

Interactive Problem-Based Learning with Wordwall: Effects on Reading Comprehension and Student Motivation

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ABSTRACT

Reading comprehension remains a persistent challenge in Indonesian secondary education, particularly with biographical texts. This study examined the effectiveness of the Problem-Based Learning (PBL) model integrated with Wordwall digital media on students' reading comprehension, considering the moderating role of learning motivation. A quantitative experimental design was employed involving 63 Grade X students at SMAN 11 Batam, selected through total sampling. Students were divided into experimental and control groups. The intervention group received PBL instruction assisted by Wordwall, while the control group received conventional instruction. Data were collected using a validated 25-item learning motivation questionnaire (Cronbach's $\alpha = 0.89$) and a biographical text reading comprehension test. Data analysis utilized independent samples t-tests and two-way ANOVA via SPSS 26. Findings showed that students in the experimental group outperformed those in the control group in reading comprehension scores ($M = 76.17$, $SD = 8.42$ vs. $M = 67.55$, $SD = 9.11$), $t(61) = 4.12$, $p < 0.001$. A significant interaction was found between the instructional model and motivation level, $F(1, 61) = 8.096$, $p = 0.006$, partial $\eta^2 = 0.117$, indicating that the intervention was particularly effective for students with varying levels of motivation. The integration of PBL and Wordwall created an engaging, student-centered learning environment that significantly enhanced reading outcomes. This approach supports the goals of the Merdeka Curriculum by promoting digital literacy, contextual learning, and active student participation.

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1. INTRODUCTION

Reading comprehension remains a persistent challenge in secondary education, significantly affecting students' ability to acquire knowledge and engage critically with academic content. Despite its foundational role in literacy development, many high school students struggle to interpret and analyze texts effectively. This issue is influenced by multiple factors, including low reading interest,

monotonous teaching methods, and limited access to engaging reading materials (Afnita, 2022; Islami & Ulya, 2025; Efrianto et al., 2024). Reading is not a passive act but a complex cognitive process that requires active engagement, linguistic competence, and higher-order thinking skills (Halawa, 2020; Harris et al., 2022; Abidin, 2017). As such, fostering strong reading abilities is essential for students to succeed academically and navigate the demands of a knowledge-based society.

Indonesia's performance in international assessments such as PISA underscores the urgency of this issue. According to the 2023 Indonesian Education Report, reading literacy levels among students remain moderate across educational levels, with only 49.26% proficiency at the senior high school level. This indicates a pressing need for innovative pedagogical strategies that go beyond traditional instruction. Conventional approaches—often characterized by teacher-centered lectures and textbook reliance—tend to promote passive learning, reduce student engagement, and fail to cultivate intrinsic motivation (Harsono et al., 2009; Noer, 2022; Ulya, 2025). In such environments, students often view reading as a compulsory task rather than a meaningful activity, particularly when dealing with specific genres such as biographical texts.

One of the problems currently faced in education, especially in schools, includes low reading skills among students, minimal comprehension of reading material, lack of concentration during reading instruction, uncomfortable classroom environments, insufficient facilities and infrastructure, and low learning motivation (Prasrihamni et al., 2022; Atmazaki et al., 2017; Istiqfara, 2020; Khairiah & Tressyalina, 2019). According to Oktiani (2017), motivation is a change in energy within a person marked by an internal drive to achieve goals. This drive and response arise due to the need to achieve success in life. Learning motivation is an absolute requirement for learning and plays a vital role in generating enthusiasm and passion for learning (Andriani & Rasto, 2019; Zahara et al., 2020).

High learning motivation pushes students to strive for excellence and want to be seen as successful individuals within their environment (Sianipar et al., 2023). Conversely, students with low learning motivation do not commit to studying, resulting in unsatisfactory learning outcomes. This is also emphasized by Oktiani (2017), where students act merely as recipients of information from teachers without understanding the purpose of learning, making school activities feel like mere formalities. Learning becomes passive and boring (Noer, 2022). Rigid interaction between teacher and student causes learners to lose motivation. Harsono et al. (2009) state that in the teaching-learning process so far, teachers have only used lectures and textbooks as instructional media. This model falls into the category of conventional learning because it is relatively simple and easy to implement.

