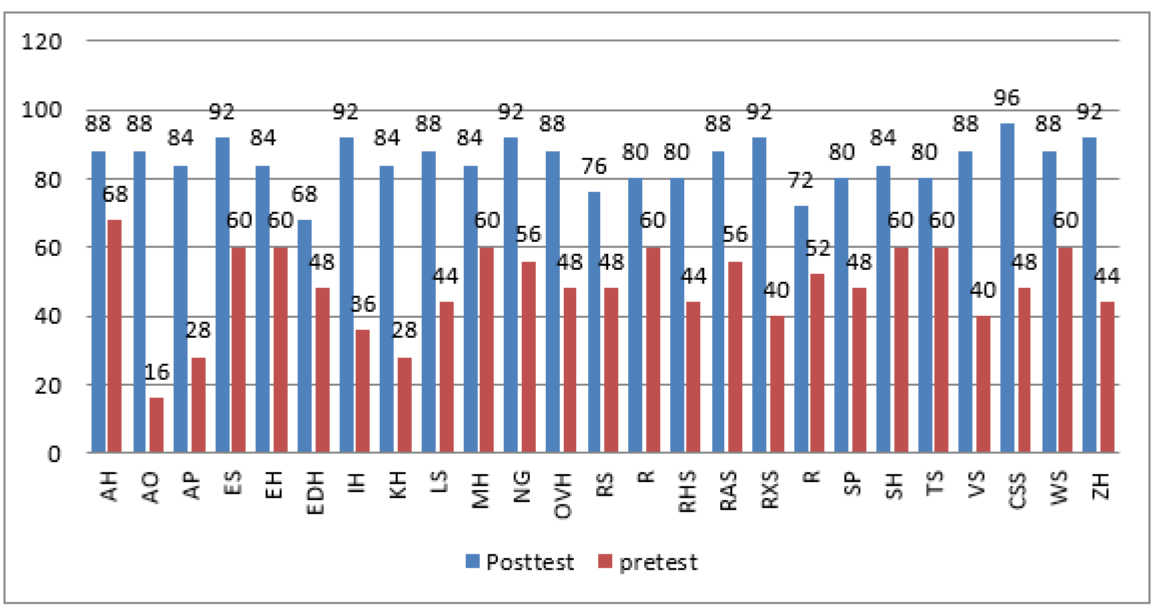

Figure 1. Comparison of Mean Scores between Experimental and Control Groups

C. Inferential Statistics (T-Test Analysis)

To determine whether the observed improvement was statistically significant, a t-test was conducted comparing the gain scores of both groups.

1) Mean Gain (Experimental): 14
2) Mean Gain (Control): 10.4
3) Standard Deviation (Experimental): 650
4) Standard Deviation (Control): 596
5) t-test result: 3.536
6) Degrees of Freedom (df): 48
7) t-table value at $\alpha = 0.05$: 1.6772

Since t-test (3.536) > t-table (1.6772), the result is statistically significant.

The analysis yielded $t(48) = 3.536$, $p < 0.05$, indicating a statistically significant difference between the two groups.

D. Hypothesis Testing

The research hypothesis (Ha) posited that the use of WordWall media would significantly improve students' learning outcomes in Physics compared to conventional teaching methods. Based on the t-test result, the following conclusions were drawn:

1) H_0 (Null Hypothesis): There is no significant difference in learning outcomes between students taught using WordWall and those using traditional methods – Rejected.

2) H_1 (Alternative Hypothesis): There is a significant difference – Accepted.

The significant improvement in the experimental group confirms that WordWall media positively influences students' comprehension and learning performance in Physics.

In addition to the t-test, the effect size was calculated using Cohen's d, resulting in a value of approximately 0.8, which indicates a large effect size. This suggests that the use of WordWall had a substantial impact on student learning outcomes

5. Discussion

The significant difference in learning outcomes between the experimental and control groups suggests that the integration of WordWall not only improves test performance but also enhances the quality of students' conceptual understanding. This finding indicates that interactive and gamified learning environments can facilitate deeper cognitive processing, particularly in subjects such as Physics that require abstract reasoning. Rather than merely increasing scores, the use of WordWall appears to support meaningful learning by promoting active engagement, immediate feedback, and repeated practice.