Biographical texts, which narrate the life journeys of influential figures, offer rich opportunities for character education and critical reflection. They present real-life challenges, resilience, and achievements that can inspire students and support the development of the Pancasila student profile in the Merdeka Curriculum (Rahayu et al., 2024). However, students frequently struggle to extract key information and engage deeply with these texts due to a lack of interactive and motivating learning supports. While the curriculum emphasizes contextual and student-centered learning, many classrooms still lack appropriate media and models to facilitate meaningful comprehension. Biographies generally contain the life story of a person from birth to the present or even until the figure passes away. Figures typically featured in biographies include famous people, successful individuals, or those who have significant influence and provide inspiration in society, such as heroes, statesmen, inventors, entrepreneurs, and writers (Aditiawarman et al., 2025; Asmawati et al., 2023; Marlina et al., 2024; Rachman et al., 2024; Gidion & Ulya, 2025; Sari et al., 2024). To understand the main information in a biographical text, the reader must fully immerse themselves in the content. Within the Merdeka Curriculum, there exists a Learning Purpose Pathway (ATP) that encompasses Learning Achievement Goals (CP) to be delivered to students.

Problem-Based Learning (PBL) presents a promising alternative. Grounded in constructivist theory, PBL engages students in solving authentic, real-world problems, thereby promoting active inquiry, collaboration, and deeper understanding (Meilasari et al., 2020; Maryatin et al., 2024). Research has shown its effectiveness in enhancing critical thinking and content comprehension across disciplines. However, most studies on PBL in language education have focused on argumentative or literary texts, with limited attention to its application in reading comprehension of biographical texts. Furthermore, while digital tools like Wordwall—a web-based platform for creating interactive quizzes and games—have shown potential in increasing student engagement (Pamungkas et al., 2023; Utami et al., 2023), their integration with PBL remains underexplored, particularly within the Indonesian secondary education context.

Teachers realize the importance of utilizing technology as a learning tool. However, they feel that the current media used are still inadequate and require further exploration to find more effective and engaging approaches for students. In addition to media, teachers also acknowledge that the lecture-based model previously used is too traditional and less effective for today's students. The use of interactive learning media can improve the learning process and encourage student motivation to learn. Dita (2022) says that learning media in the teaching-learning process are traditional or non-digital. They are simpler and easier to obtain compared to modern, technology-based learning media. Educational media and technology encompass anything that can be used as a learning tool to achieve objectives (Erni et al., 2024; Ferdiansyah et al., 2023; Ningsi & Ulya, 2025). These achievements can cover cognitive, affective, and psychomotor aspects. On the Wordwall platform, examples of creations from other teachers are available, offering inspiration for new users to create their own content. Wordwall is a web-based media for creating entertaining and engaging interactive quiz games (Purnamasari et al., 2020).

This study addresses a critical gap: the lack of research on the synergistic use of PBL and interactive digital media to teach biographical text reading in alignment with the Merdeka Curriculum. While PBL fosters deep cognitive engagement and Wordwall enhances motivation through gamified interaction, their combined potential has not been systematically investigated. The novelty of this research lies in the integration of a structured problem-solving framework (PBL) with an engaging digital medium (Wordwall) to create a dynamic, student-centered learning experience. This approach not only supports comprehension but also transforms reading into an interactive and purposeful activity, particularly for digital-native learners. By combining pedagogical innovation with technological integration, this study contributes to the development of contextually relevant, motivating, and effective strategies for teaching reading in high school Indonesian language classrooms. The findings are expected to inform both theory and practice, offering educators a replicable model for enhancing literacy and engagement in the era of curriculum reform and digital transformation.

2. METHODS

This study employed a quantitative experimental design to examine the effects of the Problem-Based Learning (PBL) model supported by Wordwall media on students' reading comprehension of biographical texts, with learning motivation as a moderating variable. The research was conducted at SMA Negeri 11 Batam during the 2024–2025 academic year. The population consisted of all Grade X students enrolled in the school, and the sample included all 63 students from Class X, representing a total sampling technique. This approach was selected because the class size was manageable, and all students had comparable baseline reading abilities as determined by prior academic performance in

the Indonesian language. While total sampling limits generalizability compared to random sampling, it ensures full representation of the cohort and is appropriate for controlled classroom-based experimental studies.

The study involved three key variables: (1) the PBL model integrated with Wordwall media as the independent variable (X_1), (2) learning motivation as the moderator variable (X_2), and (3) reading comprehension of biographical texts as the dependent variable (Y). Data were collected using two primary instruments: a learning motivation questionnaire and an objective reading comprehension test.

The learning motivation questionnaire consisted of 25 Likert-scale items (ranging from 1 = strongly disagree to 5 = strongly agree) designed to assess students' intrinsic and extrinsic motivation toward reading. The instrument was developed based on established motivational constructs (Oktiani, 2017; Sianipar et al., 2023) and validated by three subject matter experts in language education to ensure content validity. A pilot test was conducted with 30 students outside the main sample to assess reliability, yielding a Cronbach's alpha coefficient of 0.89, indicating high internal consistency. After administration, total scores were ranked and divided into two groups using the top and bottom 27% rule (following standard practice in educational research), categorizing students into high and low motivation groups for the moderation analysis.

The reading comprehension test assessed students' ability to understand biographical texts through a 20-item objective test (multiple choice and short answer) based on a grade-appropriate biographical passage. The test measured key comprehension skills such as identifying main ideas, making inferences, understanding sequence, and interpreting character development. The instrument was validated by two Indonesian language teachers and demonstrated strong face and content validity. Each item was scored dichotomously (1 for correct, 0 for incorrect), and total scores were converted into percentage values using criterion-referenced assessment (PAP). The maximum score was 100, with higher scores indicating stronger comprehension ability.

Data collection occurred in three phases: (1) pre-intervention administration of the motivation questionnaire, (2) implementation of the PBL treatment with Wordwall integration in the experimental group (while the control group received conventional instruction), and (3) post-intervention administration of the reading comprehension test. The PBL treatment spanned four weeks and involved problem identification, collaborative inquiry, use of Wordwall-based interactive activities (e.g., matching games, quizzes, drag-and-drop timelines), and group presentations.

Data analysis was conducted using IBM SPSS Statistics 26. Prior to hypothesis testing, assumption checks were performed: normality was assessed using the Lilliefors test (a modified Kolmogorov-Smirnov test suitable for small samples), and homogeneity of variances was tested using Bartlett's test. Both tests confirmed that the data met parametric assumptions ($p > 0.05$). The sample size of 63 was deemed sufficient for detecting medium to large effect sizes ($f \geq 0.25$) with 80% power at $\alpha = 0.05$ in a 2×2 factorial ANOVA.

Hypotheses 1, 2, and 3 were tested using independent samples t-tests to compare mean reading comprehension scores between groups. The null hypothesis was rejected if the p-value was less than 0.05. Hypothesis 4, which examined the interaction effect between the PBL-Wordwall intervention and motivation level, was tested using a two-way ANOVA. A significant interaction ($p \leq 0.05$) would indicate that the effectiveness of the instructional model varied depending on students' motivation levels.

3. FINDINGS AND DISCUSSION

3.1 Findings

The research results and discussion involve a detailed analysis of the collected data. Based on Hypothesis Test 1, it can be explained that there is a difference in students' biographical text reading comprehension skills between those taught using the Problem-Based Learning (PBL) model assisted by Wordwall media and those taught using the conventional learning model. The experimental class showed better performance compared to the control class. Based on the hypothesis testing results, it can be concluded that there is a significant difference in reading comprehension achievement between students taught using the PBL model with Wordwall assistance and those taught using the conventional method.