Moreover, the t-test value of 3.536, which is greater than the t-table value of 1.6772 at a significance level of 0.05, confirms that the difference in post-test outcomes between the two groups is statistically significant. This indicates that the improvements observed were not due to random chance but rather the result of the intervention using WordWall. These findings are in line with previous studies that emphasize the role of interactive learning tools in enhancing student learning outcomes. For instance, research by Alshammari et al. (2022) found that gamified learning platforms like WordWall promote better retention and understanding of scientific concepts by actively engaging students in the learning process. Similarly, a study by Fatimah and Prasetyo (2021) observed that digital learning tools improve cognitive outcomes in science subjects due to the multisensory stimulation they provide.

The positive effect of WordWall in this study can be attributed to several factors. First, WordWall's game-based format transforms traditional content delivery into an enjoyable experience, which increases student motivation. Second, the visual and interactive nature of WordWall accommodates diverse learning styles, helping students grasp abstract Physics concepts more effectively. This is particularly beneficial in middle school contexts, where students may struggle with the symbolic and conceptual demands of the subject.

In contrast, the control class, which was taught using conventional lecture-based methods, showed only moderate improvement. This may be due to the passive nature of such instructional approaches, where students play a more receptive rather than participatory role. This finding aligns with Akçayır and Akçayır (2017), who argue that traditional methods often fail to engage learners actively, especially in subjects that require critical thinking and application like Physics. Another factor contributing to the success of the experimental group could be the increased level of student-teacher interaction facilitated by the WordWall platform. As reported by Kurniawati et al. (2023), the use of interactive digital media creates more dynamic and responsive learning environments, where students feel more comfortable participating and receiving immediate feedback.

Overall, the study illustrates that integrating WordWall media into Physics instruction not only improves academic performance but also promotes more active, enjoyable, and meaningful learning experiences. This has important implications for curriculum designers, educators, and policymakers who aim to improve science education outcomes through innovative pedagogical strategies.

6. Conclusion

This study aimed to examine the effectiveness of WordWall teaching media in improving students' learning outcomes in Physics at SMP Methodist Pematangsiantar. The results of the research showed that students in the experimental class who were taught using WordWall experienced a significant increase in their post-test scores compared to those in the control class who received instruction through conventional methods. The statistical analysis confirmed the significance of this difference, with a t-test value (3.536) greater than the critical t-table value (1.6772) at the 0.05 level of significance, thus supporting the hypothesis that WordWall media positively influences learning outcomes in Physics.

The use of WordWall transformed the learning environment from passive and lecture-based to active and interactive. It allowed students to engage with Physics concepts through visual, auditory, and game-based formats, making abstract ideas more concrete and understandable. These results suggest that integrating digital learning tools such as WordWall into science education can enhance student motivation, participation, and academic achievement, especially in subjects traditionally seen as difficult.

In conclusion, this research affirms that WordWall is a valuable instructional tool for improving student performance in Physics. Teachers are encouraged to adopt such interactive media to better meet the needs of 21st-century learners. Furthermore, educational institutions and policymakers should support the integration of digital teaching media in classroom instruction as a means to promote deeper learning, higher student engagement, and improved academic outcomes in science education.

This study has several limitations. First, the sample size was relatively small (N = 50) and limited to a single school, which may affect the generalizability of the findings. Second, the duration of the intervention was relatively short (two weeks), making it difficult to assess the long-term impact of WordWall on student learning outcomes. Future studies are recommended to involve larger and more diverse samples and to examine the long-term effectiveness of digital learning media.

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Acknowledgments

Not applicable.

Authors contributions

Not applicable.

Funding

Not applicable.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.