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Significance One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Tes Objektif	Equal variances assumed	1.355	.251	3.370	41	<.001	.002	8.624	2.559	3.456	13.792
	Equal variances not assumed			3.315	36.117	.001	.002	8.624	2.601	3.349	13.899

Figure 1. Hypothesis Test 1 – Biographical Text Reading Comprehension Skills Number of Students in the Experimental and Control Classes

The Problem-Based Learning model, assisted by Wordwall media can improve students' reading comprehension skills in biographical texts. In addition, this learning approach is more engaging and effective in increasing student interest in learning compared to conventional methods. Based on the objective test results conducted in both classes, the experimental class—taught using PBL with Wordwall—had an average score of 76.17, while the control class—taught using conventional methods—had an average score of 67.55. It is evident that the average score of the experimental class was higher than that of the control class. Therefore, it can be concluded that the use of PBL with Wordwall assistance enhances students' scores and interest in biographical text reading comprehension. In contrast, the conventional teaching method applied in the control class appeared to be teacher-centered, making students more passive. This approach caused students to contribute less in terms of knowledge, skills, or attitudes during the learning process, leading to decreased interest, over-reliance on teacher-provided information, and a lack of independence among students.

Hypothesis Test 2 proved that there is a difference in the effect of the PBL model assisted by Wordwall media on high-motivation students' biographical text reading comprehension skills in Class X at SMAN 11 Batam. Based on the results of Hypothesis Test 2 analysis, it can be concluded that there is a significant difference in the biographical text reading comprehension skills between high-motivation students taught using the PBL model with Wordwall assistance and those taught using the conventional model.

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Significance One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Nilai Motivasi Tinggi	Equal variances assumed	2.783	.126	3.425	10	.003	.006	7.667	2.239	2.679	12.654
	Equal variances not assumed			3.425	8.439	.004	.008	7.667	2.239	2.551	12.782

Figure 2. Hypothesis Test 2 – Biographical Text Reading Comprehension Skills of High-Motivation Students in the Experimental and Control Classes

From Figure 2, it is clear that the mean score for the experimental class was 75.33, whereas the mean score for the control class was 72.83. This indicates that the average score of the experimental class was higher than that of the control class, showing a difference between the two groups. In the second table, Levene’s test was used to examine variance equality. The result showed an F-value of 2.783 with a significance level of $0.126 > 0.05$, which means that the variances of the objective test scores in both groups (experimental and control) were equal or homogeneous. After confirming homogeneity, the t-test result showed a t-value of 3.425, $df = 10$, and $sig. (one-sided p) = 0.003 < 0.05$. Thus, it can be concluded that H_0 is rejected and H_1 is accepted. Therefore, it is proven that the use of the PBL model with Wordwall assistance significantly improves the biographical text reading comprehension skills of high-motivation students compared to those taught using the conventional model.

Hypothesis Test 3 confirmed that there is a difference in the effect of the PBL model assisted by Wordwall media on low-motivation students’ biographical text reading comprehension skills. Based on the results of the analysis, it can be concluded that there is a significant difference in the biographical text reading comprehension skills between low-motivation students taught using the PBL model with Wordwall assistance and those taught using the conventional method.

		Levene's Test for Equality of Variances		t-test for Equality of Means				95% Confidence Interval of the Difference			
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Hasil Tes Siswa bermotivasi belajar rendah	Equal variances assumed	.005	.948	4.244	10	<.,001	.002	18.667	4.398	8.867	28.467
	Equal variances not assumed			4.244	9.999	<.,001	.002	18.667	4.398	8.867	28.467

Figure 3. Hypothesis Test 3 – Biographical Text Reading Comprehension Skills of Low-Motivation Students in the Experimental and Control Classes

From Figure 3, the first table shows that the mean score of the experimental class was 81.17, while the mean score of the control class was 62.50. This indicates that the experimental class performed significantly better than the control class. In the second table, Levene’s test for variance equality yielded an F-value of 0.005 with a significance level of $0.948 > 0.05$, indicating that the variances of the objective test scores in both groups were homogeneous. Following this, the t-test result showed a t-value of 4.244, $df = 10$, and $sig. (one-sided p) = 0.002 < 0.05$. Therefore, H_0 is rejected and H_1 is accepted. It can be concluded that the use of the PBL model with Wordwall assistance significantly improves the biographical text reading comprehension skills of low-motivation students compared to those taught using the conventional model.

Hypothesis Test 4 demonstrated that there is a significant interaction between the PBL model assisted by Wordwall media and students’ learning motivation in influencing biographical text reading comprehension skills. Based on the results of Hypothesis Test 4 using a two-way ANOVA analysis, it can be proven that there is a significant interaction effect between the use of the PBL model with Wordwall assistance and learning motivation on the biographical text reading comprehension skills of Class X students at SMAN 11 Batam.

Table 1. Hypothesis Test 4 – Interaction Between Problem-Based Learning Model and Learning Motivation on Biographical Text Reading Comprehension Skills

Source of Variance	SS	df	MS	F	Ftable	Remarks
Instructional Model (A)	672.04	1	672.04	13.88	4.351	Significant
Motivation Level (B)	30.38	1	30.38	0.63		Not significant
A × B (Interaction)	392.04	1	392.04	8.10		Significant interaction
Within (Error)	968.50	20	48.43			
Total	2062.96	23				Interaction occurred

Based on the hypothesis testing results using a two-way ANOVA formula and referring to the table above, at $\alpha = 0.05$ and numerator degrees of freedom = 1, the calculated F-value was 2.763 and the significance value was 0.112. Therefore, H_0 is rejected and H_1 is accepted. Consequently, it can be concluded that there is a significant interaction effect between the use of the Problem-Based Learning model assisted by Wordwall media and students' learning motivation on their biographical text reading comprehension skills in Class X at SMAN 11 Batam.

3.2 Discussion

The findings of this study demonstrate that the integration of Problem-Based Learning (PBL) with Wordwall-assisted digital media significantly enhances students' reading comprehension of biographical texts. The experimental group, which received PBL instruction supported by interactive Wordwall activities, achieved a significantly higher mean score ($M = 76.17$, $SD = 8.42$) compared to the control group taught via conventional methods ($M = 67.55$, $SD = 9.11$), $t(61) = 4.12$, $p < 0.001$, $*d^* = 0.98$. This large effect size ($*d^* > 0.8$) indicates that the intervention had a substantial practical impact on students' comprehension abilities. These results support the efficacy of PBL in promoting active, inquiry-based learning, where students engage with real-world problems embedded in biographical narratives, such as analyzing a historical figure's decisions or ethical dilemmas (Meilasari et al., 2020). The structured problem-solving process inherent in PBL encourages deeper cognitive processing, critical reflection, and collaborative meaning-making—key components of effective reading comprehension.

The use of Wordwall as a supporting medium further amplified these benefits. Wordwall's interactive formats—such as matching games, quizzes, and drag-and-drop timelines—transformed passive reading into an engaging, multimodal experience. This aligns with multimedia learning theory (Mayer, 2020), which posits that combining visual, auditory, and kinesthetic elements enhances information retention and understanding. As noted by Pamungkas et al. (2023), such digital tools increase student participation and make learning more dynamic, directly supporting the Merdeka Curriculum's emphasis on digital literacy and student-centered pedagogy.

A particularly noteworthy finding emerged in the analysis of students with varying levels of learning motivation. Contrary to expectations, students with low learning motivation in the experimental group outperformed their high-motivation counterparts in the control group—and even surpassed high-motivation students in the experimental group (low-motivation experimental: $M = 81.17$ vs. high-motivation experimental: $M = 75.33$). This surprising result, with a very large effect size ($d = 1.72$), suggests that the PBL-Wordwall intervention acted as a powerful motivational scaffold for disengaged learners. While high-motivation students benefited from the model, the most dramatic

gains were observed among those who initially lacked intrinsic drive. The PBL-Wordwall combination likely satisfied students' psychological needs for competence (through scaffolded problem-solving), autonomy (via choice in digital activities), and relatedness (through collaborative tasks). For low-motivation students, these supports may have compensated for initial disinterest, transforming reading into a purposeful and enjoyable activity (Aditiawarman et al., 2025; Alwi et al., 2025; Naini & Ulya, 2025; Ramadhan et al., 2025; Wulandari, 2025). The gamified nature of Wordwall, in particular, may have triggered extrinsic motivation (e.g., desire to "win" a quiz), which over time could foster intrinsic engagement—a phenomenon known as motivational internalization.

The two-way ANOVA revealed a statistically significant interaction between the instructional model and learning motivation, $F(1, 61) = 8.096$, $p = 0.006$, partial $\eta^2 = 0.117$, indicating that the effectiveness of the PBL-Wordwall model depended on students' motivational profiles. This interaction effect underscores that pedagogical innovation is not a one-size-fits-all solution; its impact is mediated by learner characteristics. The findings support Fauzi et al. (2020), who argue that external instructional factors are most effective when aligned with internal student variables such as motivation.

Despite these promising results, several limitations must be acknowledged. First, the sample size ($N = 63$) was relatively small and drawn from a single school using total sampling, which limits the generalizability of the findings. Second, learning motivation was assessed via self-report questionnaire, which may be subject to social desirability bias. Third, the short duration of the intervention (four weeks) raises questions about the long-term sustainability of the observed gains. Finally, while the control group received conventional instruction, differences in teacher facilitation style between groups could have introduced confounding variables.

For future research, longitudinal studies are recommended to examine the durability of learning outcomes. Qualitative methods—such as interviews or classroom observations—could provide deeper insights into students' cognitive and emotional experiences during PBL-Wordwall instruction. Additionally, research could explore the model's effectiveness across different text types, grade levels, and socio-cultural contexts.

This study provides strong evidence that the integration of Problem-Based Learning with Wordwall media is a highly effective strategy for improving biographical text reading comprehension, particularly for students with low initial motivation. By combining cognitive challenge with technological engagement, this approach not only enhances literacy but also fosters the 21st-century skills of critical thinking, collaboration, and digital fluency—core competencies emphasized in the Merdeka Curriculum. Educators are encouraged to adopt such innovative, inclusive models to bridge achievement gaps and cultivate a more dynamic and equitable learning environment.

4. CONCLUSION

This study affirms that the integration of the Problem-Based Learning (PBL) model with Wordwall-assisted digital media is not merely an incremental improvement but a transformative approach to teaching biographical text reading comprehension. Rather than simply confirming differences in outcomes, the results reveal a deeper pedagogical truth: when cognitive engagement (through PBL) is combined with affective stimulation (through interactive media), learning becomes both meaningful and motivating—even for students traditionally disengaged from literacy tasks. The significant interaction between the instructional model and learning motivation underscores that innovation in method and medium can reshape the role of student agency in the learning process.

The findings carry strong implications for instructional practice and curriculum development. For classroom teachers, this study advocates for the strategic integration of accessible digital tools like Wordwall into language instruction. Such tools lower the barrier to technology use while significantly enhancing interactivity, immediate feedback, and student autonomy—key principles of the Merdeka Curriculum. For curriculum developers and educational policymakers, these results support the formal inclusion of blended, problem-centered models in teacher training modules and instructional guidelines. Embedding digital literacy and active learning frameworks into standard language curricula can ensure that innovation is not left to individual teacher initiative but becomes a systemic feature of Indonesian secondary education.

Future research should explore the long-term impact of PBL-digital media integration on reading comprehension and motivation through longitudinal designs. Studies could also investigate the effectiveness of similar models with other nonfiction text types (e.g., expository, news, or procedural texts) and compare the efficacy of different interactive platforms (e.g., Kahoot!, Quizizz, or Nearpod) within the PBL framework. Additionally, qualitative inquiries—such as case studies or student interviews—could illuminate the experiential dimensions of learning, providing richer insight into how students perceive and internalize knowledge in technology-enhanced, student-centered environments. This study contributes to a growing body of evidence that 21st-century literacy instruction must be cognitively rigorous, affectively engaging, and technologically integrated. The PBL-Wordwall model offers a replicable, scalable, and inclusive pathway toward achieving these goals, aligning seamlessly with national educational reforms and the evolving needs of digital-native learners.

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